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2013 Water Quality Initiative Report

December 4, 2013 BEL 213090

Mr. Michael Bidwell
Director, Environment and Water Quality Committee
Muskoka Lakes Association
65 Joseph St.
Port Carling, Ontario
P0B 1J0

Re: Muskoka Lakes Association 2013 Water Quality Initiative Report.

Dear Mr. Bidwell:

Beacon Environmental is pleased to provide you with the Muskoka Lakes Association 2013 Water Quality Initiative Report.

Should you have any questions or concerns, we would appreciate the opportunity to speak with you at your convenience.

Yours truly,
Beacon Environmental Inc.

Report Prepared by:

Jamie Nairn, M.Sc., P.Ag.
Senior Ecologist

Report Prepared by:

Sarah Aitken, B.Sc.
Aquatic Ecologist

Table of Contents

Tables

Appendices

Appendix A - Area Summaries

1. Introduction

The Muskoka Lakes Association (MLA) is a non-profit organization that was founded in 1894 to represent the interests of lakeshore residents on Lakes Rosseau, Joseph and Muskoka and many smaller surrounding lakes, and is presently Canada's oldest cottage association. The MLA's mission is to 'promote the responsible use, enjoyment and conservation of the unique Muskoka environment.' The MLA objectives of monitoring lake water quality to provide data to protect vulnerable areas and promoting stewardship are carried out through the Water Quality Initiative.

The MLA Water Quality & Environment Committee is a group of volunteers that utilize professional expertise to analyze the yearly water quality data and to provide recommendations and development options. This year Beacon Environmental has become the primary consultant to assist the MLA with these tasks. This Water Quality Report presents the most recent data collected in 2013 and compares it to data collected from 2002 to the present survey. Total phosphorus (TP) concentrations, in particular, are discussed relative to historic concentrations.

A one-page Area Summary has been prepared for each of the sampling areas in the 2013 program and these are presented in **Appendix A**. The Summaries provide an analysis of the data collected in 2013, and include historical total phosphorus and *E.coli* results where sampled. In addition, specific recommendations for the sampling areas are provided to continue to improve the health of the lakes.

1.1 Water Quality Initiative – Past and Present

The MLA's Water Quality Initiative (WQI) is a citizen-science based water quality monitoring program designed to measure key biological, chemical, and physical indicators of water quality in lakes throughout Muskoka. The WQI has been running since its inception in 2001 and updates and upgrades have improved the program through the years. The program is directed by the MLA Water Quality & Environment Committee, administered by support staff based at the MLA office in Port Carling, and implemented by a dedicated group of more than 100 volunteers. This program is one of the most comprehensive water monitoring programs of any lake association in Canada.

Prior to the inception of the MLA's WQI, monitoring for secchi depth and phosphorus concentrations in the lakes was undertaken by the Ministry of the Environment (MOE) Lake Partner Program (LPP). The LPP Program is a province wide, volunteer-based, water quality monitoring program in which the MOE monitors more than 600 of the province's inland lakes, dating back in excess of 20 years.

The MLA has adopted a long-term monitoring strategy for phosphorus, calcium, water clarity, and water temperature, and has recently (2013) introduced a monitoring strategy for dissolved organic carbon (DOC) concentrations. Additionally, bacteria monitoring activities have focused on determining whether chronically elevated conditions exist in targeted nearshore recreation areas. This document provides a comprehensive overview of the monitoring program including sampling and analytical methodologies.

Similar monitoring programs are presently being undertaken by the District of Muskoka, Lake of Bays Association, Lake Partner Program, and other lake associations. In recent years, there has been a major collaborative effort throughout the region to establish standardized water quality monitoring protocols and methodologies. This has allowed for better comparability between datasets and enhances the usability of all data collected. The MLA WQI complements and expands upon other monitoring programs conducted in the region by government agencies and other volunteer groups.

