AQUATIC MONITORING PROGRAM
2006 Annual REPORT

Central Lake Ontario Conservation Authority

DURHAM REGION

Central Lake Ontario Conservation

"What we do on the land is mirrored in the water."

2006 AQUATIC MONITORING PROGRAM REPORT

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1.0 Introduction

In order to make sound, science-based management decisions about local **watersheds**, the Central Lake Ontario Conservation Authority (CLOCA) conducts long-term watershed health monitoring. This information helps CLOCA understand current conditions, identify ecological trends, provides a strong basis to measure the effectiveness of stewardship activities and also provides guidance in making informed land-use decisions. Typical components of the watershed are monitored: aquatic habitat (e.g. habitat assessments and temperature monitoring); fish and benthic macroinvertebrates (benthos); terrestrial habitat (e.g. riparian and tableland vegetation, wildlife); and, water quality and quantity of both surface water and groundwater. This report focuses on the Aquatic Monitoring Program, specifically Fisheries, Biological Water Quality and Stream Temperature.

To help ensure that monitoring is done using standardized protocols, whenever possible, CLOCA participates in national, provincial or municipal networks. Our partners include Environment Canada (EC), Fisheries and Oceans Canada (DFO), Ministry of Environment (MOE), Ministry of Natural Resources (MNR) and other Conservation Authorities.

Located east of Toronto within the Region of Durham (Figure 1), the Authority's jurisdiction encompasses 638 square kilometres and is defined by the area drained by fifteen watersheds (Figure 2). Local municipalities located within the jurisdiction, in whole or in part, include the cities of Oshawa and Pickering, the towns of Ajax and Whitby, the Municipality of Clarington, the townships of Scugog and Uxbridge.

Figure 1. Location of CLOCA jurisdiction (highlighted in green).

A **watershed** is defined as an area drained by a river or creek and its tributaries.

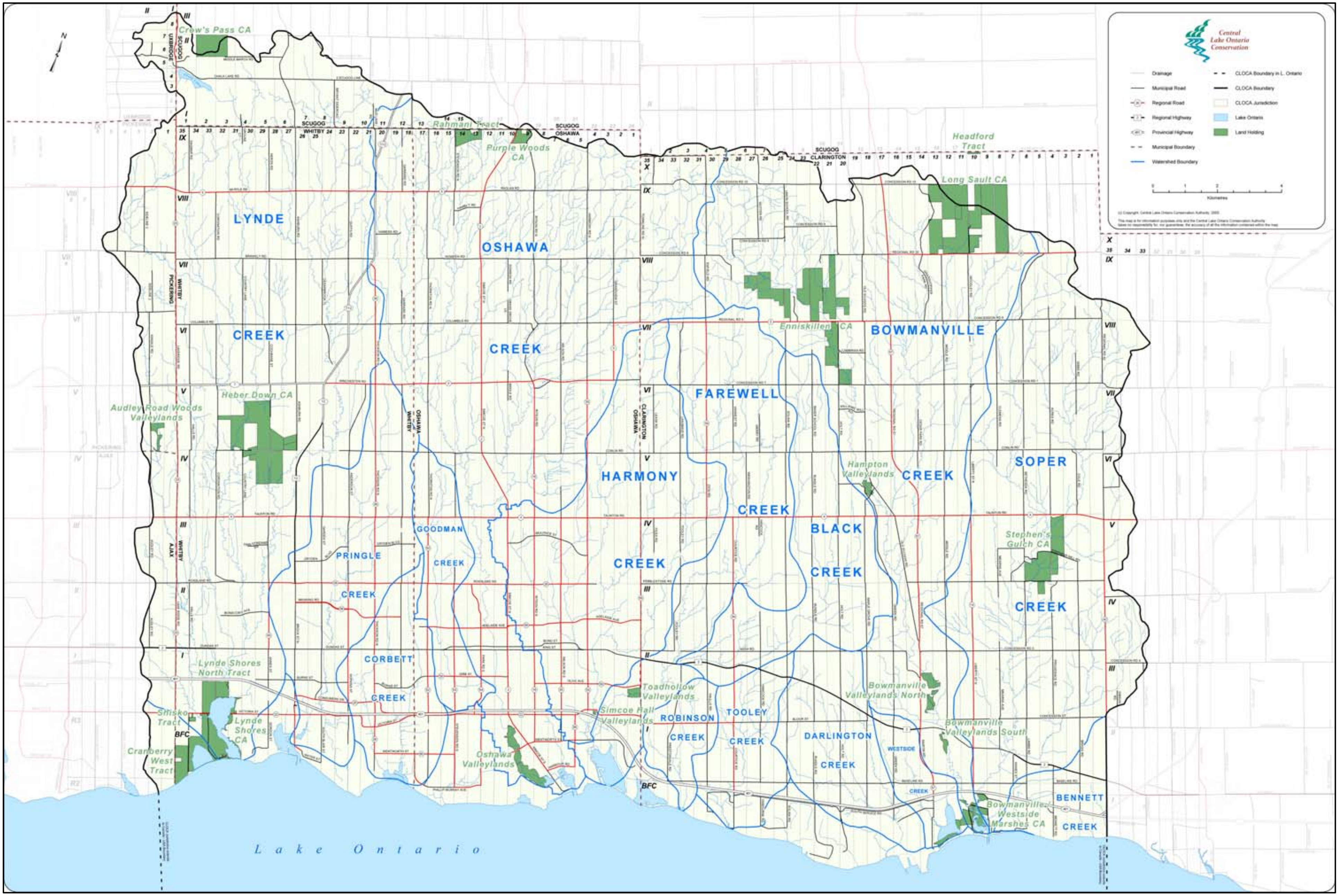

Figure 2. CLOCA jurisdiction.

2.0 Fisheries - Streams

Fish are one of our most valued natural resources from ecological, economic, social and cultural perspectives. Healthy fish and environments result from protecting and/or restoring aquatic ecosystems (Draft Terms of Reference, 2005). In order to help determine aquatic ecosystem health and monitor it over time CLOCA conducts fisheries assessments in various watersheds each season. Ongoing annual aquatic monitoring is recommended in the Central Lake Ontario Fisheries Management Plan (CLOFMP; CLOCA/MNR 2007). Information collected during these programs supports the goals and objectives of the CLOFMP and allows for an adaptive management approach.

Historically, watersheds within the Central Lake Ontario Conservation Authority supported healthy cold-water fish communities and a strong brook trout and Atlantic salmon fishery. With increasing urbanization and changing land-use patterns, many of the cold water streams have become cool or warm-water systems. The Atlantic salmon fishery has since collapsed and has been supplemented by stocking of Pacific salmon and trout species. The distribution of brook trout in many areas has been reduced to the undeveloped headwater reaches where natural cover is still present (CLOCA/MNR 2007).

While there have been many changes to the fisheries, the Central Lake Ontario watersheds are still home to a diverse array of fishes including cold-, cool- and warm-water species. Some of these watersheds, most notably Bowmanville/Soper Creek, support healthy populations of sport fishes and as such are popular destinations for anglers. Angling opportunities include Chinook salmon, rainbow trout, and coho salmon during the spring and fall spawning runs, and brook trout and brown trout fishing during the regular season. Anglers also take advantage of fishing popular warm-water species like bass, sunfish and carp in the coastal areas (CLOCA/MNR, 2007).

Generally, CLOCA conducts fisheries sampling in streams using a common sampling method called **electrofishing** (see photo). On occasion, when electrofishing is not a suitable technique, other sampling methods, such as seine nets, fyke nets and minnow traps, are utilized. Backpack electrofishing, is conducted, for the most part, according to the Ontario Stream Assessment Protocol (OSAP) published by the MNR (Stanfield, 2005).

During 2006, 24 OSAP sites were sampled in the Bowmanville and Soper Creek watershed (Figure 3). Fish species that were captured are listed in Table 1.

Electrofishing is a sampling method that temporarily immobilizes fish in water using electricity. Once immobilized, they can be captured with nets and fisheries staff can collect biological information (e.g., species, length, weight) before releasing them.

