

Township Of Georgian Bay

2011

Inland Water Quality Report

By

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Executive Summary

The Township of Georgian Bay inland water quality program has been ongoing for 10 years with the beginning of bacteria sampling in 2001. In 2005 the program was expanded to include water chemistry, based on a similar program underway on Georgian Bay. The results of all inland water studies were summarized in a report to the Township in 2010 entitled “Water Quality Monitoring Report, Inland Lakes – Township of Georgian Bay, Summary 2005 – 2010”.

During the spring of 2011, talks were held with the District of Muskoka Watershed Council, their environmental consultant and various lake associations to standardized sample protocol across the District. This led to a number of significant changes to the program that now allow for direct comparison of Township data to District wide data. Changes included sampling protocol and analytical services (Table 1).

Water quality results for 2011 were compared to summarize results from 2005 – 2010. Even though there were changes in analytical laboratories and protocol, results are very comparable (Table 2-8). The only lake of concern was Stewart Lake where the results were 60% higher than the first year of sampling in 2010 (Table 8).

Bacteria results were comparable to previous years except for Go Home Lake (GHL) where results for Total Coliform exceeded the Provincial criteria on five occasions at three different sites (Figure 1 and Appendix 1). There was also one E. coli value from GHL that exceeded the Provincial limit (Appendix 1). All values that exceeded the Georgian Bay and Inland Objective are highlighted in red in Appendix 1.

Due to the new methodology adopted in 2011, the inland water quality program should continue for another four years to establish a reliable long term trend that would be acceptable to the District.

1.0 Introduction

In 2011, a total of eight inland lakes were sampled as part of a Township wide volunteer program for water quality and bacteria. The inland lakes sampled were Severn River (above the Big Chute), Gloucester Pool, Six Mile Lake, Baxter Lake, Gibson Lake, Galla Lake, Go Home Lake and Stewart Lake. Water quality analysis included vertical temperature and oxygen profiles (top to bottom at every meter), conductivity and total phosphorous at the surface and below the thermocline (1 meter off the bottom) and water clarity at the surface.

In early spring, lake water temperatures, oxygen levels and chemistry tend to be uniform from top to bottom. As the surface waters warm up in late spring and summer, the lakes stratify whereby a thermocline is formed at about the 5-8 meter depth. A thermocline is a horizontal layer of water about 3 meters wide where temperature and oxygen levels suddenly drop. This thermocline prevents the mixing of the top and bottom water columns. It is also a barrier to vertical fish movement and chemical mixing.

Total Phosphorous (TP) above the thermocline tends to be a result of local surface runoff (wetlands, septic systems, storm runoff, etc.), while TP below the thermocline tends to be dominated by the release from bottom sediments. This TP release from the bottom happens when oxygen levels are <1 mg/l (anoxic conditions). TP levels < 10 $\mu\text{g/L}$ are considered good, 10-20 $\mu\text{g/L}$ moderate and > 20 $\mu\text{g/L}$ of concern.

Conductivity is used as an indicator of water movement and mixing throughout the lake. Thermoclines prevent this mixing and thus conductivity can be used to determine surface and bottom horizontal water movements.

Clarity is measured to determine the turbidity of the surface waters. High turbidity is usually the result of high biological productivity (algae growth) which is a result of higher nutrient (TP) levels. It can also be caused by sediments from storm runoff.

Bacteria samples were mostly collected on a bi-monthly basis from late June to early September. The ColiPlate test kit was used to analyze all water samples for total coliform and fecal coliform (*E. coli*). This method has been approved by the American Public Health Association and the Environmental Protection Agency. Water samples are incubated for 24-26 hours. After incubation, individual cells in the microplate turn blue in the presence of total coliform indicating contamination from runoff. If cells exhibit fluorescence under a UV light then fecal *E. coli* is present. The Most Probable Number technique is used to convert the positive well counts to cell density in cfu's/100mL sample.

The limits are:

Total Coliform (Provincial) – 1000 TC/100 mL sample

E. coli (Provincial) – 100 EC/100 mL sample

E. coli (Georgian Bay and Inland Lakes Objective) – 10 EC/100 mL samples

2.0 Water Quality Analyses

The 2011 field results for the eight inland lakes are outlined in Tables 2 - 8. The 2011 data is compared to the mean results collected over the previous six years as summarized in the Township report – “Water Quality Monitoring Report, Inland Lakes – Township of Georgian Bay, Summary 2005 – 2010”. However, due to valued input from the District Watershed Council and their consultant - Hutchison Environmental, critical changes were made to the 2011 program as summarized in Table 1. The results of these changes may not allow for a direct comparison of previous results with the 2011 data.

