Freshwater Aquatic Habitat Quantification
Andrew's Pond
Shoal Harbour River, Newfoundland

Prepared for:
SGE-Acres Limited
45 Marine Drive
Clarenville, NL
A0E 1J0

Prepared by:
James H. McCarthy
Andrew Peach
AMEC Earth and Environmental Limited
95 Bonaventure Ave
St. John's, NF
A1C 5R6

February 10, 2003
TF05207

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

List of Appendices

1.0 INTRODUCTION

As part of an on-going program to upgrade the municipal water supply, treatment and distribution infrastructure, the Town of Clarenville is in the process of constructing a new water treatment plant (WTP) for the Shoal Harbour River (SHR). The SHR WTP will produce approximately 8.5 million litres of treated water per day to the residents and businesses of Clarenville. The new WTP will address some of the water quality problems in Shoal Harbour in addition to helping the Town to meet the increasing water demand in the area.

An integral part of the infrastructure program calls for the construction of upstream water storage facilities in the watershed. This structure will be designed and constructed such that it will create water storage in Andrew's Pond but allow for, on a controlled basis, the release of additional water into Shoal Harbour River. The rationale for the control structure is that it will allow the Town of Clarenville to discharge the stored water during the low flow months of June, July and August. By doing so, both the municipal water demand(s) and fish flow requirements can be satisfied during the critical summer months.

This document provides an overview and quantification of the freshwater fish habitat of Andrew's Pond. This includes a classification scheme for standing water as outlined in Bradbury *et al*. (2001). Flowing water (streams) into and out of Andrew's Pond have also been quantified to some extent due to the potential for inundation. Using the classification schemes, the quantity of freshwater fish habitat has been established.

Using the results of survey work completed in September 2002 as well as literature, the fish species in the area are described. As available, information is also presented on fisheries utilization in the freshwater systems within the Project area.

A preliminary description is presented of the proposed control dyke for spring runoff control, with emphasis on those activities which will affect freshwater fish habitat. The material presented includes a description of applicable mitigation measures. The potentially affected freshwater habitat is quantified in order to assist DFO in establishing whether a HADD exists from the Project on freshwater fish habitat in Andrew's Pond.

2.0 PROJECT DESCRIPTION

The town of Clarenville is proposing to construct a small control weir on the outflow of Andrew's Pond. Andrew's Pond is within the Shoal Harbour River watershed and is part of the system currently supplying water to the town. The intent is to retain a portion of the spring runoff so that additional supply is available during the summer months.

The detailed design of the control weir has not been finalized, however, preliminary surveys indicate that it will be approximately one metre in height. The expected elevation of the crest (i.e. spillway) is 100.0m which is approximately 0.90m higher than current typical summer water levels. This crest elevation is near the pond's natural spring flood level.

The control structure will be located at the outflow of Andrew's Pond. The operation of the structure will be such that the spring floodwater will be retained until the summer months when it

will be released into Shoal Harbour River. The excess flow will then be used by the water treatment plant which has its intake located approximately 13km downstream from Andrew's Pond.

2.1 OVERVIEW

The proposed structure will be a reinforced concrete structure. The work is in the preliminary design stages and therefore a detailed footprint of the structure is not available at this time. A description of the aquatic habitat in the proposed project area is provided in Section 3.1. The structure would provide flow at all times for fish passage and maintenance of downstream habitat within the outflow of Andrew's Pond.

Schedule

The structure is scheduled for construction during 2003.

Construction Access and Accommodation

The proposed site will be accessible using an existing forest access road system which will be upgraded for machinery access. Accommodations will not be provided on site and all employees will be brought in each day. Appropriate temporary and portable lunchroom facilities with applicable water and sewer facilities will be provided for the duration of the construction. All facilities will adhere to all applicable existing legislation.

Crossing of streams may be required for construction. It is not anticipated that streams in the area will require additional crossings or structures as access will be provided by an existing forest road system. It is expected, however, that some of the crossings on the access road may require upgrading and/or repair prior to equipment deployment. Repair/installation of stream crossings will follow accepted engineering and construction practices to accommodate spring runoff conditions and comply with existing regulatory requirements. All stream crossings will be repaired/constructed in accordance with authorizations and following the procedures outlined in a site-specific Environmental Protection Plan.

Repairs to all stream crossings will be constructed with erosion resistant materials such as rock or clean gravel. Any materials placed in streams to improve the crossing site will be clean, non-erodible and non-toxic to aquatic life. All culverts will be sized to handle the 1 in 25 year return period flood.

Culvert repairs in streams that are deemed to be fish habitat will be designed to allow the passage of fish and preserve habitat. Cylindrical culverts will be countersunk below stream beds so that there is a sufficient depth of water for fish passage. In multiple culvert installations, this will be accomplished by installing one culvert at an elevation lower than the others. At any particularly sensitive crossings, appropriate structures will be used to reduce the disturbance of the stream bed and preserve the natural substrate for resident fish populations. The stipulations of the Department of Fisheries and Oceans will be incorporated as required. In addition, the Coast Guard will be informed such that the Navigable Waters Protection Act can be addressed.

When fording any watercourse, the Environmental Guidelines for Fording from the *Newfoundlandand Labrador Department of Environment*, Water Resources Division will be applied. This site is also a portion of the existing water supply for the town of Clarenville.

Fuel Storage and Handling

All fuel tank spacing and containment dyke designs will conform to the provincial *Gasoline and Associated Products* regulations and the *National Fire Code of Canada*.

2.2 OPERATION

The control weir will be a relatively passive structure once constructed, therefore, no personnel will be regularly on site. There will be the requirement for routine surveys of the structure and maintenance. No fuel, accommodations, or excess traffic will persist once the control weir is constructed.

The operation of the control weir would see the augmentation of flow to Shoal Harbour River during the drier summer months. The augmentation would come from the use of a control gate on the weir where excess retained water would be released into Shoal Harbour River for collection at the water treatment plant intake downstream. This operation would be conducted such that flows would be similar to natural high flow events.

2.3 CLOSURE AND DECOMMISSIONING

The control weir is expected to operate in perpetuity once constructed.

3.0 EXISTING ENVIRONMENT

From a review of the baseline information collected for the Andrew's Pond project area and literature, it is clear that resident brook trout (*Salvelinus fontinalis*) and ouananiche (*Salmo salar*) utilize Andrew's Pond. Anadromous Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*) may also utilize the pond for some life cycle stages (Porter *et al*. 1974). Other species present in the area include three-spine stickleback (*Gasterosteus aculeatus*).

Fish harvesting activities may include recreational fisheries for brook trout and ouananiche/Atlantic salmon, however, no fishing effort has been documented for Andrew's Pond.

3.1 FISH HABITAT

Surveys have been conducted on Andrew's Pond in order to quantify the aquatic habitat as per Bradbury *et al.* (2001). Sampling necessary to characterize the habitat has also been completed on all inflowing and out flowing tributaries of Andrew's Pond. The habitat descriptions have been separated into lacustrine (pond) and fluvial (stream) for ease of quantification. This section is also separated this way.

3.1.1 Pond Habitat

Extensive survey work was completed on Andrew's Pond. In general, the pond was surveyed for bathymetry, secchi depth, substrate/sediment, and shoreline vegetation. Literature was reviewed to determine additional details regarding geology, precipitation, and prevailing wind directions.

This information was used to describe in detail the habitat within Andrew's Pond in terms of habitat available for each fish species present.