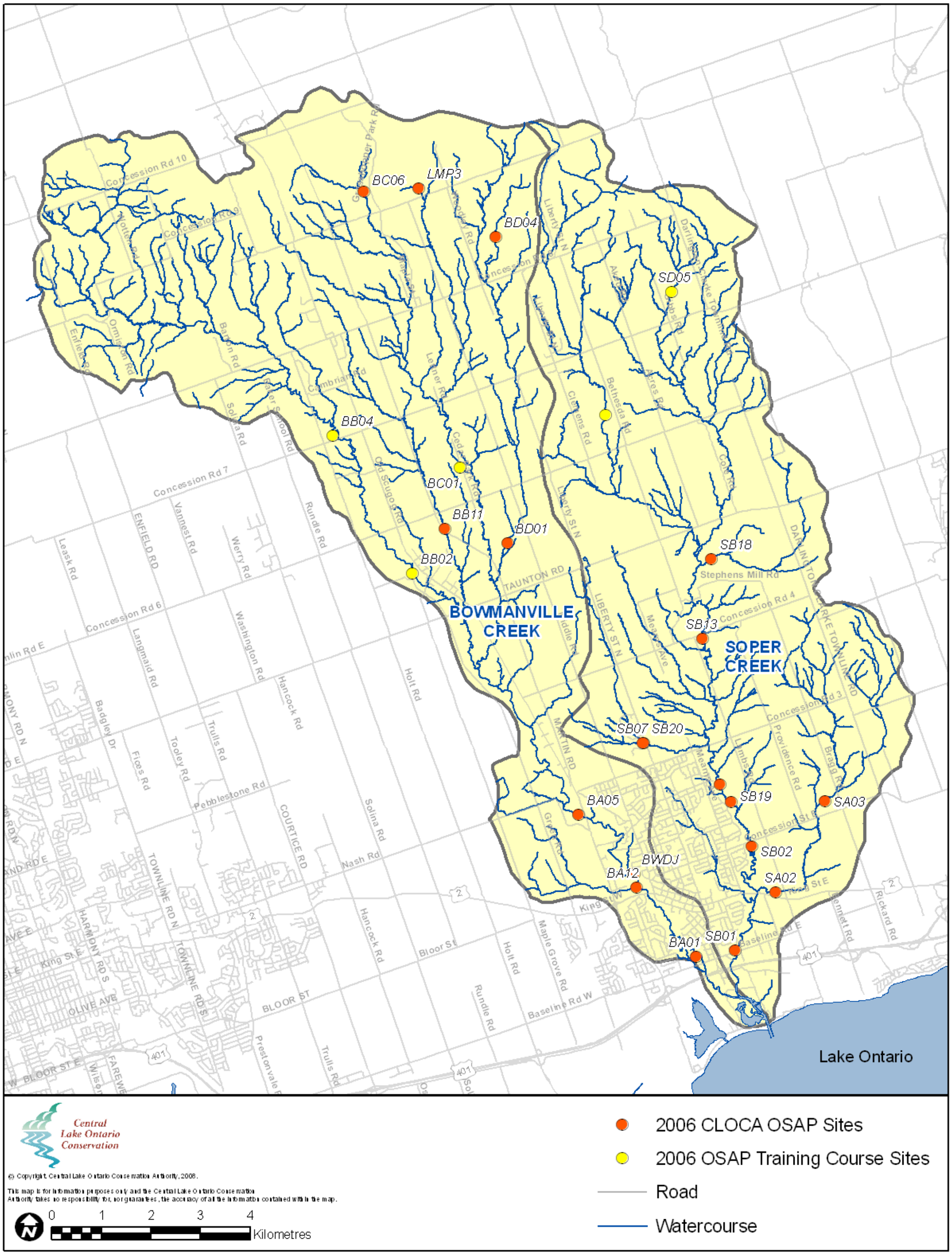

Figure 3. 2006 stream fisheries sites.

Table 1. Number of fish species and individuals caught at OSAP sites within the Bowmanville Creek watershed during 2006 sampling compared to historical sampling results (where available).

		Sites																					
		BA01		BA05		BA12		BB02*		BB04*		BB11	BC01		BC06		BD01		BD04		BWDJ	LMP3	
	Fish Species (common name)	1998	2006	1998	2006	1998	2006	1999	2006	1999	2006	2006	1999	2006***	1999	2006	1998	2006	1999	2006		2002	2006
1	brook trout YOY														2	1			3	5			5
2	brook trout														5	4			14	12		1	1
3	rainbow trout YOY	3	13	153	98	45	9						40	47	2			8					
4	rainbow trout		5	8	4	7						1	16	2	1	2	2	2					
5	brown trout YOY							8	1	5	15		19	1	7	4	10	3					
6	brown trout		1		4	2		1	7	22	16	2	2	2	12	12	6	4					1
7	Chinook salmon YOY		3																				
8	coho salmon YOY				1								5										
9	lamprey sp.																						
10	American brook lamprey									4	8												
11	goldfish																						
12	creek chub	1	5	2	1		10				2	5					1	5					
13	western blacknose dace	26	24		10	3	6	12	11	14	12	1					7	31			See Table 3		
14	longnose dace	61	173	11	110	1																	
15	fathead minnow										4												
16	common shiner	4	5					1															
17	golden shiner		1																				
18	bluntnose minnow	29	17																				
19	northern redbelly dace						27				7												
20	finescale dace		1																				
21	white sucker	3	3		10	2		1		1	5							3					
22	brown bullhead																						
23	sculpin sp.	5		12		52									12**				8**			4**	
24	mottled sculpin		3		8			3		21	2		25	11			11	2					
25	slimy sculpin															17				13			3
26	pumpkinseed		1		2	1	1				2	1											
27	rainbow darter	20	83																				
28	johnny darter	20	4																				
29	yellow perch	1																					
30	logperch	1	1																				
	Grand Total	174	343	186	248	113	53	26	19	67	73	10	107	63	29	40	37	58	17	30	0	1	10
	Species Total	12	17	5	10	8	5	6	3	6	10	5	6	5	6	6	6	8	2	3	0	1	4

Note: YOY or young of year refers to fish that are in their first year of life i.e. < 100mm.
* represents OSAP sites that were sampled through the 2006 OSAP Training Course.
** most likely were slimy sculpin but this can not be confirmed as a reference sample does not exist.
*** site was only half sampled due to inclement weather.

Table 2. Number of fish species and individuals caught at OSAP sites within the Soper Creek watershed during 2006 sampling compared to historical sampling results (where available).

	Sites	SA02		SA03		SB01		SB02		SB05		SB07		SB13		SB18	SB19	SB20	SC02*		SD05*
	Fish Species (common name)	1999	2006	1998	2006	1999	2006	1998	2006	1998	2006	1999	2006	1998	2006	2006	2006	2006	1998	2006	2006
1	brook trout YOY																				11
2	brook trout																				14
3	rainbow trout YOY		6		2	1		5	1	159	28		8	99	59	4	25		15		
4	rainbow trout					8	3	11	1	31	6			25	5		5		3		2
5	brown trout YOY					1				1	2			8	3		1		8	4	
6	brown trout				1	7	4	1	8	3				7	17	2	13		8	10	
7	Chinook salmon YOY							1		1	3			5			1				
8	coho salmon YOY										10				7	4	2				
9	lamprey sp.													7							
10	American brook lamprey														**2**					1	
11	goldfish																				
12	creek chub	51	33	20	126				4				9			13					
13	western blacknose dace	14	30	115	100	9		40	29	4		5	28			13	9	20			
14	longnose dace	22	11	18	6	52	40	38	10	39	34						28				
15	fathead minnow	3																			
16	common shiner	1	8																		
17	golden shiner																				
18	bluntnose minnow	40																			
19	northern redbelly dace																				
20	finescale dace																				
21	white sucker		25	13	6	22	5	9	14		1			1			8				
22	brown bullhead																				
23	brook stickleback											10									
24	sculpin sp.																				
25	mottled sculpin					5	2	33	34	58	28			35	68		46		5	6	
26	slimy sculpin																				
27	rock bass					1	1														
28	pumpkinseed					1			1	1	15	1					19		7		
29	rainbow darter						16	2		2							1				
30	johnny darter	53	57	1	16	9	3	8	64	10	5						18				
31	yellow perch					1			1												
32	logperch																				
	Grand Total	184	170	167	257	117	74	148	167	309	132	16	45	187	161	36	176	20	46	21	27
	Species Total	7	7	5	7	12	8	10	11	11	10	3	3	8	7	5	13	1	6	4	3

Note: YOY or young of year refers to fish that are in their first year of life.
* represents OSAP sites that were sampled through the 2006 OSAP Training Course.
** most likely were slimy sculpin but this can not be confirmed as a reference sample does not exist.

2.1 Long-Term Monitoring

2.1.1 BWDJ

Site BWDJ (Figure 3) was selected as a long-term monitoring site for a stormwater pond and was first sampled in 1996. This site has been sampled for 11 consecutive years and during that time some interesting trends have appeared. From 2004 to 2006 the number of salmon, brown trout and rainbow trout that were captured during sampling events has decreased below the average catch over the 11 years of sampling (Table 3). Some possible explanations include upstream channel re-alignment in 2003 and 2004, fish stocking rates and varying sampling times.

Photo 1 - July 6, 2005

Table 3. Fish species and quantities caught at site BWDJ in the Bowmanville Creek watershed from 1996 - 2006.