Parameter	2005-2010 Methodology	2011 Methodology
Sample filtration	Not filtered	Filtered through 80 µ mesh
TP Laboratory Used	Maxxium Analytical	Dorset – Trent University
Collection of bottom samples for TP	Collected 2-3 meters below thermocline	Collected 1 meter off the bottom.

2.1 Results

The 2011 water quality results are mainly presented in table form and compared to the mean values measured from 2005 to 2010. All lake results were within expectations, except for Stewart Lake that saw a 60% increase in TP from 2010. Sampling was conducted on all the lakes between September 4 -8, 2011.

2.1.1 Severn River

Four sites were sampled on the Severn River – Russian Bay, Wood Bay, Lost Channel and Copp Bay. The results and summarized in Table 2.

Table 2
Severn River
2011 Water Quality Results

Water Quality Indicator	Top Bottom	2006-2010 Mean	Russian Bay	Wood Bay	Lost Channel	Copp Bay	2011 Mean
Conductivity (µS/cm)	T B	303.9	310.7	303.8	240.0	303.6	289.5
Secchi Disk (meters)		4.8	3.5	4.0	4.0	3.5	3.8
Total Phosphorous (µg/L)	T B	10.9	12.8	12.5	8.6	12.6	11.6

Conductivity on the Severn River continues to be consistent from year to year in Russian Bay, Wood Bay and Copp Bay indicating it is one continuous stream. Lost Channel continues to receive an addition source of water.

Total Phosphorous (TP) seems to be up a little this year but this may be related to the difference in the two laboratories. Severn River TP is always the highest of all the inland lakes tested, mainly due to the higher density source waters upstream – Lake Couchiching and Lake Simcoe. It is interesting to note that the TP measured in Lost Channel is consistently lower then the other sites. This is probably due to the addition source water entering this bay containing a lower TP level.

2.1.2 Gloucester Pool

Nine sites continued to be sampled on Gloucester Pool – Big Chute Bay, Six Mile Channel, White Falls Bay, Main Pool, Little Go Home Bay, Black River Channel, Upper Little Lake, Lower Little Lake and Baxter Lake, The results are outlined in Table 3.

Table 3
Gloucester Pool
2011 Water Quality Results

Water Quality Indicator	Top Bottom	2005-2010 Mean	Big Chute Bay	Six Mile Channel	White Falls Bay	Main Pool	Little Go Home Bay	Black River Channel	Upper Little Lake	Lower Little Lake	Baxter Lake	2011 Mean
Conductivity (µS/cm)	T B	273.0	304.6	251.7	271.8	179.4	153.8	106.5	273.8	269.0	248.1	228.7
Secchi Disk (meters)		4.9	4.5	Bottom	5	4	5	Bottom	4.5	Bottom	5.5	4.8
Total Phosphorous (µg/L)	T B	11.7	11.4	9.1	9.1	11.1	9.6	9.8	9.4	8.2	7.3	9.4
							56.8				18.3	

Conductivity in Big Chute Bay reflects the upstream Severn River value. As additional sources of water is added to Gloucester Pool from Six Mile Lake via Six Mile Channel

and White Falls Bay and from MacLean Lake via Black River Channel conductivity values become lower. These values increase again in Little Lake.

Two locations experienced a thermocline this year, one in Gloucester Pool – Little Go Home Bay and one in Baxter Lake. The bottom waters of Little Go Home Bay continue to show a higher level of TP which originate from the bottom sediments under anaerobic conditions. Overall, TP values in Gloucester Pool are lower than the Severn River (SR) (Table 2) but higher than Six Mile Lake (SML) (Table 4). This indicates a mixing situation of the two main Gloucester Pool source waters – SML and SR.

2.1.3 Six Mile Lake

Six sites were sampled in Six Mile Lake (SML) – Lost Channel, Main Lake, Crooked Bay, Long Lake, Hungry River and TransCanada Bay. From previous years, East Crooked Bay and West Crooked Bay have been combined into one sample site. Results are outlined in Table 4.