Literature Information

Limited literature could be found on Andrew's Pond specifically, however, information regarding Shoal Harbour River and the area were reviewed and if applicable were included and summarized below.

Shoal Harbour River is a scheduled Atlantic salmon river with a total basin area of 129.24km^2 located in Precambrian volcanic rock (Porter *et al*. 1974). Water quality data is provided in Table 3.1.

Species present include Atlantic salmon, brook trout, and rainbow trout (Porter *et al*. 1974). Table 3.2 presents a summary of past and recent Atlantic salmon angling data for Shoal Harbour River. The total run in the river is unknown. There is also a rainbow trout population in Shoal Harbour River, however, no angler catch data has been found.

Table 3.2. Summary of angling data for Shoal Harbour River (Porter *et al*. 1974 and DFO Aquatic Resources Div.).

Year	Rod-Days	Grilse	Salmon*
1971	80	6	- -
1972	352	21	- -
1973	125	22	- -
1994	374	21	5
1995	271	10	0
1996	335	48	2
1997	275	5	0
1998	175	32	4
1999	393	30	0
2000	303	28	11
2001	126	3	0

* Large salmon were catch and release.

Table 3.1. SUMMARY OF WATER SAMPLING OF SHOAL HARBOUR WATER SUPPLY

(DAY/MONTH/YEAR)

Parameter	Units	MAC	02/11/83#	17/2/84#	3/4/84#	25/05/84#	22/06/84#	24/09/84#	28/09/87	6/10/87#	27/11/87#	8/6/88#	08/06/88*#	Unknown#	Unknown#	15/06/89	23/10/89	09/06/92	29/10/92	07/06/95	10/10/95	18/06/96	01/10/96	19/05/98	15/10/98	16/02/99	27/05/99	20/07/99	05/10/99	11/02/00	12/12/00#	19/12/00#	2/01/01#	9/01/01#	9/01/01#2	AVERAGE To Date
Alkalinity	mg/L CaCO3	-	2.60	1.80		1.90	3.00		6.90					12.40	9.40	4.80	4.90	4.30	2.50	3.57	6.53	3.53	4.80	2.90	3.80		2.60		3.40		3.00	nd	4.00	3.00	4.00	
Acidity	mg/L CaCO3	-		4.50		1.70	3.30																												
Color	TCU	15	50.00	45.00		45.00	45.00	60.00	35.00	15.00		60.00	120.00	5.00	5.00	30.00	30.00	55.00	65.00	25.00	100.00	50.00	42.00	72.00	62.00	54.00	62.00	32.00	97.00	57.00	28.00	28.00	42.00	44.00	43.00	**48**
Hardness	mg/L	-	7.40	4.80		4.80	6.00	5.70					7.70	16.10	16.90																7.60	7.30	6.80	7.10	7.30	
pH	units	6.5-8.5	6.20	6.48	6.70	6.60	6.32	5.46	6.12	5.69	6.17		6.29	6.82	6.37	6.60	6.65	6.50	6.15	6.71	6.84	6.46	6.35	6.21	6.60	6.02	6.41	6.90	6.52	5.64	6.60	5.30	6.50	6.30	6.50	
Turbidity	NTU	5	0.70	0.62	20**	0.74	0.56	0.50	0.50							0.30	0.55	0.30		0.35	0.80	0.30	0.62	0.23	1.86	0.30	0.29	0.14	2.18	0.38	0.40	0.60	0.30	0.50	0.40	
Calcium	mg/L	-	1.98	1.23		1.29	1.62	1.38	1.75		1.63		2.15	4.90	5.20	2.50	2.35	2.10	1.60	2.00	2.88	1.86	1.58	1.47	2.10		1.58		2.27		2.20	2.10	1.90	2.00	2.10	
Magensium	mg/L	-	0.50	0.34		0.36	0.42	0.43	0.50		1.88		0.43	0.93	0.96	0.53	0.50	0.45	0.46	0.40	0.67	0.47	0.42				0.01				0.50	0.50	0.50	0.50	0.50	
Manganese	mg/L	0	0.02	0.02	<0.01	<0.01	<0.01	0.01	0.00		0.21		0.03	<0.01	<0.01	0.04	0.02	0.02	0.03	0.01	0.04	0.01	0.00	0.01	0.02		0.01		0.17		0.01	0.03	0.02	0.01	0.01	**0.03**
Iron	mg/L	0	0.22	0.16	0.37	0.08	0.11	0.26	0.01	0.14	0.11		0.31	0.09	0.13	0.18	0.19	0.21	0.30	0.14	0.13	0.15	0.17	0.17	0.21		0.16		0.72		0.13	0.29	0.18	0.24	0.20	**0.20**
Kjeldahl Nitrogen	mg/L	-	0.17						0.14							0.02				0.12	0.30			0.11	0.23		0.25		0.33							
Nitrate	mg/L	10	0.0220													0.0200	0.0050			0.0250	0.0250	0.0250	0.0020	0.0180	0.0150		0.0025		0.0810			0.1100	0.07	0.07	0.07	
Total Phosphorus	mg/L	-	0.013						0.005											0.003	0.008			0.005	0.005		0.005		0.005							
Specific Conductan	microohms/cm	-	30.00						28.00							40.00	39.00	34.00	26.00	30.20	18.60	29.60	27.00	30.70	30.60	40.30	29.90	37.50	37.20	28.40	36.60	45.40	39.70	40.00	44.20	
COD	mg/L	-	30.00																																	
Copper	mg/L	1	<0.005						0.005		1.100		0.190			0.001	0.001	0.001	0.001	0.000	0.005			0.005	0.005		0.005		0.005		nd	0.010	nd	nd	nd	
Zinc	mg/L	5	<0.005						0.009							0.005	0.005	0.005	0.005	0.005	0.005			0.005	0.005		0.005		0.005		nd	nd	nd	nd	nd	
Cadium	mg/L	0	0.00																																	
Chloride	mg/L	250							5.90		16.00		8.00			6.70	5.80	5.70	4.40	5.08	4.36	2.63	4.20	4.60	5.30		4.10		4.40		6.60	9.00	7.10	7.40	8.60	
Aluminum	mg/L								0.100							0.077	0.087	0.120	0.170	0.111	0.160	0.130	0.080	0.160	0.025		0.025		0.240							
Arsenic	mg/L	0							0.00							0.00	0.00	0.00	0.00																	
Cadmium	mg/L	0							0.00							0.00	0.00	0.00	0.00	0.00	0.00															
Chromium	mg/L	0							0.00								0.00	0.00		0.00	0.00															
DOC	mg/L								0.02							3.10	4.85	5.70	7.00	6.00	9.20	8.20	4.70	7.40	7.00	6.30	5.80	3.10	11.00	4.90	7.00	8.60	8.20	6.60	7.60	**6.30**
Fluoride	mg/L	2														0.030	0.030	0.030	0.030	0.070	0.050						0.025									
Pottasium	mg/L								0.18							0.16	0.24	0.29	0.20	0.17	0.22			0.15	0.18		0.01		0.27		0.10	0.20	0.30	0.20	0.20	
Lead	mg/L	0							0.0005							0.0010	0.0010	0.0010	0.0010	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005		0.0005		0.0300							
Mercury	ug/L	1														0.01	0.01		0.01																
Sodium	mg/L	200							4.80							4.40	3.90	4.00	3.00	3.60	3.59	3.55	2.73	3.35	3.04		3.36		3.73		3.80	5.70	4.30	4.20	4.70	
Nickel	mg/L								0.01							0.00	0.00	0.00	0.00																	
Sulphate	mg/L	500							3.10							2.20	1.70	1.70	1.60	1.40	1.83	3.30	2.60	1.10	1.00		1.10		0.90		0.90	2.00	1.10	3.00	3.00	
TDS	mg/L	500							28.00											30.00	30.00	30.00	22.00	24.00	21.00		20.00		27.00		28.00	23.00	31.00	23.00	25.00	
Temperature	C	15																		9.80	8.90	12.90	11.60				13.00	21.00	10.00							
TSS	mg/L								1.00															1.00	1.00		1.00		4.00							
Total Coliform	/100ml	0																		15.00	57.00	16.00	33.00						80.00							
Faecal Coliform	/100 ml	0																		8	55	12	14						60							

NOTES:

* Treated Water

** JTU

\# Samples taken by SGE Group. (All other samples were taken by Water Resources Division, Dept. of Environment).