Species	Sampling Years										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
rainbow trout (YOY)		105	98	143	71	163	61	223	9	25	7
rainbow trout	8	21	44	24	18	18	8	17	1	18	64
brown trout (YOY)								7			
brown trout	2	2	4	2	5	2	1	1	1		1
Chinook salmon				21	2	11		1			10
coho salmon			2		2						
creek chub		8	5		5	3	5		1		2
western blacknose dace	5	21	41	35	42	54	63	100	17	24	24
longnose dace	13	27	76	54	58	81	210	186	72	205	64
fathead minnow							3	23	2		
johnny darter	1	1	4	1		2	25	5	1	1	
rainbow darter				10	1	2	17	10	7	22	12
white sucker	16	11	19	10	9	9	35	9		14	3
mottled sculpin		2	12	3	10	4	13	4	1		3
lamprey sp.											2
American brook lamprey					2						
common shiner			2								
pumpkinseed		1		7	30	1	9	1	3		1
goldfish					2		1				
bluntnose minnow					2	1	3				
brown bullhead									2		
finescale dace	1										
Grand Total	46	199	307	310	259	351	454	587	117	309	193
Species Total	7	10	11	11	15	13	14	13	12	7	12

2.2 Monitoring Results and Fisheries Management

The draft Central Lake Ontario Fisheries Management Plan (MNR/CLOCA 2007) outlines watershed and subwatershed-based goals and objectives for the fisheries resource and habitat within Bowmanville and Soper Creeks, and identifies target species and fish communities for management. CLOCA's annual aquatic monitoring helps to assess these goals and objectives and is consistent with the management recommendations made within the Plan. Further, it allows for an adaptive management approach.

The results of the 2006 CLOCA Aquatic Monitoring are consistent with the goals and objectives of the FMP. The main branches of Bowmanville and Soper Creeks are still dominated by migratory salmonids and should remain managed as such. Upstream of impassable barriers to fish migration, streams remain dominated by resident coldwater fish communities including brook trout, brown trout and sculpin species. These headwaters should continue to be managed for these sustainable and diverse fish communities.

Bowmanville and Soper Creeks have been selected for Atlantic salmon reintroduction and associated habitat improvement projects in the coming years. Reintroduction of Atlantic salmon into their historical range has been identified as an objective in the CLOFMP. Existing datasets and future aquatic monitoring projects in these watersheds will allow CLOCA and its partner agencies to prepare for Atlantic salmon reintroduction and evaluate the success of these efforts.

3.0 Fisheries - Wetlands

Great Lakes coastal wetlands are a unique wetland type that have formed at the mouths of streams and rivers where they empty into the lakes, or in open or protected bays along the shoreline. Lake Ontario's water level has been regulated since 1960 to accommodate increased demand for shipping and hydroelectric power. Natural water level variability has been diminished, reducing the biological diversity of coastal wetlands that depend on water level fluctuations to maintain diverse vegetation communities (Environment Canada and Central Lake Ontario Conservation Authority, 2004a).

The Durham Region Coastal Wetland Monitoring Program (DRCWMP) is designed to be a long-term monitoring program that enables reporting on the condition of coastal wetlands in the Region. The project was initiated in 1999 and monitoring began in 2002. Partners involved include Environment Canada, Central Lake Ontario Conservation Authority, Toronto Region Conservation Authority (TRCA) and Ganaraska Region Conservation Authority (GRCA) (Environment Canada and Central Lake Ontario Conservation Authority, 2004b).

As part of the DRCWMP, fish communities in wetlands are assessed using a sampling method called boat electrofishing (see photo on right; see page 3 for a definition of electrofishing). In order to have consistent sampling effort, fish are sampled within the DRCWMP wetlands using the same electrofishing boat, owned and operated by CLOCA. Boat electrofishing is conducted according to DRCWMP fish sampling protocol (Environment Canada and Central Lake Ontario Conservation Authority, 2003).

The relative condition of the fish community at each wetland and over multiple years is compared using an Index of Biotic Integrity (IBI). IBIs, which are multi-metric indices, were first developed for use with stream fish communities by James Karr in central Illinois and Indiana (Karr, 1981). Metrics, or attributes, appropriate to Lake Ontario coastal wetland fish communities were selected and tested for suitability in the IBI based on a significant ($p<0.05$) or moderate ($p<0.20$) response to disturbances of the wetland. Six metrics were found to correlate either negatively or positively with disturbance and were, thus, retained for use in this IBI: number of native species, number of centrarchid species, percent piscivore biomass, number of native individuals (metric was corrected for site-specific interaction) and biomass (g) of yellow perch. Each wetland receives an IBI score between 0 and 100 each year/time that it is sampled (Table 4) (Environment Canada and Central Lake Ontario Conservation Authority, 2004b).

In 2006, for the first time since the project began, round goby (see photo on right) were captured in Frenchman's Bay Marsh and Port Newcastle Marsh (Table 4). Round goby are an invasive species from eastern Europe that were first discovered in the St. Clair River in 1990. It is believed that they were introduced through ballast water from ships (Ontario Federation of Anglers and Hunters, 2007). Round goby distribution in Ontario, as of 2006, is shown in Figure 4.

In Frenchman's Bay Marsh, six round goby were caught on the same sampling transect along the barrier beach that separates the marsh from Lake Ontario. Since electrofishing is not the most effective capture method for round goby in wetlands, it is likely that they were present in fewer numbers during the previous year(s).

While preparing equipment for sampling, CLOCA staff were informed by children fishing with their father at the public boat launch (Bond Head Park) that they were catching countless round goby. Consequently numerous round goby were captured near the outlet through a qualitative supplemental sample. This was the first time round goby has been officially documented at this location. No round goby were caught on official DRCWMP transects within Port Newcastle Marsh.

Since monitoring began in 2002, the barrier beach that isolates McLaughlin Bay Marsh from Lake Ontario has only completely opened once (see photo below). In the spring of 2005 (~April 8) it is likely that high water levels within the marsh caused the barrier beach to break open for an extended period (end of July) until Lake Ontario wave action closed the outlet with beach material.

During the 2005 fish sampling in August, it was noted that many new species were caught compared to 2003 sampling (Table 4). Some of these new species such as freshwater drum (see photo on right) and common species such as brown bullhead (see photo below) were showing signs of stress. During 2006 sampling, the numbers

of species captured were similar to 2003 results which were almost half of 2005 results. This drastic change was likely due to poor water quality (e.g., turbid water) and habitat requirements (e.g., closed barrier beach prevented seasonal and diurnal fish movement).

Goldfish (see photo on right) have been captured in Rouge River Marsh, Corbett Creek Marsh, Pumphouse Marsh and Oshawa Second Marsh. Indigenous to eastern Asia they are a non-native species that has been introduced by the release of aquarium pets. This is an ongoing problem as goldfish compete with native species for food and habitat, contribute to turbidity and damage vegetation (Richardson et al., 1995). Goldfish often find suitable conditions in various wetlands and ponds.

Table 4. Number of fish and species caught at Durham Region coastal wetlands from 2002 - 2006.

Coastal Wetland – TRCA

Fish Species Common Name	Rouge River Marsh 2003	Rouge River Marsh 2005	Rouge River Marsh 2006	Frenchman's Bay Marsh 2003	Frenchman's Bay Marsh 2005	Frenchman's Bay Marsh 2006	Hydro Marsh 2003	Hydro Marsh 2005	Hydro Marsh 2006	Duffins Creek Marsh 2002	Duffins Creek Marsh 2003	Duffins Creek Marsh 2004	Duffins Creek Marsh 2005	Duffins Creek Marsh 2006	Carruthers Creek Marsh 2002	Carruthers Creek Marsh 2003	Carruthers Creek Marsh 2006
alewife				11			4		3			5					
banded killifish																	
black crappie							1					1			5		3
bluegill				4												2	
bluntnose minnow	2		2	7	6			2		31	6	10		5	37	6	3
bowfin			2														
brook silverside																	
brook stickleback																	
brown bullhead	64	21	14	2		9	66			38	1	5			12	8	1
central mudminnow																	
common carp	3	1	5	5	1	1	3	3			3	1		2	7	7	1
common shiner	1	1	18					2		41	14	1	4	1	32		
emerald shiner	5	1		35	9	1			4		1	8				1	
fathead minnow	2		3			6	22		18		13	17		29		37	12
freshwater drum				1													
gizzard shad	3	10	7	1	23	6	1	3	24	59	12	5	13	20	87	6	1
golden shiner							5	18	7			3					
goldfish			1														
johnny darter				1						5	1				6		
largemouth bass		2		5	4	4		1	1	4					4		
logperch											5	1					
northern pike			1									1					
pumpkinseed	8	58	22	57	36	3	4	15	20	45	8	7		5	66	31	12
rock bass										91	1						
round goby†						6											
smallmouth bass				2				1									
spotfin shiner				5													
spottail shiner			1		1					36	2	24					
walleye																	
white perch																	
white sucker			1	1		1			1		1	25		2			
yellow perch	9	6	3	2	50			4	2	2	5	2	6	2	5		1
Grand Total	**97**	**100**	**80**	**139**	**130**	**37**	**106**	**49**	**80**	**352**	**73**	**116**	**26**	**66**	**270**	**98**	**34**
Species Total	**9**	**8**	**13**	**15**	**8**	**9**	**8**	**9**	**9**	**10**	**14**	**16**	**3**	**8**	**10**	**8**	**8**
IBI Score	**32**	**50**	**49**	**45**	**56**	**30**	**17**	**47**	**48**	**--**	**26**	**32**	**38**	**23**	**--**	**30**	**33**