Water Quality Indicator	Top Bottom	2005-2010 Mean	Lost Channel	Main Lake	Crooked Bay	Long Lake	Hungry River	TransCanada Bay	2011 Mean
Conductivity (µS/cm)	T	202.8	237.2	227.4	197.0	142.5	218.9	212.2	205.9
	B	191.4	158.7	159.3		89.6			
Secchi Disk (meters)		5.5	6	6	6.5	6	Bottom	5	5.9
Total Phosphorous (µg/L)	T	8.6	6.7	6.0	6.8	5.4	9	8.2	7.0
	B	13.7	7.5	7.2		12.4			

Based on conductivity, SML stratifies into five separate basins over the summer months. Lost Channel and the Main Lake remain as one single large basin.

TP values seem to be a bit lower this year in several basins. However, Hungry River continues to be the highest value due to the cottage density in the area. Bottom TP values are similar to previous years.

2.1.4 Gibson Lake

Sampling continued at three sites on Gibson Lake– South Lake, Middle Lake and North Lake. Much of the 2011 data is similar to previous years as outlined in Table 5.

Table 5
Gibson Lake
2011 Water Quality Results

Water Quality Indicator	Top Bottom	2006-2010 Mean	South Lake	Middle Lake	North Lake	2011 Mean
Conductivity (µS/cm)	T	39.2	31.6	32.0	40.3	34.6
	B	46.7	27.6	27.2	38.0	30.9
Secchi Disk (meters)		2.9	3.8	3.3	3.5	3.5
Total Phosphorous (µg/L)	T	11.7	9.5	9.3	9.3	9.4
	B	21.8	28.0	19.4	16.4	21.2

The lake continued to stratify this year with limited oxygen levels below the thermocline. As a result, TP was released from the bottom sediments in values similar to previous years. Surface levels of TP were consistent throughout the lake and slightly down from the five year mean.

2.1.5 Go Home Lake

Seven locations were sampled in Go Home Lake on Sept. 5, 2011 – Control Dam, Blue Lagoon, Four Seasons Bay, Bay of Many Winds, Crystal Bay, Swallow Bay, and Manning Bay.

Table 6
Go Home Lake
2011 Water Quality Results

Water Quality Indicator	Top Bottom	2005-2010 Mean	Control Dam	Blue Lagoon	Four Seasons Bay	Bay of Many Winds	Crystal Bay	Swallow Bay	Manning Bay	2011 Mean
Conductivity (µS/cm)	T	53.9	54.3	54.2	53.8	50.0	54.0	53.8	45.4	52.2
	B				38.9	44.3			26.1	
Secchi Disk (meters)		4.7	4.4	4.4	4.3	4.7	5.5	5.8	4.4	4.7
Total Phosphorous (µg/L)	T	8.3	6.4	5.8	7.2	7.4	5.7	7.5	7.4	6.8
	B				9.1	7.9			47.4	

Only Four Seasons Bay, Bay of Many Winds and Manning Bay were stratified by a thermocline. TP levels at the surface and 1 meter off the bottom for both Four Seasons Bay and Bay of Many Winds were in the range of 7-9 µg/L indicating no release of nutrients from bottom sediments. However, as in previous years, Manning Bay was 7.4 µg/L at the surface and 47.4 below the thermocline (1 meter from the bottom). This value of 47.4 µg/L (2005 -2010 average of 36.3 µg/L) continues to be of concern since it

indicates that phosphorous is still being released back into the water column from bottom sediments.

Nutrient levels throughout the rest of the lake were surprisingly very similar. From a TP value of 7.5 µg/L at the north inlet of Swallow Bay, the levels did not vary more than 1 or 2 µg/L, with the south outlet value of 6.4 µg/L at the Control Dam.

Conductivity/mixing throughout the lake was again very uniform with values at the inlet (Swallow Bay) of 53.8 µS/cm and outfall (Control Dam) of 54.3 µg/cm.

Overall, clarity was very uniform throughout the lake this year with depth visibility of between 4.3 – 4.7 meters except for Crystal Bay with a value of 5.5 meters and Swallow Bay of 5.8 meters.

2.1.6 Galla Lake

For the third year in a row, samples were collected at three sites on Galla Lake –Easy Bay, Lot 7 and Outfall Bay. Again results are very similar when compared to previous year.