The WQI has evolved over the years since its initiation as a pilot program in 2001. Changes occur to add analytical power to the existing database. For example, Calcium was sampled for in 2011 and 2012 in response to recent findings that suggested calcium was declining faster than what would be realized under natural processes. The decline of calcium is anticipated to be associated with a long time scale and as such, it can be sampled for in intermittent years.

Another example of change is the addition of sampling for dissolved organic carbon (DOC) in 2013 and 2014. Research has indicated that natural levels of total phosphorus from Precambrian Shield watersheds can most likely be correlated with levels of DOC. By having background data, unnatural (human influence) increases in phosphorus can be more easily realized.

Some of the more notable changes that have helped shape the WQI are presented below:

2001 The program was initiated in the summer of 2001 in order to gather preliminary information on innovative means of water quality determination in the Muskoka lakes. The first year's programme focussed on developing protocols for the collection of replicable data.

2002 The program confirmed the hypothesis that water quality programs should focus on near shore areas and not just on open water areas as they have done in the past. Results showed that nutrient and bacterial levels were higher in near shore areas than in open water and that there were areas of concern.

2003 In 2003 the Board of Directors made a long term commitment to the initiative. Phosphorus samples started to be filtered and the Program was extended to "affiliate" partner associations.

2004 The study was focused on the residential land use activities and their effect on water quality. Monitoring efforts grew to 136 sites monitored by an all-time high number of volunteers. The program discontinued filtering the phosphorus samples because the filters appeared to significantly alter the data collected.

2005 The focus of research in 2005 was to develop a correlation between MLA total phosphorus concentration data with the data that has been collected by both the District of Muskoka and the MOE.

2006 Statistical analysis conducted on the water quality data collected from 2002-2006 indicated that the WQI program did not have the capacity to consider highly complex relationships.

2007 Additional monitoring efforts were directed towards specific lakes and bays classified as "over-threshold" by the DMM. The MLA's attention was refocused in 2007 following recommendations of the 2006 Annual Report and the introduction of the District Municipality of

Muskoka's Lake System health Program which classifies lakes and parts of lakes based on estimated human impact on trophic status. The resources of the WQI were directed to specific sampling areas where concerns about water quality had come to light and focussed on determining the sources of phosphorus loading and other contaminants in these areas.

2008 Monitoring efforts scaled back very slightly to 158 sites monitored by over 110 volunteers. Turbidity measurements were discontinued in favour of the secchi depth protocol that was added in 2007 in order to enable volunteers in the field to complete more of the program.

2009 The WQI monitoring program data showed a general decreasing trend over the past nine years in phosphorus concentrations in Lake Rosseau, Muskoka and Joseph.

2010 Through the support of the WQI, Stream Monitoring Action Plans were implemented for Muskoka Bay and Cox Bay. Both areas had historically been identified as areas of concern through the WQI. Data analysis revealed that land-based influences on nearshore phosphorus were only detectable at sites located in close proximity to creek outlets. The Summary Report and Technical Reports were condensed into one report.

2011 Several changes occurred in 2011 in an effort to standardize the methodology to allow comparison with other sampling programs. The changes included:

- Filtering phosphorus samples, collection of samples at secchi disk depth, and collection of duplicate samples.
- Sampling frequency was reduced from eight sampling events to four.
- Calcium sampling was undertaken, in correlation with spring turnover phosphorus to increase the analytical ability of the WQI program.
- Twenty-three sampling areas were added to the 2011 WQI, based on volunteer input and areas identified with the potential for concern during the 2010 review.

2012 Bacteria monitoring was discontinued at selected sites that were exhibiting chronically low average bacteria levels (three or more years below the MLA upper limit of 10 cfu/100 mL). New bacteria sampling sites were established in high-use areas where potential risks to health and recreational water quality were of particular concern (e.g., beaches, popular swimming sites, etc.). Calcium concentration data collected in 2011-2012 suggested that there was limited year-to -year variation (+/- 0.18 mg/L); however, it was determined that further data was required to determine overall trends. Changes to the program were limited to modifications of the deep-water phosphorus sampling methodology, revisions to bacteria sampling sites, and the addition of new sampling areas. The deep-water sampling methodology was changed for 2012 and results suggested that 2012 deep-water total phosphorus data were in general unreliable and were not included in the report.