Coastal Wetland – CLOCA and GRCA

Fish Species Common Name	Lynde Creek Marsh 2002	Lynde Creek Marsh 2003	Lynde Creek Marsh 2004	Lynde Creek Marsh 2005	Lynde Creek Marsh 2006	Corbett Creek Marsh 2003	Corbett Creek Marsh 2005	Corbett Creek Marsh 2006	Pumphouse Marsh 2003	Pumphouse Marsh 2006	Oshawa Second Marsh 2002	Oshawa Second Marsh 2005	Oshawa Second Marsh 2006	McLaughlin Bay Marsh 2003	McLaughlin Bay Marsh 2005	McLaughlin Bay Marsh 2006	Westside Marsh 2005	Westside Marsh 2006	Bowmanville Marsh 2002	Bowmanville Marsh 2003	Bowmanville Marsh 2004	Bowmanville Marsh 2005	Bowmanville Marsh 2006	GRCA: Wilmot Creek Marsh 2003	GRCA: Wilmot Creek Marsh 2004	GRCA: Wilmot Creek Marsh 2006	GRCA: Port Newcastle Marsh 2003	GRCA: Port Newcastle Marsh 2005	GRCA: Port Newcastle Marsh 2006
alewife		1	2		12										1				6	1	2								
banded killifish						1						28	1																
black crappie	4		1		4					3				13	2	12	1												
bluegill							5			6								1											
bluntnose minnow		3	7		1										3			2		4	1	9		2	36	1		8	1
bowfin	1																												
brook silverside																													
brook stickleback							1					4																	
brown bullhead	12	18	129	19	9	6	55	32	5	5	3	22	49	17	16	4	23	5	2	13	7	24	1	12	13	26		2	16
central mudminnow									32																				
common carp	2		4	5	1	3	6	2						1	2	3	3	1			1		3	5	13	37	1	9	2
common shiner				1																								3	14
emerald shiner			33		11																24				51	1			
fathead minnow	46	24	3		4	21	3	15	484	10	154	167	12				17	7			1	3			1	5		3	1
freshwater drum															3														
gizzard shad		10	6	30	4										212	36	37	5	1			8	1					4	3
golden shiner		6	3		1		17										1		2	16	4	33		2		6		97	1
goldfish								1	37	60	10	69	30																
johnny darter			2																	1				19	4	8	4	1	3
largemouth bass			1															1						1	1			1	
logperch			9																										
northern pike				3	1		1	1															1	4	2				
pumpkinseed	92	38	32	45	11	8	23	3		36		50	97	6	24	4	7	18	11	28	36	42		31	4	11	24	85	12
rock bass																								1				5	
round goby†																													✓
smallmouth bass	2				1																1								
spotfin shiner																													
spottail shiner	23	18	1	1	6										1		1			7	19	2	1	1	2				3
walleye		1	1																		1								
white perch															4														
white sucker			5		1							1			1						1			2	57	11	1	1	1
yellow perch	1		1	9	3		1				20		4	5	11	5	2	4		5		1	1	3	5	9	3	6	8
Grand Total	**183**	**119**	**240**	**113**	**70**	**39**	**112**	**54**	**558**	**120**	**187**	**341**	**193**	**42**	**280**	**64**	**92**	**44**	**22**	**75**	**98**	**122**	**8**	**85**	**195**	**115**	**33**	**225**	**65**
Species Total	**9**	**9**	**17**	**8**	**15**	**5**	**9**	**6**	**4**	**6**	**4**	**7**	**6**	**5**	**12**	**6**	**9**	**9**	**5**	**8**	**12**	**8**	**6**	**12**	**12**	**10**	**5**	**13**	**12**
IBI Score	**--**	**41**	**34**	**60**	**48**	**27**	**66**	**31**	**27**	**34**	**--**	**46**	**41**	**36**	**57**	**30**	**30**	**35**	**--**	**44**	**36**	**49**	**26**	**56**	**45**	**36**	**26**	**52**	**31**

† - invasive species, ✓ - observed through a qualitative supplemental sample

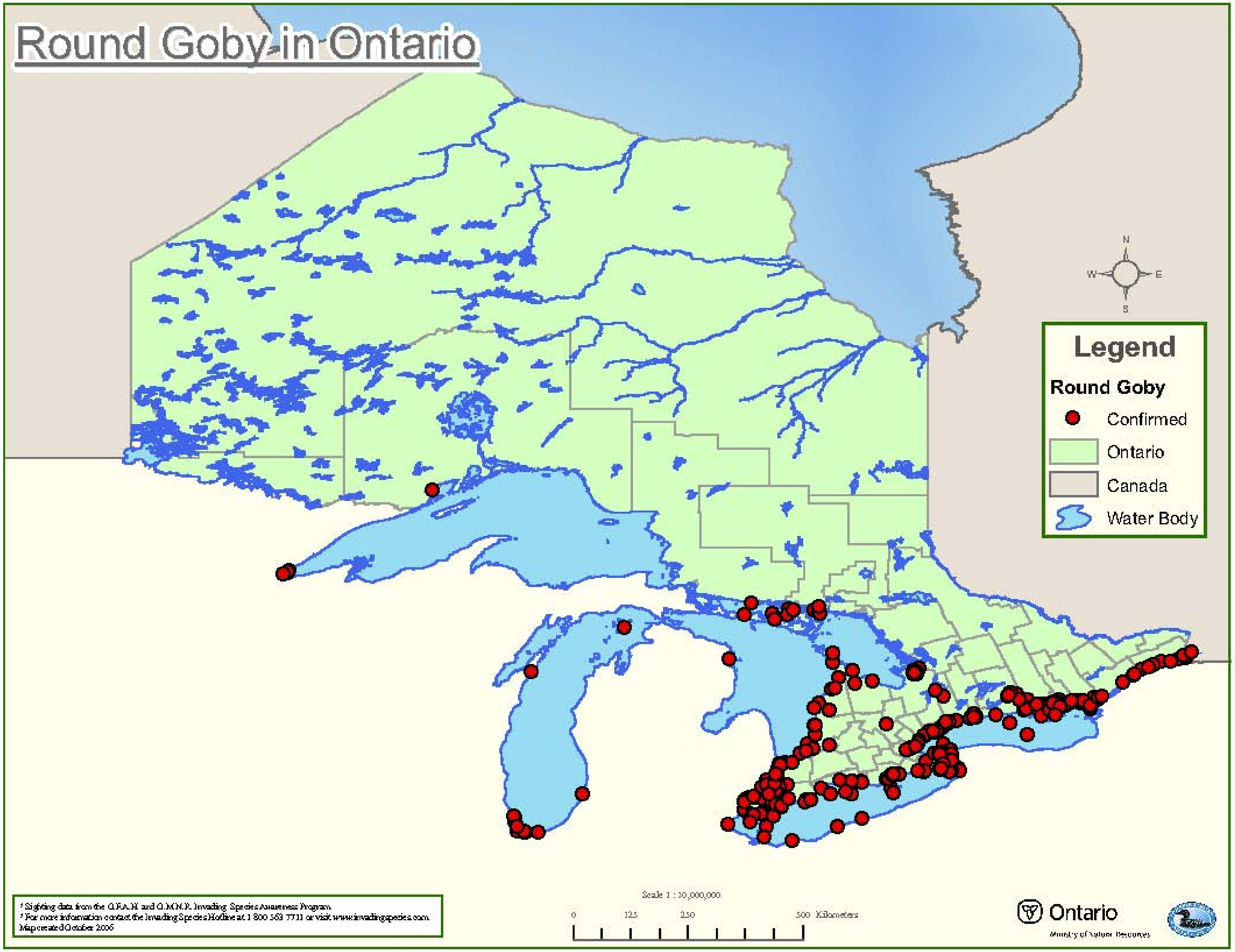

Figure 4.   Round goby distribution in Ontario as of 2006.

4.0 Biological Water Quality

CLOCA monitors surface water quality through both chemical and biological sampling. In general, sampling for chemical and physical parameters measures stressors (e.g., environmental contamination), whereas biological sampling measures ecological effects. Biological surveys involve sampling creatures, such as benthic macroinvertebrates ("aquatic bugs") and fish, found living within the aquatic environment. Benthic macroinvertebrates or benthos, make good health indicators of aquatic ecosystems for a number of reasons:

- they generally have limited mobility that makes them vulnerable to many creek stresses that may occur;
- they have short life cycles;
- they are easily collected and identified;
- they are relatively inexpensive to sample;
- and they exist almost everywhere (Ontario Benthos Biomonitoring Network, 2004).

Similar to other biological communities, certain species of invertebrates have specific tolerances to various stresses and are referred to as indicator species. Therefore, the presence or absence of these indicator species can be related to the quality of the water.

In the past, CLOCA sampled benthos following two separate protocols. The primary protocol for assessing water quality was through BioMAP (Griffiths, 1998). The second protocol is part of the OSAP and is a coarse measure of water quality, which uses the Hilsenhoff Index. In order to coordinate long-term monitoring efforts, CLOCA is now a partner in the Ontario Benthos Biomonitoring Network (OBBN) coordinated by the MOE and EC. This provincial network allows practitioners to follow a standardized methodology, share resources and receive technical support.