Table 7 Galla Lake 2011 Water Quality Results						
Water Quality Indicator	Top Bottom	2009- 2010 Mean	East Bay	Lot 7	Outlet Bay	2011 Mean
Conductivity (µS/cm)	T	24.0	23.8	23.7	23.7	23.7
	B					
Secchi Disk (meters)		3.2	3	3	3	3
Total Phosphorous (µg/L)	T	6.8	7.2	7.7	6.7	7.2
	B					

Conductivity and clarity is spot on previous years and TP is fairly similar. None of the sites stratified this year.

2.1.7 Stewart Lake

For the second year, Stewart Lake was samples at four locations – Kilty Bay, Big Bay, Bear Bay and Stewart Bay.

Table 8
Stewart Lake
2011 Water Quality Results

Water Quality Indicator	Top Bottom	2010 Results	Kilty Bay	Big Bay	Bear Bay	Stewart Bay	2011 Mean
Conductivity (µS/cm)	T	161.3	154.7	154.2	154.0	151.9	153.7
	B		128.6	119.1			
Secchi Disk (meters)		3.5	3.5	3.5	4.0	3.5	3.6
Total Phosphorous (µg/L)	T	3.3	5.2	5.6	6.6	5.3	5.6
	B		8.5	7.1			

While conductivity and clarity were similar to last year, TP has increased 60% over 2010 results. However, the 2011 results are still below the District ten year average of 8.0 µg/L and the development threshold of 6.2 µg/L (Table 9). However, it is above recent spring sampling results (4.1 µg/L).

Both Kilty Bay and Big Bay stratified this year but neither showed signs of bottom anaerobic conditions.

Table 9
District of Muskoka – Lake Data Report

Stewart Lake Municipality: Muskoka		Watershed: Lake Joseph
Lakes		
Surface Area:	1.55 km²	Watershed Area (excluding lake): 9.25 km²
Maximum Depth:	19 m	Lake Trout Lake? No
Wetland Area:	6.56 %	Secchi Depth (10-year average): 3.3 m
Phosphorus (10-year average):	8.0 µg/L	Sensitivity: Moderate (OT)
Spring Phosphorus Background = 4.1 µg/L		
Threshold = 6.2 µg/L		

3.0 Bacteria Results - 2011

As mentioned previously, Bacteria samples were collected on mostly a bi-monthly basis from late June to early September. The ColiPlate test kit was used to analyze all water samples for total coliform and fecal coliform (E. coli). This method has been approved by the American Public Health Association and the Environmental Protection Agency. Water samples are incubated for 24-26 hours. After incubation, individual cells in the microplate turn blue in the presence of total coliform indicating contamination from

runoff. If cells exhibit fluorescence under a UV light then fecal *E. coli* is present. The Most Probable Number technique is used to convert the positive well counts to cell density in cfu's/100mL sample.

The limits are:

Total Coliform (Provincial) – 1000 TC/100 mL sample

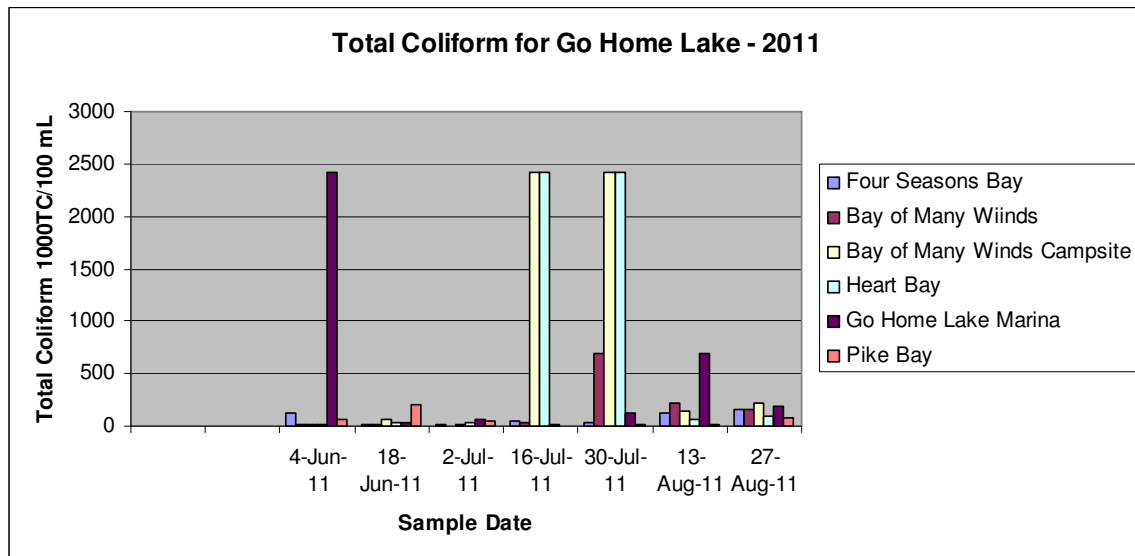
E. coli (Provincial) – 100 EC/100 mL sample