1.2 Partners and Monitoring Volunteers

The MLA Water Quality Initiative was supported in 2013 by the Ontario Trillium Foundation thanks to a grant in collaboration with the Muskoka Conservancy (MC). The MC, Ontario's fourth largest land trust and a leading regional environmental educator, has partnered with the MLA to create a flagship shoreline stewardship program. The program will include the development of teaching materials, a

series of “workshops in a box”, pilot-testing of outreach strategies, and improved water quality monitoring both in deep water and in near-shore areas. Once established, this program will become self-sustaining, and will create a platform for ongoing collaboration between the partners. More information, originally presented in a news release on the MLA website is presented in **Appendix B**.

In 2013, more than one hundred (100) volunteers dedicated their time and continued support in collecting water quality samples, including 858 phosphorus samples from 184 sampling locations.

Without the continued support from the volunteers this sampling program would not be possible.

2. Water Quality Monitoring Program

The objective of the MLA is to monitor lake water quality to provide data to protect vulnerable areas, to promote stewardship and to provide clear and appropriate communication about the annual WQI report to all interested parties, appropriate levels of government and the general community.

2.1 Regional Setting and Local Water Quality Issues

The MLA sampling locations are located in the Canadian Shield Physiographic Region (Ontario Geological Survey, 2003). The bedrock throughout this region has extensive outcroppings which are primarily the result of glaciation and post-glacial events. Prominent bedrock knobs and ridges are common and dominate features in some areas. The Precambrian landform expression strongly influences the topographic patterns of the region as well as the local overland drainage characteristics.

Where the bedrock is covered by soils, it is generally very thin and nutrient poor, therefore limiting the amount of nutrients that flow to the adjacent waterbodies.

Lakes with a phosphorus concentration below 10 µg/L are considered oligotrophic (nutrient poor). Lakes with a phosphorus concentration between 10 and 20 µg/L are considered mesotrophic (moderately enriched). Lakes with a phosphorus concentration above 20 µg/L are considered eutrophic (nutrient rich). Muskoka naturally has a range of lakes in all three categories, although the majority of lakes are oligotrophic.

Increases in the nutrient content of a lake (primarily phosphorus and nitrogen), can occur as a result of rainfall, land run-off and percolation of soil-water to the lake. Higher concentrations of these dissolved materials cause the water to become progressively more fertile and productive, stimulating the development of free-floating microscopic plants (algae).

All lakes are subject to nutrient inputs, however, artificial (man-made) enrichment will increase the rate of eutrophication. Eutrophication generally promotes excessive plant growth and decay, favouring simple algae and plankton over other more complicated plants, and causes a severe reduction in water quality.

The MLA sampling locations are located within the Great Lakes drainage basin in central Ontario and drain into Lake Huron via Georgian Bay. Within the Georgian Bay catchment area, the majority of the MLA sampling locations are within the Muskoka River watershed which drains an area approximately 4660 km^2 (Muskoka Water Web, 2013). The Muskoka River watershed is further divided into three subwatersheds: North and South subwatersheds and the Lower Muskoka subwatershed (Acres, 2006). Most of the sampling locations are within the Lower Muskoka subwatershed which originates in Algonquin Park (Acres, 2006).

Within the Muskoka River watershed, approximately 68% is covered in forest and other natural vegetation, 15% consists of water (lakes, rivers and ponds), 11% is wetlands, and 2% is rock barrens and outcrops. Settlement areas only make up 2% of the watershed while developed land such as agriculture (cropland, pasture and open fields) and golf courses make up 2% of land cover within the watershed (Muskoka Heritage Foundation. 2007).

Lake Muskoka is the largest lake in the watershed based on total surface area and is also the receiving water body for Lake Rosseau and Lake Joseph which are also the second and third largest lakes respectively.

The spring of 2013 brought with it extreme flooding conditions and most likely larger than normal nutrient inputs to the lakes and rivers within the sampling program.