To test whether an aquatic system has been impaired by human activity, a reference condition approach is used to compare benthos at "test sites" (where biological condition is in question) to benthos from multiple, minimally impacted "reference sites". A portion of sampling effort each season should focus on collecting reference sites (OBBN, 2004).

During May CLOCA staff sampled 8 OBBN sites in total throughout 2 watersheds (Figure 5). Three of the sites sampled were reference sites and the remaining five sites were test sites, generally at long-term monitoring sites. This was the second season that CLOCA has sampled benthos using the recently developed OBBN protocol.

At the time of this report the results from 2006 sampling had not been analyzed. The online database warehoused by MOE has been undergoing upgrades and analysis tools are not yet functional. Currently, site information (i.e., identified species) has been entered into the provincial database and the results, i.e. whether a site is impaired or not, will be available once this upgrade is complete.

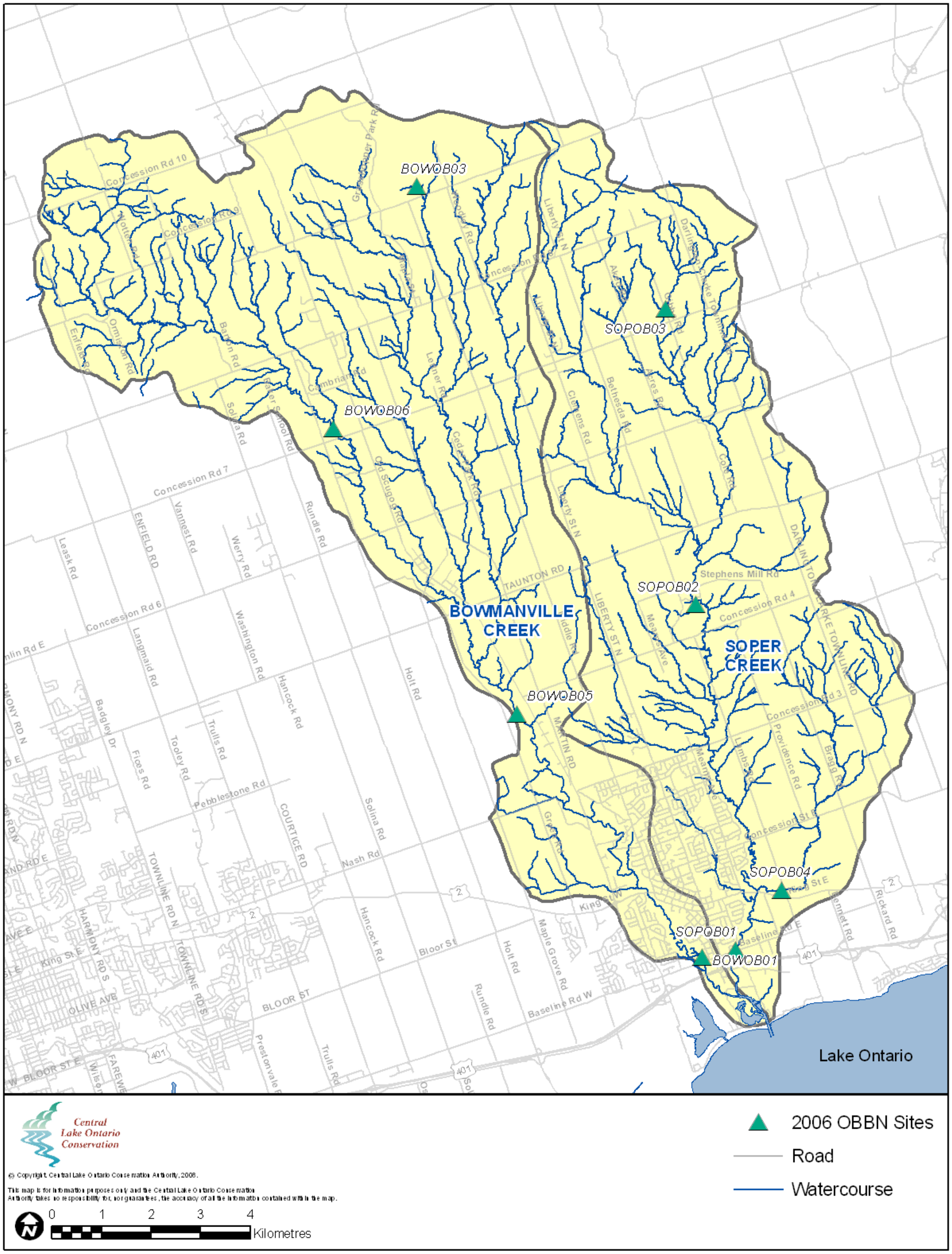

Figure 5. Biological water quality sites sampled in the CLOCA jurisdiction during 2006.

5.0 Stream Temperature

Temperature is considered a controlling factor with respect to habitat suitability for fish. For species such as brook trout, summer stream temperature is considered the single most important factor influencing distributions (MacCrimmon and Campbell, 1969). CLOCA relies on quality stream temperature data for use in plan review, Watershed Management Plans, Aquatic Resource Management Plans, Fisheries Management Plans, etc.

Fifteen portable temperature loggers (Figure 6) were installed in seven watersheds throughout the CLOCA jurisdiction in 2005 (Figure 7). In 2006 CLOCA acquired an additional sixteen temperature loggers and deployed thirty loggers (one lost in 2005) in seven watersheds (Figure 9). All loggers were installed in wadable streams and non-wadable sections were not surveyed. The loggers were programmed to collect water temperature every half-hour generally between May and December.

Onset HOBO Water Temp Pro - H20-001

An underwater temperature logger with infrared (IR) communication port. Fully sealed, waterproof to 100 ft.

Part #:	H20-001
Manufacturer:	Onset
Range:	0° to 50°C (32° to 122°F) In water (nonfreezing), and –20° to 70°C (-4° to 158°F) in air
Accuracy:	±0.2° at 0-50°C (±0.36° at 32°-120°F)
Resolution:	0.02° at 25°C (0.04° at 77°F)
Response Time:	5 min (water), 12 min (air)
Requires:	BoxCar or BoxCar Pro software, Optic Base Station

Figure 6. Attributes of one of the temperature logger models used by CLOCA.

It should be noted that the interpretation of stream temperature data can be confusing due to overlapping terminology. Historically in Ontario only two thermal classification categories were used, coldwater and warmwater. Coldwater fishes include but are not limited to salmon and trout. Salmon and trout can be found in both coldwater and coolwater temperature zones and so these zones represent coldwater streams in the traditional sense (Bowlby, 2003).

Classification of stream temperature is divided into three categories: coldwater, coolwater and warmwater (Coker et al., 2001). The thermal classification for each site is determined by analyzing data summarized through the Stream Temperature Analysis Tool and Exchange (STATE), (Jones and Chu, 2007).

In the Bowmanville and Soper Creek watershed, data indicates that coldwater habitat exists from the headwaters in the north to just south of Taunton Road. Coolwater habitat occupies the remainder of the watershed south to Baseline Road with the exception of one location on a small tributary of Soper Creek near Conc. Rd. 3 and Mearns Ave. Site TLSOP01 (Table 5) was classified as warmwater based on 2005 data and coolwater based on 2006 data. These two data sets are very dissimilar with a difference of almost 10°C in maximum temperature. It should be noted that generally temperature data from one location collected over multiple years does not differ greatly. It is unknown what caused this fluctuation but it is likely due to water flow or land use.

Site TLBOW03 is located within Long Sault Conservation Area in a section of headwater stream. This site was selected because it is a long-term reference site for various CLOCA monitoring activities, e.g., surface water quality, fisheries, temperature, etc. Groundwater temperature is moderated by the sub-surface ground temperature. Depending on the amount of groundwater entering a stream it has the ability to moderate the stream temperature. If enough groundwater enters a stream it will have more of an influence than the air temperature and prevent the stream from freezing. The minimum temperature for both 2005 and 2006 was between 4 and 5°C indicating that this coldwater location has a substantial amount of groundwater entering the stream.

Various small watersheds such as Darlington, Tooley, Robinson, Corbett and Pringle Creek were sampled during 2005 and 2006. Data from all of these watersheds indicated coolwater habitat with the exception of one location on a small tributary of Robinson Creek (TLROB01). Data from 2005 and 2006 resulted in a classification of warmwater and coolwater respectively. Both data sets were similar and the coolwater classification was close to meeting the warmwater criteria. This small tributary is likely being influenced by warmwater inputs from a stormwater pond and land-use activities near its headwater area. A second location (TLROB02) sampled in 2006 in Darlington Provincial Park located south of Highway 401 within the main branch of Robinson Creek resulted in a coolwater classification. The water temperatures were substantially cooler at this location compared to the location upstream.

One logger within Pringle Creek (TLPR01) was lost in 2005 and no data was retrieved. Also, one logger within Pringle Creek (TLPR02) malfunctioned in 2006 and did not yield any data.