No source water sampling or testing by DOEL since February 2000. Non e budgeted at this time.

An overview of the weather pattern in the Shoal Harbour area has been summarized based on the closest long-term weather recording station (1951-1980). This station is located in Arnold's Cove, to the south of Shoal Harbour (Environment Canada 1982).

The winds in the area are principally south and southwest. The wind tends to come from this direction between 30-75% of the time. The mean wind speed throughout the year is between 17 and 26 km/hr (Environment Canada 1982). Total mean annual precipitation in the area is 1265 mm with mean monthly precipitation between 75 and 142 mm.

Bathymetry

Bathymetric surveys were conducted throughout Andrew's Pond. Water depth was collected along numerous geo-referenced transects. Location (UTM coordinate) and water depth (m) were recorded for each survey point along the transects (approximately every 10m). The data was transcribed into Surfer 6.0™ contouring software. A digital shoreline of Andrew's Pond was created and the bathymetric contours of the pond were modeled. Figure 3.1 presents the bathymetric profile of Andrew's pond.

The total water volume of Andrew's Pond, based on the bathymetric profile, was also estimated using Surfer. The total volume is estimated at 6.65 million litres. The total surface area is estimated at 2.19 km^2 using ArcView GIS software and digital mapping. Mean depth is estimated at 2.54 m with a maximum depth of 8.0 m.

Secchi Depth

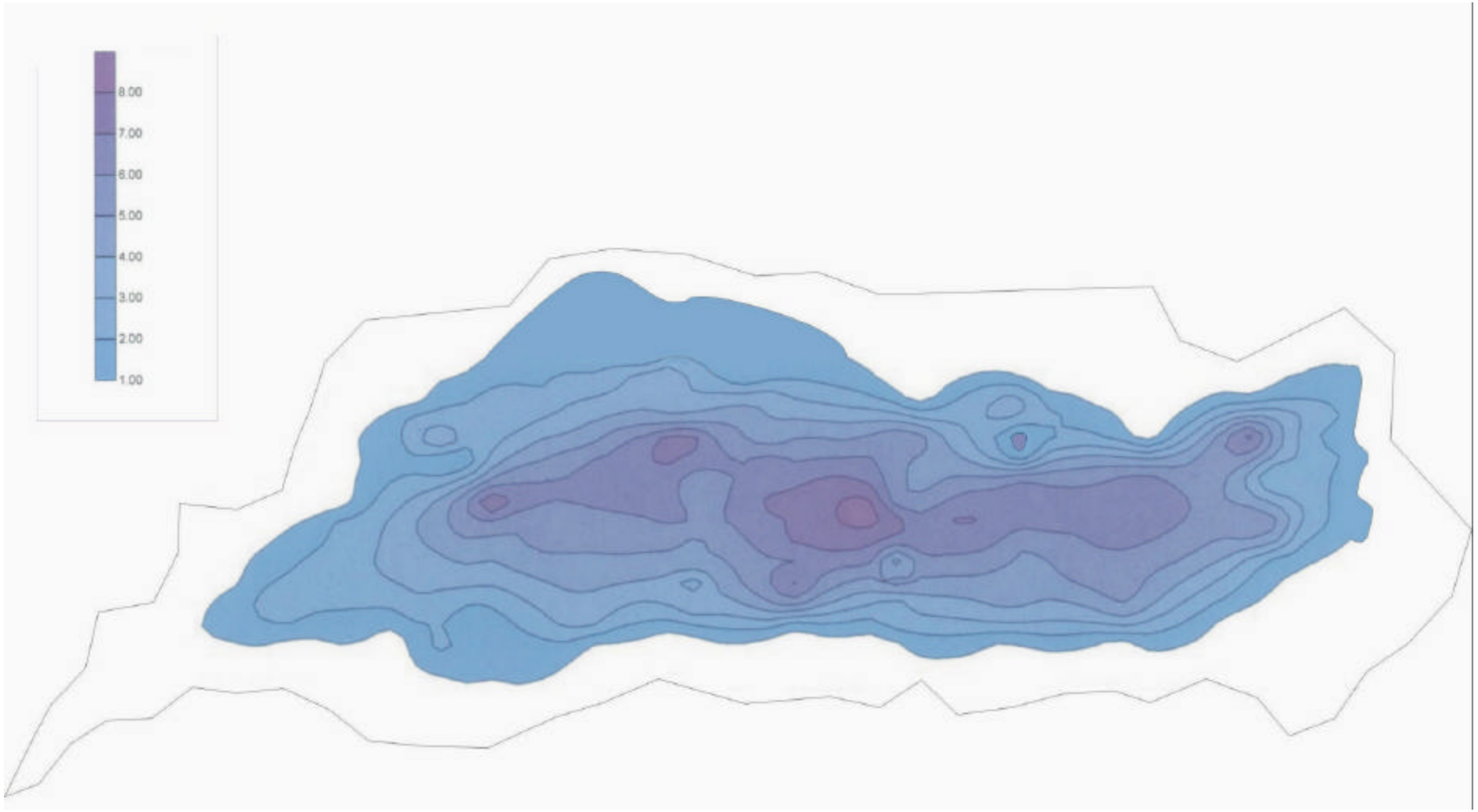
The delineation between the littoral and profundal habitat was determined with the use of secchi depth readings. Secchi Depths were recorded at three locations in Andrew's Pond. These locations were located in the deepest points of the pond. The submerging (as the disk sank) and emerging (as the disk rose) secchi readings were taken at each location and a mean depth determined from all six readings. The secchi depth was determined to be 2.7m and hence this depth was used to delineate the littoral and profundal zones in Andrew's Pond.