Water management can typically be broken down into two interrelated components; water quality and quantity. Water quality is directly affected by quantity. For example, flooding and heavy precipitation events can cause a number of contaminants to enter waterways due to overland flow picking up contaminants on adjacent lands or overflow of sewage treatment systems.

Under normal circumstances, during rainfall events, nutrients (phosphorus and nitrogen) associated with overland flow are generally retained by physical absorption in the lands adjacent to the waterbodies.

Typically during extreme rainfall and snowmelt conditions, water flows across the land picking up contaminants before entering waterways. As well as chemical contaminants such as nutrients being flushed into natural water systems, E. coli and other bacterial contaminants from flooded septic systems may also enter waterways in this fashion.

Nutrient loading from a watershed increases significantly when precipitation rates exceed the average rate. The intensity of the precipitation event in the spring of 2013 lead to significant rises in lake elevations and overland runoff. Nutrients associated with overland flow would not have had sufficient time to become bound in the soils onshore and the newly flooded land, rich with organic matter and nutrients, would also have contributed to nutrient loading of the lakes and rivers during the time of high water in the spring of 2013.

2.2 Water Quality Parameters

Water samples collected for each of the sampling locations are analyzed for a variety of parameters and help to characterize the chemical composition of the lake and identify potential issues. The water

quality parameters sampled during the 2013 program are provided below in **Table 1** along with a brief description of the parameter and reason for measuring.

Table 1. Water Quality Parameters

Water Quality Parameter	Description	Reason for Measuring
Dissolved Organic Carbon (DOC)	DOC is the most abundant dissolved substance entering lakes and rivers in Muskoka Parry Sound. DOC affects the acid-base chemistry which in turn affects the availability of some forms of nitrogen and phosphorus in lakes and rivers. Waterbodies that have a tea or brown colour tend to be high in DOC.	DOC is an important component in the carbon cycle and a primary food source for aquatic webs. Research has indicated that natural levels of total phosphorus from Precambrian Shield watersheds can most likely be correlated with levels of DOC.
Total Phosphorus	Total phosphorus measures all forms of phosphorus present in the sample. There are many sources of phosphorus which are both man-made and naturally occurring in the environment. Phosphorus is the principal nutrient causing eutrophication.	Phosphorus is an essential nutrient for all living organisms. However elevated levels of phosphorus can affect aquatic ecosystems, often leading to algal blooms and increased plant growth, therefore decreasing water quality.
***Escherichia coli* (*E. coli*) and Total Coliforms**	Total coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in soils, plants and in intestines of warm-blooded and cold-blooded animals. Fecal coliforms, particularly *Escherichia coli*, are found exclusively in the intestinal tract of warm-blooded animals.	In abundance E. coli will indicate contamination from excreta from warm-blooded animals, including humans, and may pose an immediate health risk.
Secchi Depth	The Secchi disk is used to measure water clarity at the deep water sampling sites.	Clear water allows light to penetrate deeper into lakes which allows for photosynthesis and oxygen production. Secchi depth is one indicator of lake health used in conjunction with nutrient concentrations from the laboratory analyses.
Temperature	The temperature of the water is recorded during each sampling event using a thermometer and recorded in degrees Celsius.	Water temperature affects different physical, biological and chemical characteristics of a lake. Long term records assist in trend analysis.

Water Quality Parameter	Description	Reason for Measuring
Calcium	Calcium is released from soil and bedrock by acid rain and is also made available by the decomposition of vegetation. Most aquatic organisms require calcium for growth. Calcium was sampled for in 2011 and 2012 and will be sampled for again in 2014. Concentrations of calcium measured in 2011 and 2012 are illustrated in Figure 1 of the 2012 MLA Water Quality Report.	Recent studies have found that calcium levels are dropping, leading to a decrease in the populations of crayfish and other calcium dependant organisms. Calcium in the lakes is measured to understand the rate of decline in the long term.