As mentioned above, the presence of groundwater moderating stream temperature can be detected through temperature logger data. This data can be used to help validate modeling of potential groundwater discharge that CLOCA has recently produced (Figure 8 and 10).

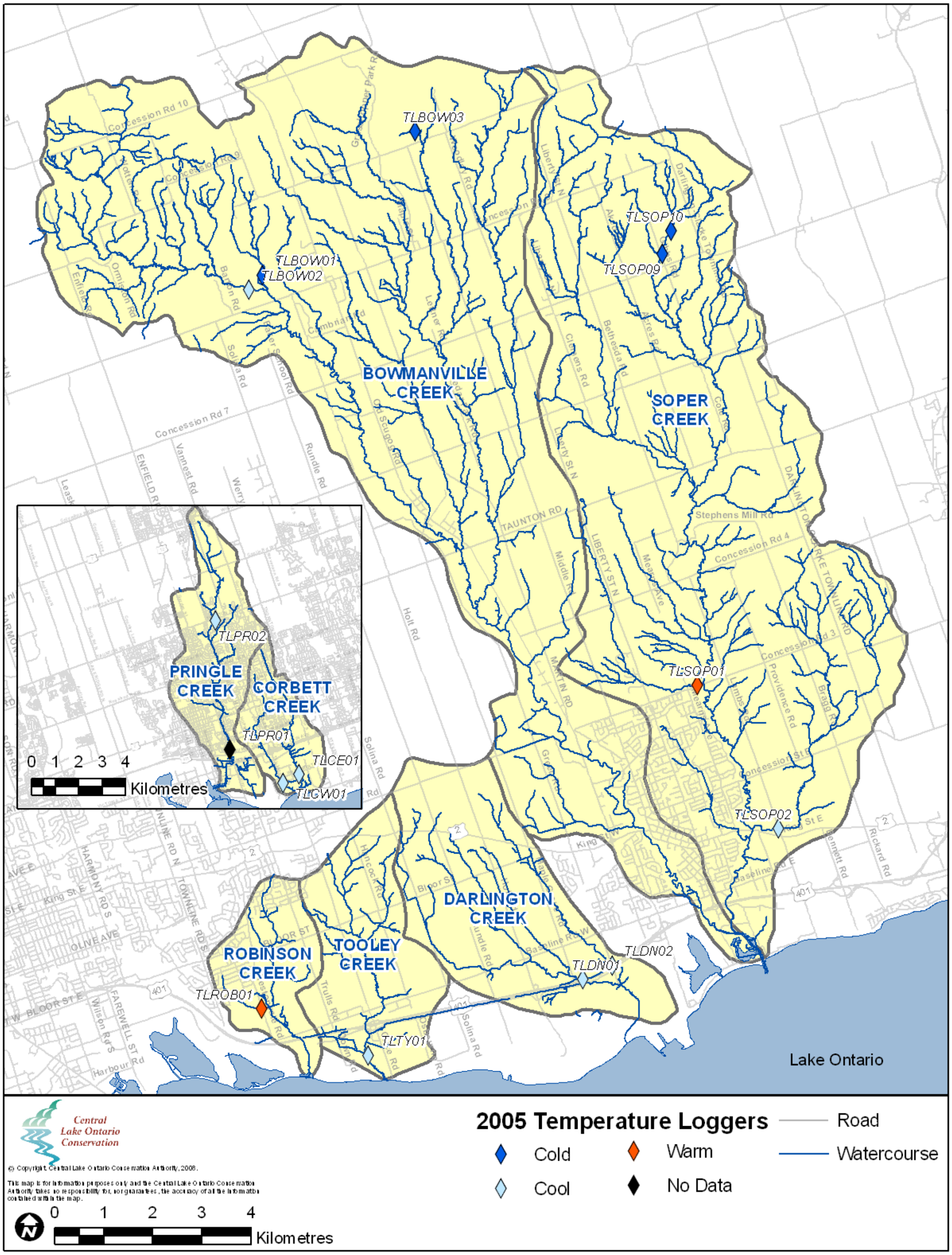

Figure 7. Location and thermal classification of stream temperature loggers during 2005.

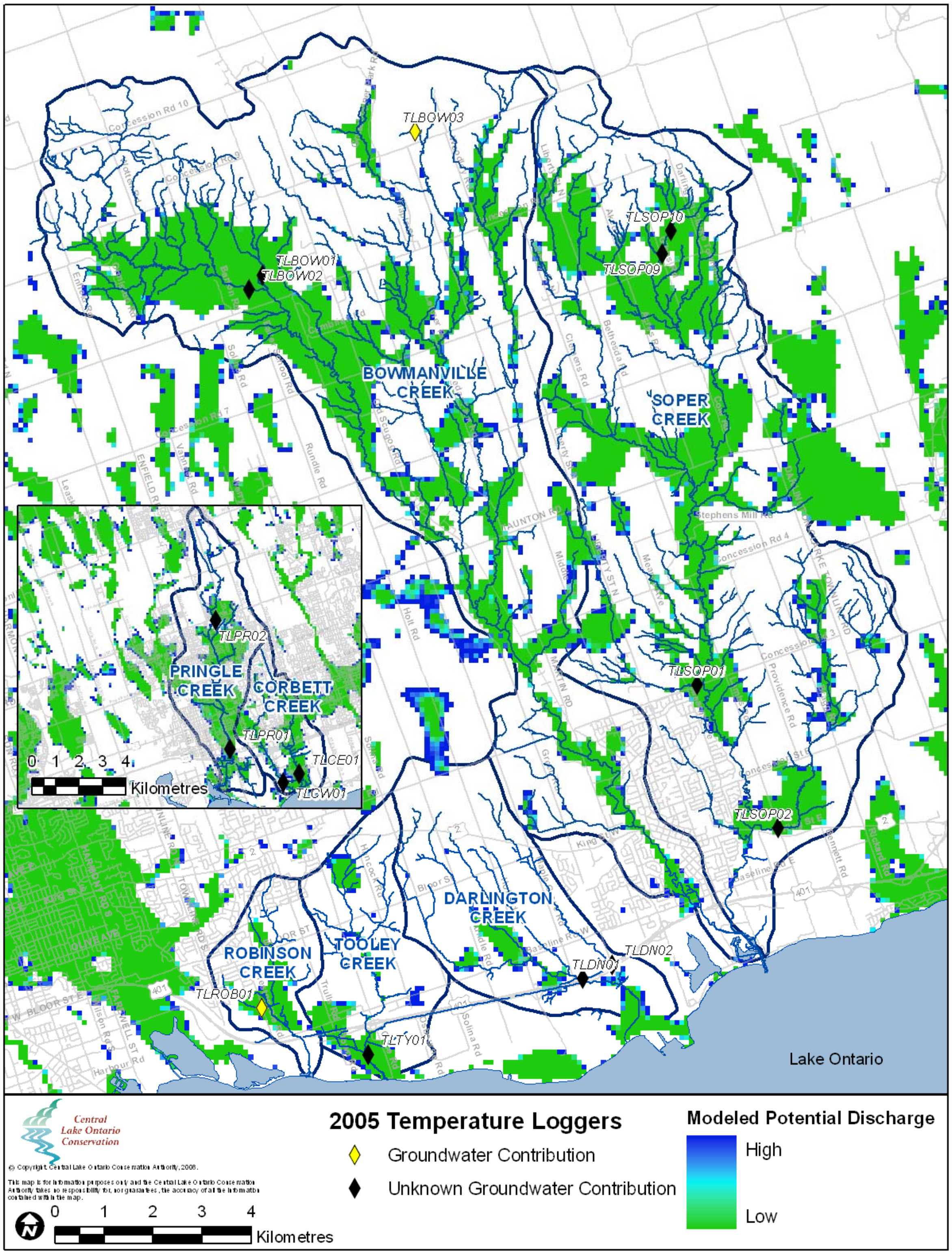

Figure 8. 2005 stream temperature sites compared to modeled potential discharge.