Bottom Substrate

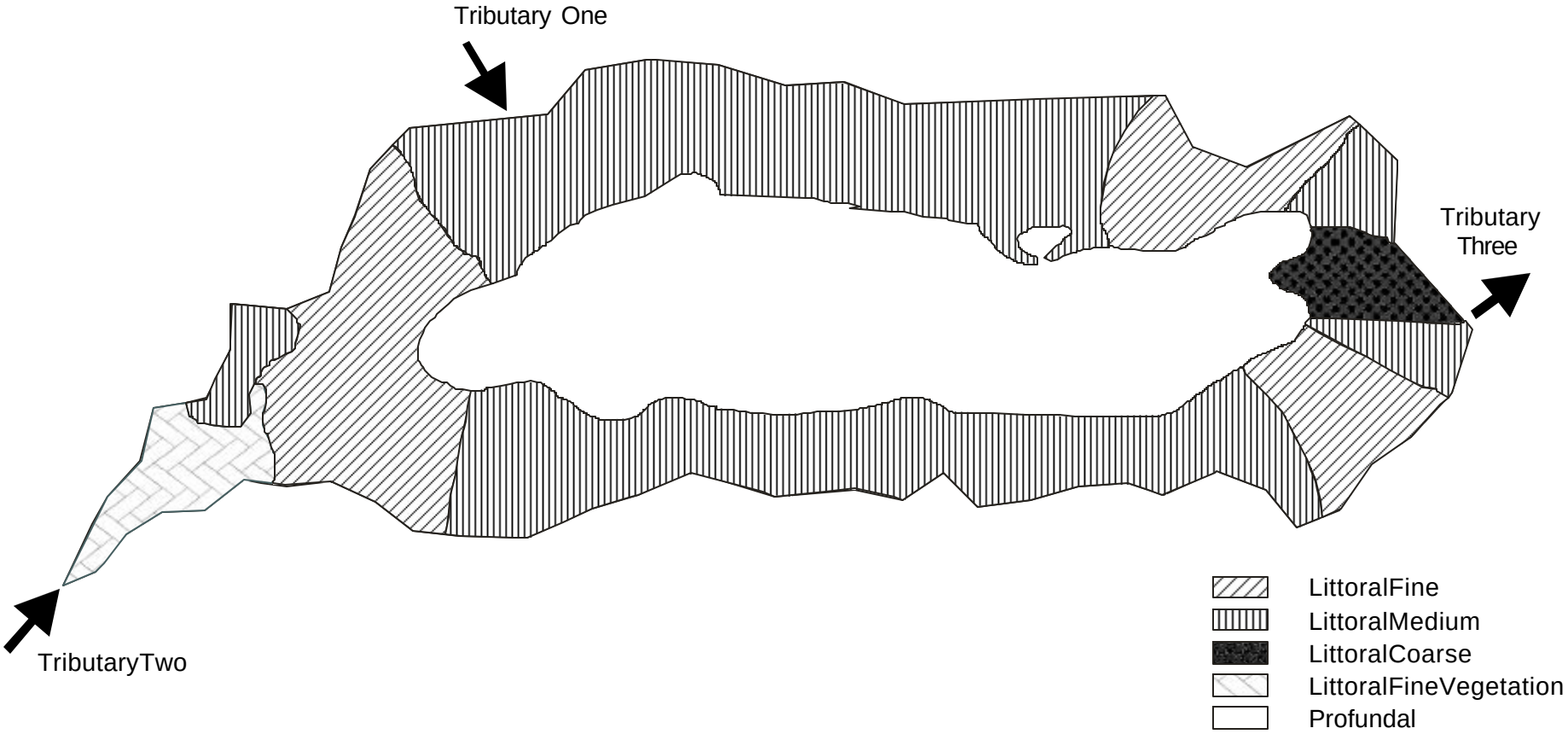
Bottom substrate was surveyed throughout the littoral and profundal zones of Andrew's Pond. Littoral substrate was recorded from select areas along the shoreline (approximately every 100m). If the bottom substrate was found to change dramatically, surveys were conducted at closer intervals. The substrate was visually determined in the littoral zone.

Profundal sampling of bottom substrate was conducted using an Eckman grab (0.25m^2). The resulting sample was brought to the surface and the substrate analysed for its physical composition as per Scruton *et al.* (1992). This sampling was conducted in several locations.

The substrate composition was used to determine the substrate mapping for Andrew's Pond using the applicable habitat types outlined in Bradbury *et al*. (2001). Figure 3.2 presents the mapping of the habitat. In order to incorporate the littoral/profundal mapping using the



SGE-AcresLimited	amec	BathymetricProfile,Andrew's Pond			
	DRAWN JHM	PROJECT Habitat Quantification,Andrew'sPond			
	CHECKED AP	DRAWING Figure3.1			
	FILEnumber Tf05207	SCALE	DATE Dec 9,2002	DWG.NO.	REV. 0



SGE-AcresLimited	amec	HabitatClassification,Andrew'sPond			
	DRAWN JHM	PROJECT Habitat Quantification,Andrew'sPond			
	CHECKED AP	DRAWING Figure3.2			
	FILEnumber Tf05207	SCALE	DATE Dec 9,2002	DWG.NO.	REV. 0

bathymetry, the 3m contour was used to delineate the littoral and profundal zones since secchi depth was estimated at 2.7m. Table 3.3 presents the habitat types and their aerial extent.

Table 3.3. Lacustrine habitat types, Andrew's Pond.

Habitat Classification	Habitat Description	Bottom Surface Area (ha)
Profundal Zone - All pelagic and benthic habitat in water depths greater than 3m.		
Profundal Fine (PF)	All profundal benthic habitat was depositional in environment and consists of a narrow range of fine substrates (fine sand and silt).	74.09
Littoral Zone – All pelagic and benthic habitat in water depths less than 3m.		
Littoral Coarse (LC)	Erosional environment, bedrock and boulder substrate predominates (Includes steep slopes, and near-shore areas affected by wave/ice action).	4.65
Littoral Medium (LM)	Rubble to gravel substrate predominates (Includes moderate slopes, near-shore zones affected by wave/ice action or surface water inflow/outflow movement).	91.30
Littoral Fine (LF)	Areas where fine material is present/deposited in the substrate. Sand and silt predominate. Includes areas of low gradient and low wave/current energy.	42.47
Littoral Fine with Vegetation (LFV)	Areas where fine material is present/deposited in the substrate and emergent aquatic vegetation is present. Sand and silt predominate.	6.51
Total		219.02

Shoreline Vegetation

The shoreline vegetation was surveyed at each of the littoral substrate survey points. The dominant canopy and under story vegetation was recorded. A review of the aerial photography was also conducted (Appendix A).

The majority of the shoreline along the north and south sides has a beach of gravel to boulder-sized substrate. The west shore consisted of fines (sand and silt) and the east shore contained zones of fine substrate and course.

The shoreline is generally steep just beyond the beach areas. Less steep shoreline was recorded just west of Tributary One near a small bog and at the mouths of Tributary Two and Three. The north shore is dominated by black spruce (*Picea mariana*) (Figure 3.3) with some alders and ferns in lower, wetter areas (such as the outflow of Tributary One). While black spruce is the dominant canopy vegetation along the south shore, the shore has a more alder/shrub (i.e. under story) dominated vegetation along the shoreline (Figure 3.4).

Figure 3.3. Typical north shore vegetation and slope (note alder-fern zone in distance).

Figure 3.4. Typical south shore vegetation and slope.

3.1.2 Stream Habitat

Habitat Mapping

Aquatic habitat mapping was completed for the two inlet tributaries and outlet stream of Andrew's Pond. Habitat classification was in accordance with Beak (1980) as summarized in Table 3.4.

Table 3.4. Beak (1980) Habitat Classifications.