The 2013 sampling season began in mid-May, ended in late August and included a total of four sampling events. Components of the program included:

- Total phosphorus (TP) samples were collected on four separate occasions throughout the sampling season. All TP samples collected within or prior to the first sampling event in May at the deep stations are considered spring turnover TP samples. This is because the lakes in this area have not yet stratified, separating the lake into layers. This allows for vertical mixing of the water column and phosphorus concentrations are mixed in the water column. The remaining TP samples in June, July and August were taken from a mix of locations including deep-water and nearshore sampling locations.

- Bacteria samples were tested for *E.coli* and total coliforms. These samples were collected from near shore locations during the second and third sampling event.

- Secchi disks were used to measure water clarity at the deep-water locations, taken during each of the 4 sampling events.

- Dissolved organic carbon was sampled at 6 site locations during the 4 sampling events. DOC was collected in Cox Bay (COX-5), Hamer Bay (HMB-8), Muskoka Sands (MSN-4), Willow Beach (WLB-2), Brackenrig Bay (BRA-4), and Windermere (WIN-1). Each of these nearshore sites was selected based on their proximity to potential sources of natural phosphorus.

  Water clarity in the lakes in Muskoka is partially determined by DOC that imparts a tea colour in the water. DOC compounds in Precambrian Shield waters are formed by the decomposition of organic plant matter in wetland areas and concentrations in lake waters are determined by the amount of wetland in the catchment of a lake (GLL 2005). The influence of DOC is entirely natural and cannot be managed to improve water clarity (Secchi depth).

  Natural total phosphorus concentrations in lakes in Muskoka increase with DOC concentration. DOC samples obtained in 2013 and 2014 will be analysed in 2014 to look for trends in natural phosphorus concentrations (DOC and phosphorus levels remain consistent with each other) versus potential human inputs (higher phosphorus concentrations without higher DOC levels). There will be no DOC analysis for 2013.

A summary of the 2013 sampling program for each location is provided below in **Tables 2** through **6**, outlining which areas or affiliate lakes were included in the program, their sampling location and water quality parameters sampled for each. **Figure 1** illustrates the sampling areas in 2013.

Table 2. Summary of the Lake Joseph 2013 Monitoring Program

Sampling Area	Sampling Location	Water Quality Parameters Collected in 2013			
		Secchi Disk	TP	DOC	Bacteria
Cox Bay	COX-0	✓	✓		
	COX-2		✓		
	COX-4		✓		
	COX-5*		✓	✓	
Foot's Bay	FTB-0	✓	✓		
	FTB-3		✓		
Gordon Bay	GNB-0	✓	✓		
Hamer Bay	HMB-0	✓	✓		
	HMB-1		✓		✓
	HMB-2		✓		
	HMB-3		✓		
	HMB-6				✓
	HMB-7				✓
	HMB-8		✓		
Little Lake Joseph	LLJ-0	✓	✓		
	LLJ-12				✓
	LLJ-13				✓
Main Basin	JOS-1	✓	✓		
Stanley Bay	STN-0	✓	✓		
	STN-1		✓		
	STN-3		✓		
Stills Bay	STI-0	✓	✓		
	STI-2		✓		