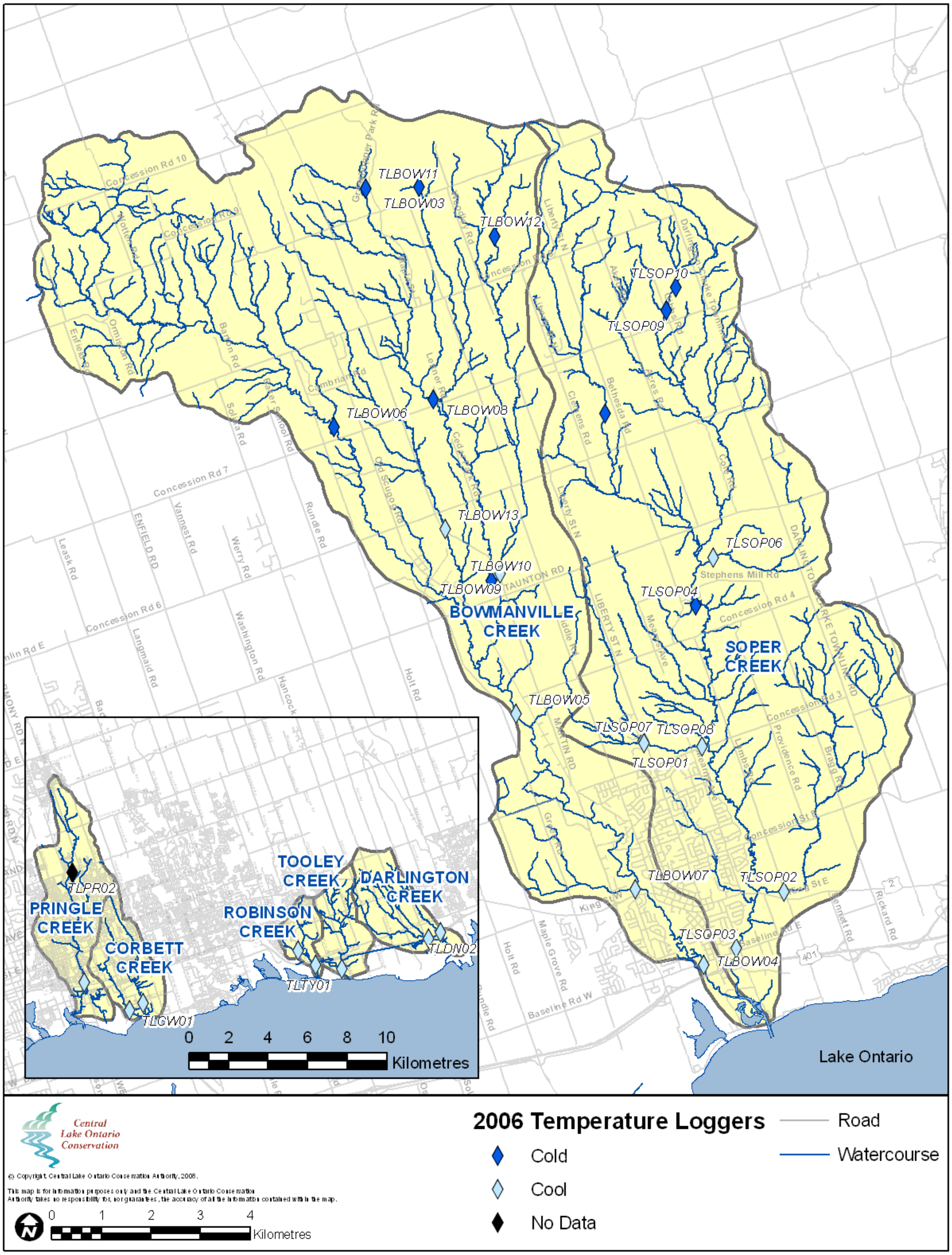

Figure 9. Location and thermal classification of stream temperature loggers during 2006.

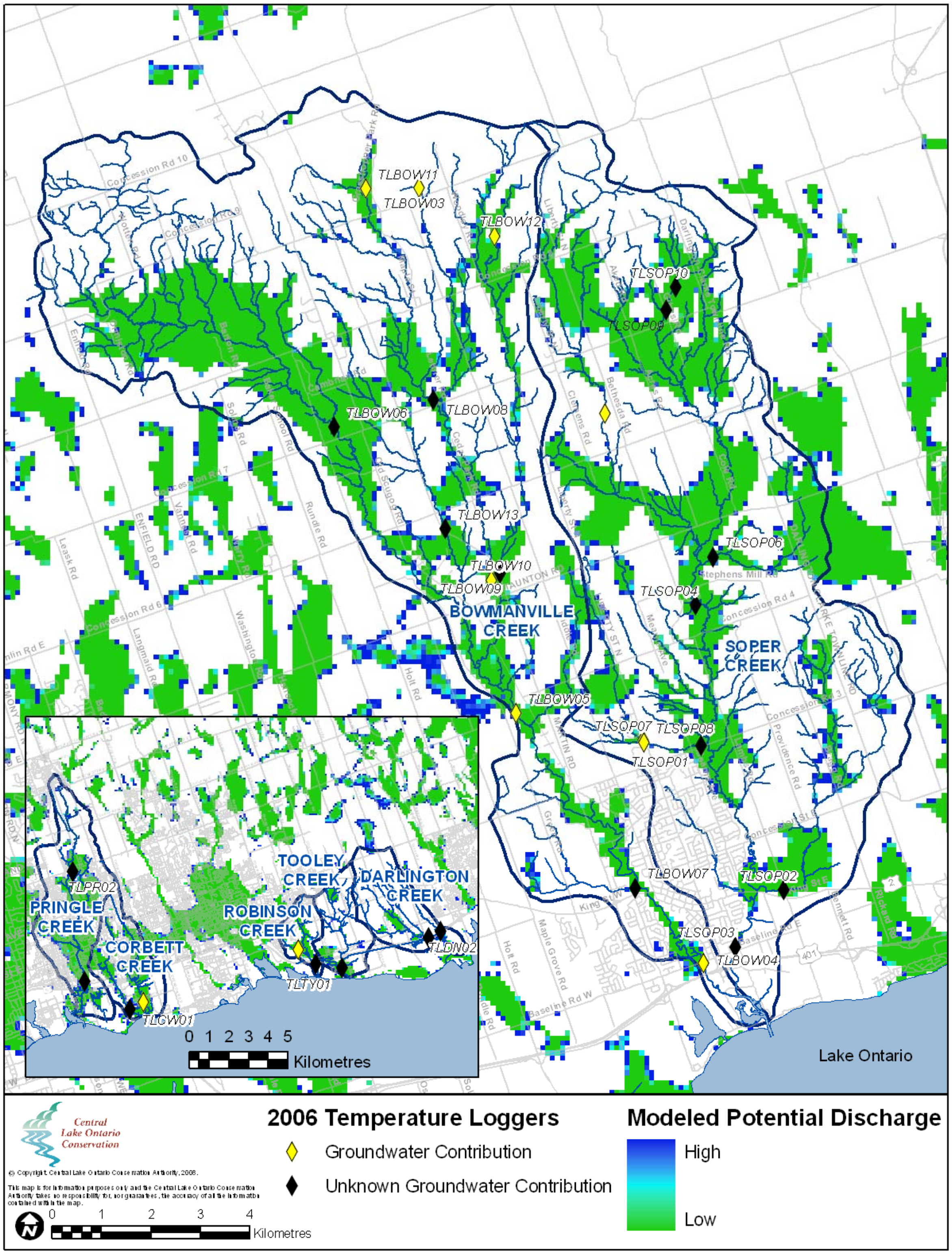

Figure 10. 2006 stream temperature sites compared to modeled potential discharge.

Table 5. Summary of temperature logger data collected from CLOCA jurisdiction during 2005 and 2006.

	Site Code	Year	Logger Serial No.	Period of Record	Cold	Cool	Warm	Max. (°C)	Min. (°C)	Days Above Upper Lethal					Classification
									Entire Data Set	Atlantic salmon (> 23 °C)	brook trout (> 24 °C)	brown trout (> 24 °C)	Chinook salmon (> 25 °C)	rainbow trout (> 26 °C)	
1	TLBOW01	2005	787477	June 10, 2005 to Jan 12, 2005	217	0	0	16.439	0.135	0	0	0	0	0	**Coldwater**
2	TLBOW02	2005	787475	June 8, 2005 to Aug 31, 2005	63	22	0	22.465	0.190	0	0	0	0	0	Coolwater
3	TLBOW03	2005	842229	July 1, 2005 to Aug 31, 2005	62	0	0	14.697	5.231	0	0	0	0	0	**Coldwater**
4	TLBOW03	2006	877051	May 31, 2006 to Jan 4, 2007	219	0	0	16.368	4.506	0	0	0	0	0	**Coldwater**
5	TLBOW04	2006	842238	May 11, 2006 to Dec 21, 2006	162	63	0	29.265	0.715	5	4	4	0	0	Coolwater
6	TLBOW05	2006	787475	May 30, 2006 to Dec 21, 2006	186	20	0	23.352	0.467	0	0	0	0	0	Coolwater
7	TLBOW06	2006	787473	May 30, 2006 to Jan 4, 2007	218	2	0	20.960	0.024	0	0	0	0	0	**Coldwater**
8	TLBOW07	2006	905540	June 16, 2006 to Dec 21, 2006	168	21	0	23.232	0.384	0	0	0	0	0	Coolwater
9	TLBOW08	2006	877052	June 17, 2006 to Jan 4, 2007	202	0	0	18.033	0	0	0	0	0	0	**Coldwater**
10	TLBOW09	2006	877050	June 21, 2006 to Jan 3, 2007	166	31	0	23.809	0	0	0	0	0	0	Coolwater
11	TLBOW10	2006	905537	June 24, 2006 to Jan 4, 2007	195	0	0	19.056	1.561	0	0	0	0	0	**Coldwater**
12	TLBOW11	2006	1019270	July 21, 2006 to Aug 31, 2006	42	0	0	15.724	2.236	0	0	0	0	0	**Coldwater**
13	TLBOW12	2006	1019281	July 22, 2006 to Jan 4, 2007	167	0	0	16.201	2.209	0	0	0	0	0	**Coldwater**
14	TLBOW13	2006	1019280	July 28, 2006 to Aug 14, 2006	10	8	0	23.954	13.185*	0	0	0	0	0	Coolwater
15	TLSOP01	2005	818797	July 1, 2005 to Aug 31, 2005	7	47	8	34.836	0	18	13	13	8	2	Warmwater
16	TLSOP01	2006	818797	May 18, 2006 to Dec 21, 2006	194	24	0	25.234	0	0	0	0	0	0	Coolwater
17	TLSOP02	2005	842228	July 1, 2005 to Aug 31, 2005	20	42	0	26.012	0	4	0	0	0	0	Coolwater
18	TLSOP02	2006	842239	May 25, 2006 to Dec 21, 2006	176	35	0	25.793	0.163	2	0	0	0	0	Coolwater
19	TLSOP03	2006	818793	May 25, 2006 to Dec 21, 2006	183	28	0	25.574	0.190	0	0	0	0	0	Coolwater
20	TLSOP04	2006	787477	May 26, 2006 to Dec 21, 2006	210	0	0	20.103	0.107	0	0	0	0	0	**Coldwater**
21	TLSOP05	2006	905539	June 17, 2006 to Dec 21, 2006	188	0	0	19.199	0.632	0	0	0	0	0	**Coldwater**
22	TLSOP06	2006	1019261	July 20, 2006 to Dec 21, 2006	141	14	0	24.098	0	0	0	0	0	0	Coolwater
23	TLSOP07	2006	1019277	July 25, 2006 to Dec 21, 2006	145	5	0	21.079	2.770	0	0	0	0	0	Coolwater
24	TLSOP08	2006	1020772	July 25, 2006 to Dec 21, 2006	138	12	0	22.944	0.412	0	0	0	0	0	Coolwater