Classification	Description
Type I	Good salmonid spawning and rearing habitat; often with some feeding pools for larger age classes: **flows**: moderate riffles; **current**: 0.1-0.3 m/s; **depth**: relatively shallow, 0.3-1 m; and **substrate**: gravel to small cobble size rock, some larger rocks or boulders.
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 m/s; **depth**: variable from 0.3-1.5 m; and **substrate**: larger cobble/rubble size rock to boulders and bedrock, some gravel pockets between larger rocks
Type III	Poor rearing habitat with no spawning capabilities, used for migratory purposes: **flows**: very fast, turbulent, heavy rapids, chutes, small waterfalls, **current**: 1 m/s or greater; **depth**: variable, 0.3-1.5 m; and **substrate**: large rock and boulders, bedrock.
Type IV	Poor juvenile salmonid rearing habitat with no spawning capability, provides shelter and feeding habitat for larger, older salmonids (especially brook trout): **flows**: sluggish; **current**: 0.15 m/s; **depth**: variable but often >1 m; and **substrate**: soft sediment or sand, occasionally large boulders or bedrock, aquatic macrophytes present in many locations.

Summaries of the stream surveys are presented below. Each tributary was surveyed for approximately 50m upstream or until an obstruction to fish movement was located. Each stream was surveyed for:

- Wetted width (m)
- Mean depth (m)
- Estimated flow (m/s)
- Substrate (% coverage)
- Bank Stability
- Cover (instream, overhang)
- Obstructions

Table 3.5 presents a summary of survey information collected. A total of 3.09 units (one unit = 100m^2) of habitat were surveyed which was either classified as Type IV (pool), Type II (rearing) or Type I (spawning) habitat. The majority of the spawning habitat was located at the outflow of the pond.

Table 3.5. Stream Habitat Survey Information, Andrew's Pond tributaries.

Tributary	Length (m)	Width (m)	Units	Depth (m)	Bank Stability	Cover %	Substrate %							Predominant Habitat Type	Obstruction Barriers
							F	G		L			B		
								SM	LG	S	L	B			
1	25	0.35	0.09	0.06	P-F	50-90	100							IV	See summary
2	50	3.5	1.75	>1.0	G	5-10		50		20	10	20		II / I	None
3	50	2.5	1.25	0.5	G (20)	5		15	70	15				I	None
# of Units Per Habitat Type			Type I = 1.5		Type II = 1.5			Type III = 0			Type IV = 0.09				
Bank stability: F - Fair, P – Poor, G – Good. Values in brackets indicate % undercut. Substrate: F- fines (<2 mm), G - gravel (sm= 2-16 mm, lg=16-64 mm), L - large substrate (s=64-128 mm, l=128-256 mm, b>256 mm), B = bedrock															

Tributary One

Tributary One is located on the north side of Andrew's Pond. Its outflow into Andrew's Pond is not distinct as it flows through vegetation and grasses (Figure 3.5). Approximately 25m upstream is an obstruction to fish passage as the water percolates through mosses with no streambed visible.

The stream is approximately 0.35m wide and 0.06m deep with low velocities (i.e. <0.5m/s). The substrate of the tributary is primarily organics with heavy cover (50% instream and 90% overhang). This tributary was classed as Type IV habitat and may have been suitable for some rearing.

Tributary Two

Tributary Two enters Andrew's Pond from the west end. There were no obstructions within the survey area (i.e. up to 50m upstream). The stream is a slow moving tributary with large boulders and deep water (primarily Type II habitat) (Figure 3.6)

The stream is approximately 3.5m wide and greater than one metre deep with low velocities (i.e. <0.1m/s). The substrate is primarily boulder, cobble and gravel. Cover consists of small shrubs (approximately 10% coverage) and overhang (approximately 5% coverage). The tributary was classed as primarily rearing (Type II) habitat with pockets of spawning gravel (i.e. Type I) in shallower water.

Figure 3.5. Tributary One outflow. The mouth is very diffuse and is difficult to distinguish.

Figure 3.6. Tributary Two outflow.

Tributary Three

Tributary Three is the outflow of Andrew's Pond. The outflow is approximately 190m long between Andrew's Pond and the main stem of Shoal Harbour River. There were no obstructions identified in the surveyed section of stream. There was, however, evidence of an abandoned bridge/dam structure near the outfow (Figure 3.7). This structure was used to impound water to facilitate the movement of logs down the river (K. Peddle pers comm.). The structure did not appear to be a barrier to fish movement at the flows encountered during the survey.

Figure 3.7. Tributary Three, the outflow of Andrew's Pond. The abandoned bridge/dam structure is visible.

The stream is approximately 2.5m wide and 0.5m deep with moderate velocities (i.e. <1.0m/s). The majority of the surveyed section (approximately 50m) was riffle habitat with bottom substrate consisting entirely of gravel, pebble and cobble (Figure 3.8). The stream section was classified as entirely riffle habitat (i.e. Type I).

Figure 3.8. Tributary Three habitat downstream of mouth. Note typical Type I spawning habitat.

3.2 FISH

Sampling of Andrew's Pond was conducted using live-capture double-bag fyke nets. A total of three overnight sets were conducted during the habitat surveys in late September. Due to the fact that many salmonid lake-dwelling species may have begun migration to spawning habitats by this time, literature was also used to supplement the capture results.

In total, one brook trout juvenile, one ouananiche juvenile, and one three-spine stickleback were captured. Literature indicates that brook trout, ouananiche/Atlantic salmon, and rainbow trout utilize Shoal Harbour River and hence may utilize Andrew's Pond for a portion of their life cycle requirements. Therefore brook trout, ouananiche/Atlantic salmon, rainbow trout, and three-spine stickleback have been included in the calculation of habitat indices (Table 3.6).

Table 3.6. Listing of all fish species, including their different life stages, which are assumed present within Andrew's Pond for the purposes of calculating habitat suitability indices.

Species	Life Stages
Brook trout	Spawning YOY Juvenile Adult
Ouananiche/Atlantic salmon	Spawning YOY Juvenile Adult (ouananiche only)
Rainbow Trout	Spawning YOY Juvenile
Three-spine stickleback	Spawning YOY Juvenile Adult

3.3 HABITAT SUITABILITY INDICES

Tables 3.7-3.10 present the species lacustrine habitat requirements taken from Bradbury *et al*. (1999). Using these values, the Habitat Suitability Indices for each depth/substrate combination as per Bradbury *et al*. (2001) were calculated (Table 3.11). Neither muck or clay were identified in Andrew's Pond, therefore these substrates were omitted from the calculations of fine substrate (Littoral, Profundal and emergent). Pelagic habitat in the profundal zone was treated as a 1:1 ratio with the benthic habitat present since the mean depth of Andrew's Pond is less than 10m (Bradbury *et al*. 2001).

The highest Habitat Suitability Indices across all life stages of each species were brought forward as the species Habitat Suitability Index for each habitat type identified (Table 3.12). This value has been multiplied by the aerial extent of each habitat to ascertain the Habitat Equivalent Units for each species. Of the 219.02ha of habitat identified in Andrew's Pond, estimated Habitat Equivalent Unit values range between 137.92ha (i.e. rainbow trout) to 173.12ha (i.e. three-spine stickleback). These values represent weighted suitable habitat for the species identified (i.e. brook trout, ouananiche/Atlantic salmon, rainbow trout, and three-spine stickleback) in Andrew's Pond.

Table 3.7. Lacustrine habitat requirements for brook trout for each habitat in Andrew's Pond (adapted from Table 17 of Bradbury *et al*. (1999)).