E. coli (Georgian Bay and Inland Lakes objective) – 10 EC/100 mL samples

The 2011 bacteria results are outlined in Appendix 1. Numbers highlight in red exceed one of the above limits.

Go Home Lake measured an *E. coli* value at the Go Home Lake Marina of 694 EC/100 mL on June 11th which is six times (6X) the Provincial standard. The corresponding total coliform number for the same date at the Marina was over 2424 TC/100 mL which is one and a half times (1.5X) the Provincial level (Figure 1). Although all the additional sampling dates on Go Home Lake had *E. coli* below 6 EC/100 mL, two more dates of July 16th and 30th had total coliform over the 2424 TC/100 mL in Bay of Many Winds and Heart Bay. None of the bacteria sampling locations were in the area of the “sewage spill” that was reported in August.

Figure 1

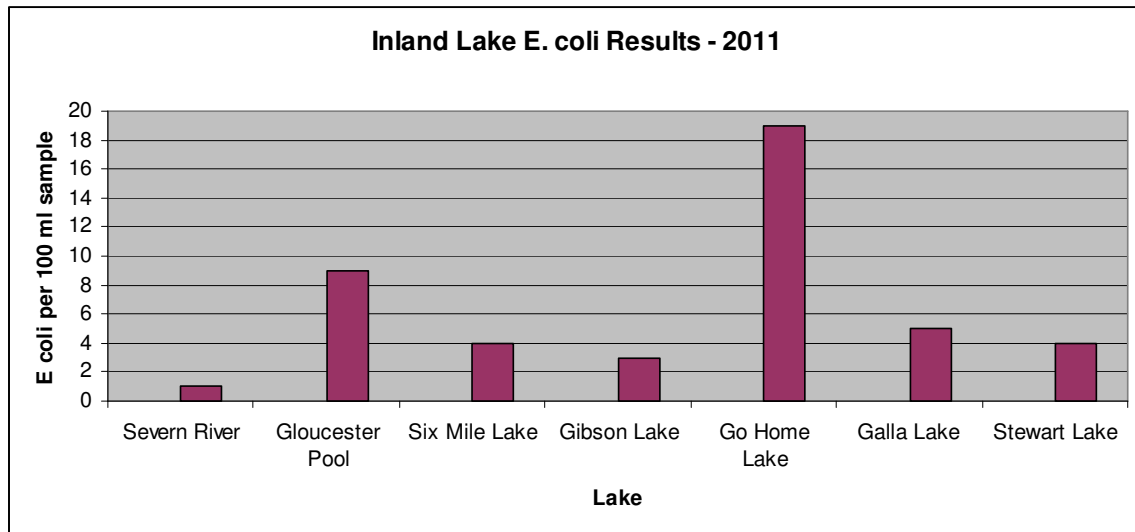


Notwithstanding the one *E. coli* incident on Go Home Lake in early June that exceeded the Provincial limit, most *E. coli* values for the other 7 inland lakes were below the Georgian Bay and Inland Lake objective of 10 EC/100 mL (Appendix 1). Figure 2 represents a seasonal average (all lake sites combined) for each of the lakes. The Go

Home Lake level reflects the one high reading in June. Gloucester Pool only sampled on two occasions and had 6 of 20 samples from 3 sites over the 10EC/100 mL objective – Six Mile Channel, Black River Channel and Dam G (Port Severn Park beach area).

Stewart Lake had four values above the 10 EC/100 mL objective with the highest value of 83 EC/100 mL at the Stewart Lake beach on June 18th.

Figure 2



4.0 Recommendation

The 2011 water chemistry program differed significantly from the previous five years as outlined in Table. 1. This makes the 2011 program the first year that results can be compared across the District and consistent with District Watershed Council protocol.

It is recommended that the inland lake water quality program continue for another four years in order to establish a long term trend that may be acceptable to the District of Muskoka.