25	TLSOP09	2005	739513	July 1, 2005 to Aug 31, 2005	62	0	0	17.520	2.890†	0	0	0	0	0	**Coldwater**
26	TLSOP09	2006	739513	June 1, 2006 to Nov 13, 2006	166	0	0	16.000	4.570†	0	0	0	0	0	**Coldwater**
27	TLSOP10	2005	739517	July 1, 2005 to Aug 31, 2005	62	0	0	17.9	3.740†	0	0	0	0	0	**Coldwater**
28	TLSOP10	2006	739517	June 10, 2006 to Nov 22, 2006	166	0	0	16.760	4.150†	0	0	0	0	0	**Coldwater**
29	TLCE01	2005	842239	July 1, 2005 to Aug 31, 2005	0	60	2	34.492	0	21	14	14	2	0	Coolwater
30	TLCE01	2006	905535	July 1, 2006 to Aug 31, 2006	9	53	0	24.629	1.126	3	0	0	0	0	Coolwater
31	TLCW01	2005	787473	July 1, 2005 to Aug 31, 2005	1	59	2	29.715	0.218	18	10	10	2	0	Coolwater
32	TLCW01	2006	877053	July 1, 2006 to Aug 31, 2006	3	57	2	28.866	0.384	18	9	9	2	0	Coolwater
33	TLDN01	2005	842237	July 1, 2005 to Aug 31, 2005	29	33	0	27.358	0	0	0	0	0	0	Coolwater
34	TLDN01	2006	842237	July 1, 2006 to Aug 31, 2006	33	27	2	30.117	0	5	3	3	2	0	Coolwater
35	TLDN02	2005	842236	July 1, 2005 to Aug 31, 2005	6	56	0	27.949	0	11	3	3	0	0	Coolwater
36	TLDN02	2006	842236	July 1, 2006 to Aug 31, 2006	25	35	2	28.518	0.329	10	4	4	2	0	Coolwater
37	TLPR01	2005	842230	No Data - Logger Missing											
38	TLPR01	2006	842229	May 24, 2006 to Jan 4, 2007	154	72	0	25.647	0.384	7	3	3	0	0	Coolwater
39	TLPR02	2005	818794	June 23, 2005 to Dec 24, 2005	163	22	0	22.489	0.246	0	0	0	0	0	Coolwater
40	TLPR02	2006	842228	No Data - Malfunction											
41	TLROB01	2005	818793	July 1, 2005 to Aug 31, 2005	0	55	7	29.790	0.742	26	17	17	7	1	Warmwater
42	TLROB01	2006	818794	July 1, 2006 to Aug 31, 2006	2	56	4	28.990	0.412	25	15	15	4	0	Coolwater
43	TLROB02	2006	905538	July 1, 2006 to Aug 31, 2006	29	33	0	23.448	0.273	0	0	0	0	0	Coolwater
44	TLTY01	2005	842238	June 29, 2005 to Aug 31, 2005	2	57	5	30.016	0	22	9	9	5	0	Coolwater
45	TLTY01	2006	905536	July 1, 2006 to Aug 31, 2006	22	40	0	27.456	0	3	0	0	0	0	Coolwater

Maximum temperature generally occurs during July or August but is reported from entire data set

Minimum temperature is reported from entire data set which generally also includes cold-weather conditions i.e., sampling period in December

*Minimum temperature does not reflect cold-weather conditions since the Period of Record was July 28, 2006 to Aug 14, 2006

†Minimum temperature does not completely reflect cold-weather conditions since the Period of Record ended mid-Novemeber

6.0 Recommendations

Section	Results	Recommendations
2.0 Fisheries - Streams	During 2006, 24 OSAP sites were sampled in the Bowmanville and Soper Creek watershed (Figure 3). The results of the 2006 CLOCA Aquatic Monitoring are consistent with the goals and objectives of the FMP. The main branches of Bowmanville and Soper Creeks are still dominated by migratory salmonids and should remain managed as such. Upstream of impassable barriers to fish migration, streams remain dominated by resident coldwater fish communities including brook trout, brown trout and sculpin species. These headwaters should continue to be managed for these sustainable and diverse fish communities.	Overall stream monitoring efforts during the 2007 field season will be focused in the Oshawa Creek watershed. It is recommended that a selection of Aquatic Resource Management Plan fisheries sites (OSAP) first sampled in 2000 be re-sampled. It is also recommended that supplemental sites be conducted to further explore slimy sculpin distribution within the Oshawa Creek watershed. In order to monitor long-term trends in fisheries it is recommended that sampling at BWDJ continue in upcoming years. Additionally, other long-term monitoring sites should be selected on other watersheds so that broader comparisons can be made.
3.0 Fisheries - Wetlands	In 2006, for the first time since the project began, round goby (see photo on right) were captured in Frenchman's Bay Marsh and Port Newcastle Marsh (Table 4). During 2006 sampling, the numbers of species captured were similar to 2003 results which were almost half of 2005 results. This drastic change was likely due to poor water quality (e.g., turbid water) and habitat requirements (e.g., closed barrier beach prevented seasonal and diurnal fish movement).	It is recommended that currently known round goby locations (i.e., Frenchman's Bay Marsh and Port Newcastle Marsh) continue to be monitored to track any changing population trends. It is also recommended that the barrier beach at McLaughlin Bay Marsh continue to be monitored for breakages to help better understand fish utilization of the marsh. It is also recommended that currently known goldfish locations (i.e., Rouge River Marsh, Corbett Creek

	Goldfish have been captured in Rouge River Marsh, Corbett Creek Marsh, Pumphouse Marsh and Oshawa Second Marsh. Indigenous to eastern Asia they are a non-native species that has been introduced by the release of aquarium pets. This is an ongoing problem as goldfish compete with native species for food and habitat, contribute to turbidity and damage vegetation (Richardson et al., 1995).	Marsh, Pumphouse Marsh and Oshawa Second Marsh) continue to be monitored to track any changing population trends. Public education regarding the harmful effects of releasing non-native species into waterways should continue through the DRCWMP and public outreach events in which CLOCA is involved.
4.0 Biological Water Quality	During May CLOCA staff sampled 8 OBBN sites in total throughout 2 watersheds (Figure 5). Three of the sites sampled were reference sites and the remaining five sites were test sites, generally at long-term monitoring sites. This was the second season that CLOCA has sampled benthos using the recently developed OBBN protocol.	In order to complement 2007 stream monitoring efforts it is recommended that the majority of OBBN test site sampling effort occur at or near OSAP site locations.
5.0 Stream Temperature	Fifteen portable temperature loggers (Figure 6) were installed in seven watersheds throughout the CLOCA jurisdiction in 2005 (Figure 7). In 2006 CLOCA acquired an additional sixteen temperature loggers and deployed thirty loggers (one lost in 2005) in seven watersheds (Figure 9).	In order to complement 2007 stream monitoring efforts it is recommended that the majority of stream temperature loggers that are not dedicated to long-term sites be installed at or near OSAP site locations. It is also recommended that temperature loggers continue to collect minimum temperature data in order to validate groundwater modeling. It is also recommended that additional temperature loggers be acquired.

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