Habitat Features	Category Ratings[1]			
	Spawning	Young-of-Year	Juvenile	Adult
Depths (metres)				
0-1	1.00	1.00	1.00	1.00
1-2	1.00	1.00	1.00	1.00
2-5	0.33	1.00	1.00	1.00
5-10	0.33	0.33	0.67	0.67
10+			0.67	0.67
Substrate				
Bedrock				
Boulder		1.00	1.00	
Rubble	0.33	1.00	1.00	
Cobble	0.67	1.00	1.00	1.00
Gravel	1.00	1.00	1.00	1.00
Sand	0.67			0.33
Silt	0.33			0.33
Muck (detritus)	0.33			
Clay (mud)	0.33			
Pelagic			0.33	0.33
Cover				
Emergents		1.00	1.00	1.00

Table 3.8. Lacustrine habitat requirements for ouananiche/Atlantic salmon for each habitat in Andrew's Pond (adapted from Table 15 of Bradbury *et al*. (1999)).

Habitat Features	Category Ratings[1]			
	Spawning	Young-of-Year	Juvenile	Adult
Depths (metres)				
0-1	1.00	1.00	1.00	0.33
1-2	0.33	1.00	1.00	0.33
2-5		1.00	0.67	1.00
5-10			0.33	1.00
10+			0.33	0.33
Substrate				
Bedrock				
Boulder		1.00	1.00	
Rubble		1.00	1.00	1.00
Cobble		1.00	1.00	1.00
Gravel	1.00	0.33	0.67	1.00
Sand		0.33	0.33	1.00
Silt		0.33		
Muck (detritus)				0.33
Clay (mud)				0.33
Pelagic			0.5	1.00
Cover				
Emergents			0.33	

Table 3.9. Lacustrine habitat requirements for rainbow trout for each habitat in Andrew's Pond (adapted from Table 21 of Bradbury *et al*. (1999)).

Habitat Features	Category Ratings[1]			
	Spawning	Young-of-Year	Juvenile	Adult
Depths (metres)				
0-1	1.00	1.00	1.00	1.00
1-2	1.00	1.00	1.00	1.00
2-5	0.33	1.00	1.00	1.00
5-10		0.33	0.33	
10+				
Substrate				
Bedrock				
Boulder		1.00	1.00	1.00
Rubble		1.00	1.00	1.00
Cobble		1.00	1.00	1.00
Gravel	1.00	0.33	0.33	
Sand		0.33	0.33	
Silt				
Muck (detritus)				
Clay (mud)				
Pelagic		0.67		
Cover				
Emergents	0.33	0.33	0.33	

Table 3.10. Lacustrine habitat requirements for three-spine stickleback for each habitat in Andrew's Pond (adapted from Table 28 of Bradbury *et al*. (1999)).

Habitat Features	Category Ratings[1]			
	Spawning	Young-of-Year	Juvenile	Adult
Depths (metres)				
0-1	1.00	1.00	1.00	1.00
1-2	1.00	1.00	1.00	1.00
2-5	0.33			1.00
5-10	0.33			1.00
10+	0.33			0.33
Substrate				
Bedrock				
Boulder				
Rubble	0.33			0.33
Cobble	0.33			0.33
Gravel	0.33			0.33
Sand	1.00			0.33
Silt	1.00			
Muck (detritus)	1.00			1.00
Clay (mud)	1.00			1.00
Pelagic				1.00
Cover				
Emergents	0.67	1.00	1.00	1.00

Table 3.11. Habitat Suitability Indices for all fish species, including their respective life stages for Andrew's Pond.

Species	Life Stage	Littoral Zone				Profundal
		LC	LM	LF	LFV	PF
Brook trout	Spawning	0.00	0.72	0.64	0.32	0.32
	YOY	0.50	1.00	0.00	0.50	0.00
	Juvenile	0.50	1.00	0.00	0.50	0.17
	Adult	0.00	0.67	0.67	0.84	0.50
Ouananiche / Atlantic salmon	Spawning	0.00	0.19	0.00	0.00	0.00
	YOY	0.33	0.59	0.22	0.11	0.11
	Juvenile	0.47	0.89	0.31	0.46	0.40
	Adult	0.00	0.78	0.39	0.20	0.69
Rainbow Trout	Spawning	0.00	0.30	0.00	0.28	0.00
	YOY	0.50	0.89	0.33	0.50	0.50
	Juvenile	0.50	0.89	0.33	0.50	0.17
	Adult	0.50	0.67	0.00	0.00	0.17
Three-spine stickleback	Spawning	0.00	0.55	0.89	0.81	0.44
	YOY	0.00	0.00	0.22	0.45	0.11
	Juvenile	0.00	0.00	0.22	0.45	0.11
	Adult	0.00	0.67	0.83	0.92	0.92

Table 3.12. Species Habitat Suitability Indices for each individual fish species present and its Habitat Equivalent Units for Andrew's Pond.

Species	Littoral Zone								Profundal Zone		Total Units (ha)
	LC		LM		LF		LFV		PF		
	HSI	**Units**	HSI	**Units**	HSI	**Units**	HSI	**Units**	HSI	Units	
Brook Trout	0.50	2.33	1.00	91.30	0.67	28.45	0.84	5.47	0.50	37.05	164.60
Ouananiche / Atlantic salmon	0.47	2.19	0.89	81.26	0.39	16.56	0.46	2.99	0.69	51.12	154.12
Rainbow Trout	0.50	2.33	0.89	81.26	0.33	14.02	0.50	3.26	0.50	37.05	137.92
Three-spine Stickleback	0.00	0.00	0.67	61.17	0.89	37.80	0.92	5.99	0.92	68.16	173.12

LC – Littoral Coarse
LM – Littoral Medium
LF – Littoral Fine
LFV – Littoral Fine Vegetated
PF – Profundal

3.4 FISHERIES

No documented fisheries were recorded, however, it can be assumed that some angling for brook trout and ouananiche adults are conducted in Andrew's Pond.

4.0 POTENTIAL EFFECTS

The proposed Project described in Section 2.0 presents a summary of the activities and potential construction which could affect aquatic habitat. Table 4.1 presents the potential effects on the aquatic habitat of Andrew's Pond based on the Project description. It lists all planned construction and operation activities which have the potential to create harmful alteration disruption or destruction (HADD) in Andrew's Pond regardless of the extent.

The definitions of destroyed and altered in the context of this quantification are as follows:

- **Destroyed** habitat is that which will be irrevocably lost either through construction or operation of the project.
- **Altered** habitat is that which will change in either quantity or quality and thereby result in a reduction of productive capacity either through construction or operation of the project. The habitat will not be rendered unsuitable for fish.

Standard proven mitigation measures will be applied in areas where stream crossings are required, thus the major freshwater habitat effects will be limited to Andrew's Pond and the lower portions of its three identified tributaries immediately adjacent to the pond (i.e. within 50m). A distance of 50m within the streams has been chosen in order to remain extremely

conservative. The total length of the outflow tributary was considered for potential alteration of habitat.

While the design of the control structure is not yet finalized, various concepts have been analyzed based on sensitivity of location, constructability, and logistics. While not outlined as mitigation as such, some alterations to the structure have been incorporated based on these surveys in order to reduce the potential effect on the more sensitive aquatic habitat in the area.

The original concept takes advantage of the relatively large bedrock outcrop along the north side of the outflow stream. The outcrop will be used as the base for all concrete features such as the overflow weir, control gates, and fishway. The remainder of the structure is to consist of an earth fill dam. This feature was initially to extend across the outflow just above a large pool at the mouth of Tributary Three. Upon review of the fish habitat survey data, the orientation of the earth fill dam was adjusted to avoid the outflow habitat as much as possible. The current design has the earth fill dam structure extending directly south from the rock outcrop so that its footprint is entirely within lacustrine habitat. This modification therefore avoids damaging potential Type I spawning habitat.

The outflow of the fishway and control gates was also placed at the most southerly end of the bedrock outcrop. This places the flows from the structure as close as possible to the original outflow of Andrew's Pond.

Table 4.1. Potential effects of the project on Fish and Fish Habitat.

Project Activity	Potential Effects
Construction Construction of control weir at the outflow of Andrew's Pond.	o Destruction of lacustrine habitat directly within footprint of Control weir o Destruction of stream habitat downstream of control weir due to excess sediment o Altered flows into outflow stream due to control weir
Operation **Water Retention** Spring runoff will be retained in Andrew's Pond by the control weir and consumed by the town of Clarenville later in the season.	o The control weir may cause the inundation of shoreline (approximately one meter additional depth to Andrew's Pond)
Operation of Andrew's Pond The control weir will operate across the outlet of Andrew's Pond.	o The weir may prevent the migration of fish between Tributary Three and Andrew's Pond o The operation of the weir may alter flows in Tributary Three and Shoal Harbour River

The Project would affect standing water (lacustrine) as well as a minor portion of stream habitat in tributaries to Andrew's Pond. The potential habitat effects are:

Ponds

- **Destruction**
  - A portion of lacustrine habitat directly in front of Tributary Three
- **Alteration**
  - Inundation of Andrew's Pond up top one metre additional depth

Streams

- **Destruction**
  - None Identified
- **Alteration**
  - Inundation of a portion of Tributaries One and Two of Andrew's Pond
  - Alteration of flow patterns in Tributary Three and Shoal Harbour River

Each of these potential effects will be considered in turn.

4.1 PONDS

4.1.1 Potential Destruction of Habitat

The total of all potentially destroyed lacustrine habitat consists of a small section of the pond which would be within the footprint of the control weir. The control weir as currently designed would cover a total of 0.03ha (3.0 units) of lacustrine habitat. The breakdown is approximately 0.024ha of Littoral Medium and 0.006ha of Littoral Coarse.

4.1.2 Potential Alteration of Habitat

Inundation of the pond by an additional meter of water would have the effect of retaining the spring runoff until later in the season. The pond will therefore remain at an elevated water level longer. Slight inundation along the shoreline into the vegetation is possible during the peak of the runoff. Based on observations of the shoreline, the contours of topographic mapping, and aerial photos, inundation would be slight. Preliminary surveys of the shoreline and outlet of Andrew's Pond by SGE-Acres indicate that the normal high water mark is close to 100.0m elevation with a typical summer water level near 99.1m. An elevation of 100.0m has therefore been chosen as the conceptual spillway elevation.

It is therefore unlikely that inundation of the surrounding shoreline vegetation would occur. The estimated increase in water depth is approximately 0.90m. This general increase in water levels is not anticipated to negatively alter the lacustrine habitat of Andrew's Pond significantly for the species and life stages identified.

4.2 STREAMS

4.2.1 Potential Alteration of Habitat

The total destruction of stream habitat would not occur as a result of the control weir as currently designed. The weir will be designed to provide fish passage between the outflow and Andrew's Pond at all flows. The final design of the fish passage structure is yet to be

determined; however there will not be any disruption to the migration patterns of fish utilizing the pond.

Tributaries One and Two which drain into Andrew's Pond may be inundated if the level of Andrew's Pond is elevated by the control weir. Given the steep shoreline around Andrew's Pond, inundation is expected to be slight. Surveys of the tributaries indicate that the majority of habitat in these tributaries is rearing (Type II) and pool (Type IV) habitat. Some pockets of potential spawning habitat may be inundated in Tributary Two (approximately 0.25 units in the first 50m of stream). Inundation would not be expected to raise the water into these tributaries beyond this point and would be considered typical to spring flood conditions.

The controlled outflow of retained spring runoff through the weir during the summer months for utilization at the water supply intake dam on Shoal Harbour River will have the effect of elevating low summer water levels during times of water need by the town. The water would be released such that it would mimic a rainfall event (excess flows will be avoided). These releases would have the effect of providing additional water into Tributary Three and Shoal Harbour River during the summer months. It is anticipated that this would provide a positive effect to the fish populations in the downstream portions of the river between Andrew's Pond and the intake dam. It is also expected that final design will incorporate fish passage and habitat maintenance flows for the outflow tributary.

An acceptable water release scenario would be incorporated into the operation of the control weir to ensure that excess flows (and associated velocities) would be avoided. The release scenario would also allow acceptable flows within the outflow of Andrew's Pond.

5.0 MITIGATION MEASURES

Applicable mitigation measures would be applied to any control weir construction. Typical measures applicable to freshwater fish habitat are:

- Provide maximum protection to salmonid populations;
- Limiting, where practicable project activities within aquatic habitat;
- Maximize design efficiency to limit areas of disturbance;
- Reduce alterations to outflow patterns and flow;
- Compliance with Environmental Protection Plan for sediment control, road grading and drainage, excavation;
- Education and training of personnel and protection of fish habitat with regards to good practice;
- Adherence to applicable federal and provincial regulations and policies;
- Design of diversion channels to control erosion and/or facilitate fish passage during construction;
- Limit construction and project operations near waterways during sensitive periods for fish (eg. avoidance of spawning/incubation); and
- Suitable fish passage structures incorporated into the control weir design to facilitate fish passage between Andrew's Pond and its outflow tributary.

Prior to construction, an Environmental Protection Plan (EPP) will be developed to eliminate or reduce environmental effects of many project activities on the aquatic environment. The EPP

will describe the measures to protect Andrew's Pond and Shoal Harbour River habitat and fish during construction activities.

6.0 RESIDUAL IMPACTS

6.1 POND

The project would result in the total destruction of 0.03ha of lacustrine habitat near the outflow of Andrew's Pond. This would include 0.024ha of Littoral Medium and 0.006ha of Littoral Coarse.

The amount of lacustrine habitat possibly altered by the project, expressed as weighted habitat equivalents, is calculated to total between 137.92 and 173.12ha for the species within the Pond (*see* Table 3.12). The alteration would be a slight increase in mean summer depths as the spring runoff water is retained and slowly released throughout the summer. The maximum increase in total depth would be approximately one meter.

6.2 STREAMS

The project would not result in the destruction of stream habitat. A fish passage structure will be incorporated into the control weir in order to ensure suitable migration between Andrew's Pond and the outflow. Since the outflow appears to provide a high degree of spawning habitat, passage for juvenile fish from the outlet stream into Andrew's Pond must be considered in the final design.

Slight inundation of the lower portions of two small tributaries into Andrew's Pond will be most likely be realized. The inundation would most likely be less than 50m of stream habitat and would affect less than 1.5 units of habitat. The majority of this is rearing (Type II) and pool (Type IV) habitat and would not be considered limiting within the system. In addition, the inundation would be similar to typical spring conditions.

Retained spring runoff in Andrew's Pond would be released into Tributary Three and Shoal Harbour River during the summer months. This would provide additional water not only to the towns of Clarenville and Shoal Harbour during this time but also provide additional flow for the fish populations in these areas. This is anticipated to contribute positively to fish production.

7.0 SUMMARY AND CONCLUSIONS

The implementation of appropriate mitigation measures during construction, as well as the development and application of a project specific EPP, will reduce impacts on fish and fish habitat as well as ensure maximum protection of fish and fish habitat. A fish passage structure capable of allowing juvenile salmonid movement from the outlet stream into Andrew's Pond will ensure that life stages utilizing Andrew's Pond will not be impacted. An acceptable water release scenario will also ensure that fish and fish habitat downstream of the control weir will not be significantly negatively affected.

Nevertheless, the project would result in destruction and alteration of stream and pond habitat. The quantity of freshwater fish habitat which would be altered, disrupted or destroyed as a result of the construction of a control weir has been determined based on conservative assumptions with respect to habitat utilization by brook trout, ouananiche/Atlantic salmon, rainbow trout, and three-spine stickleback for all applicable life stages (see Table 3.12).

A total estimate of less than 1.5 units of stream habitat would be altered due to inundation. The majority of this is rearing (Type II) and pool (Type IV) habitat and would not be considered limiting within the system.

The anticipated destruction of lacustrine habitat is 0.03ha; 0.024ha of Littoral Medium and 0.06ha of Littoral Coarse. The possible alteration of standing water habitat expressed as weighted habitat equivalents are calculated to total between 139.02 and 173.64ha for the species within the Pond (*see* Table 3.12). The possible effect of the control weir would be the increased retention of spring runoff water in Andrew's Pond. The proposed weir would retain an additional one metre of water. Due to the low level of inundation, the additional water level is not anticipated to flood surrounding vegetation or negatively affect the lacustrine habitat significantly.

Retained spring runoff in Andrew's Pond would be released into Tributary Three and Shoal Harbour River during the summer months. This would provide additional water not only to the towns of Clarenville and Shoal Harbour during this time but also provide additional flow for the fish populations in these areas. This is anticipated to contribute positively to fish production.

8.0 REFERENCES

Beak. 1980. Fisheries Resources of Tributaries of the Lower Churchill River. Prepared by Beak Consultants Limited for the Lower Churchill Development Corporation, St. John's, NF.

Bradbury, C. M.M. Roberge, and C.K. Minns. 1999. Life History Characteristics of Freshwater Fishes Occurring in Newfoundland and Labrador, with major emphasis on Lake Habitat Characteristics. Can. MS Rep. Fish Aquat. Sci. 2485:vii + 150p.

Bradbury, C., A.S. Power, M.M. Roberge. 2001. Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador. Fisheries and Oceans, St. John's, NF. 60p.

Environment Canada. 1982. Canadian Climate Normals (1951-1980). Volumes 3 & 5. Environment Canada, Ottawa, ON.

Porter, T.R. L.G. Riche, G.R. Traverse. 1974. Catalogue of Rivers in Insular Newfoundland. Data Report Series No NEW/D-74-9 Volume A. Fisheries Development Branch, Fisheries and Marine Service, Department of the Environment.

Scruton, D.A., T.C. Anderson, C.E. Bourgeois, and J.P. O'Brien. 1992. Small stream surveys for public sponsored habitat improvement and enhancement projects. Can. Manuscr. Rep. Fish. Aquat. Sci. No. 2163: v + 49pp.

APPENDIX A

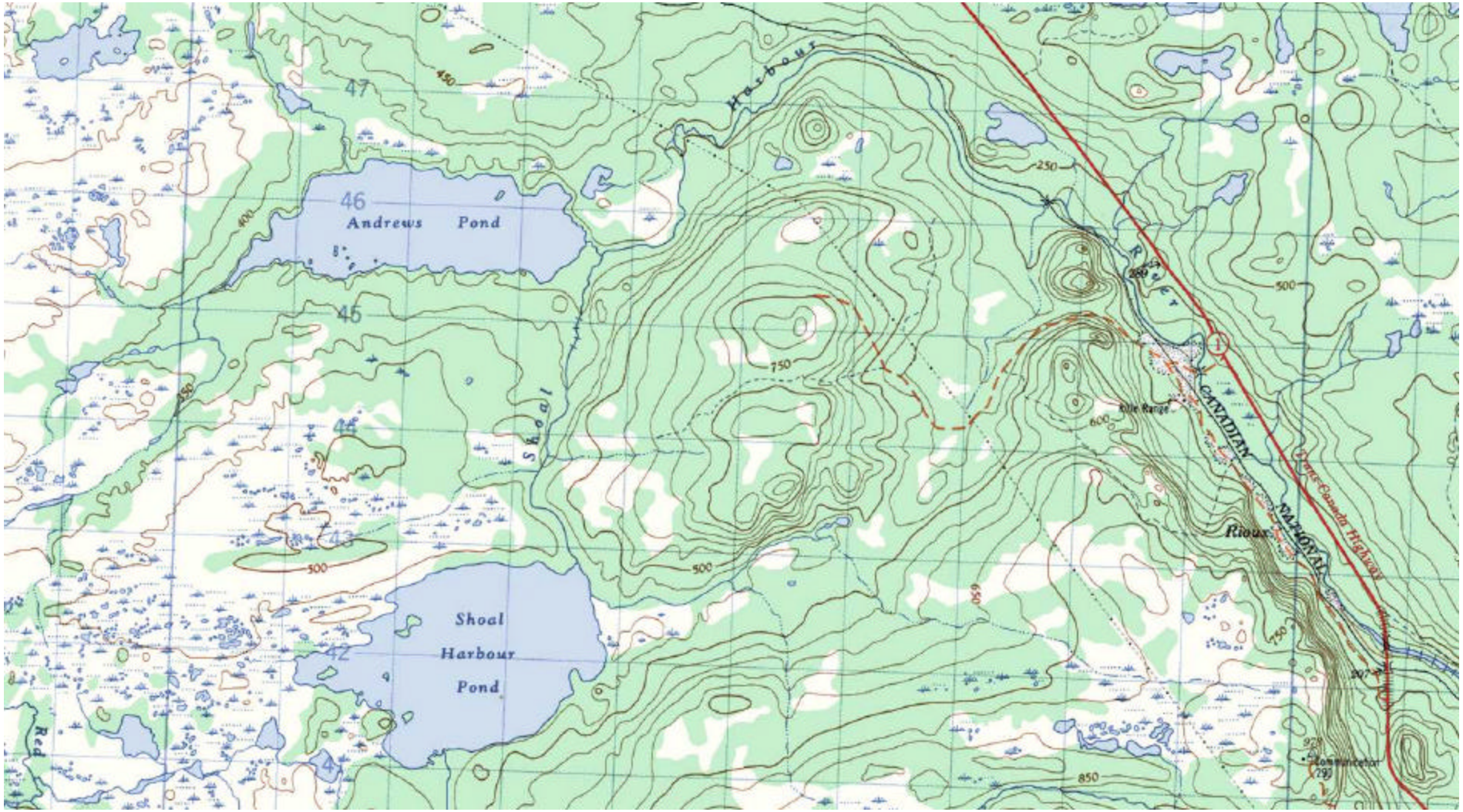
Additional maps and photographs

Typical Littoral Coarse

Typical Littoral Medium

Typical Littoral Fine

Andrew's Pond from Forest Access Road



SGE-AcresLimited	amec	TopographicMap,Andrew'sPond			
	DRAWN JHM	PROJECT Habitat Quantification,Andrew'sPond			
	CHECKED AP	DRAWING			
	FILEnumber Tf05207	SCALE	DATE Dec 9,2002	DWG.NO.	REV. 0

SGE-AcresLimited	amec	Aerial Photo,Andrew's Pond			
	DRAWN JHM	PROJECT Habitat Quantification,Andrew'sPond			
	CHECKED AP	DRAWING			
	FILEnumber Tf05207	SCALE	DATE Dec 9,2002	DWG.NO.	REV. 0