Note: ***** *indicates a new station added in 2013.*

Table 3. Summary of the Lake Muskoka 2013 Monitoring Program

Sampling Area	Sampling Location	Water Quality Parameters Collected in 2013			
		Secchi Disk	TP	DOC	Bacteria
Alport Bay	ALL-0*	✓	✓		
Arundle Lodge	ARN-0	✓	✓		
Bala Bay	BAL-0	✓	✓		
	BAL-2				✓
	BAL-4				✓
Beaumaris	BMR-0	✓	✓		
	BMR-2		✓		
	BMR-3				✓
	BMR-4		✓		✓
	BMR-5				✓
	BMR-6		✓		
Boyd Bay	BOY-0	✓	✓		
	BOY-3		✓		
	BOY-4		✓		✓
	BOY-5		✓		✓
	BOY-6				✓
Browning Island	BWN-1*				✓
	BWN-2*				✓
Dudley Bay	DUD-1		✓		
East Bay	EAS-0	✓	✓		
	EAS-1		✓		
	EAS-2		✓		
	EAS-3		✓		
Eilean Gowan	ELG-0	✓	✓		
	ELG-4				✓
Main Basin	MUS-3	✓	✓		
Muskoka Bay	MBA-0	✓	✓		
	MBA-4		✓		✓
	MBA-5		✓		✓
	MBA-12				✓
	MBA-13				✓
	MBA-14				✓
	MBA-15				✓
Muskoka Sands	MSN-0	✓	✓		
	MSN-1				✓
	MSN-4		✓	✓	✓
	MSN-5		✓		✓
	MSN-6				✓
North Bay	NRT-0**				
Stephen's Bay	STE-0	✓	✓		
	STE-1*				✓
	STE-2*				✓

Sampling Area	Sampling Location	Water Quality Parameters Collected in 2013			
		Secchi Disk	TP	DOC	Bacteria
Taylor Island	TAY-0	✓	✓		
	TAY-1				✓
	TAY-2		✓		✓
	TAY-3				✓
Walker's Point	WAK-0	✓	✓		
	WAK-5				✓
Whiteside Bay	WTS-0	✓	✓		
Willow Beach	WLB-0	✓		✓	
	WLB-2		✓	✓	✓
	WLB-3				✓
	WLB-4				✓

Note: ***** *indicates a new station added in 2013.*

*** indicates data obtained through the Lake Partner Program in 2013.*

Table 4. Summary of the Lake Rosseau 2013 Monitoring Program

Sampling Area	Sampling Location	Water Quality Parameters Collected in 2013			
		Secchi Disk	TP	DOC	Bacteria
Arthurlie Bay	ART-0**				
Brackenrig Bay	BRA-0	✓	✓		
	BRA-3		✓	✓	
	BRA-4				✓
	BRA-5				✓
East Portage Bay	POR-0	✓	✓		
	POR-1		✓		
	POR-2		✓		
	POR-3		✓		✓
	POR-4		✓		
	POR-5		✓		
Main Basin	ROS-1	✓	✓		
Minett	MIN-0	✓	✓		
	MIN-1		✓		✓
	MIN-6		✓		✓
	MIN-7		✓		✓
Morgan Bay	MGN-0	✓	✓		
	MGN-1		✓		
	MGN-2				✓
	MGN-3		✓		
Rosseau North	RSH-0	✓	✓		
	RSH-2		✓		
	RSH-4		✓		
	RSH-5				✓
Skeleton Bay	SKB-0	✓	✓		
	SKB-1		✓		
	SKB-3		✓		✓
Windermere	WIN-0	✓	✓		
	WIN-1		✓	✓	✓
	WIN-4		✓		✓
	WIN-5		✓		✓

*Note: ** indicates data obtained through the Lake Partner Program in 2013.*

Table 5. Summary of the Watercourse 2013 Monitoring Program

Sampling Area	Sampling Location	Water Quality Parameters Collected in 2013			
		Secchi Disk	TP	DOC	Bacteria
Indian River	IND-0	✓	✓		
	IND-2				✓
	IND-3				✓
	IND-7*		✓		✓
Joseph River	JOR-0	✓	✓		
	JOR-1		✓		
	JOR-2		✓		
Mirror Lake	MIR-0	✓	✓		
	MIR-1				✓
	MIR-2				✓
	MIR-3		✓		✓
Muskoka River	MRV-2	✓	✓		✓
	MRV-3	✓	✓		✓
	MRV-4	✓	✓		✓
	MRV-5		✓		✓
	MRV-6		✓		✓

*Note: ***** indicates a new station added in 2013*

Table 6. Summary of the Affiliate 2013 Monitoring Program

Sampling Area	Sampling Location	Water Quality Parameters Collected in 2013			
		Secchi Disk	TP	DOC	Bacteria
Bass Lake	BAS-2		✓		✓
	BAS-3				✓
	BAS-4				✓
	BAS-5	✓	✓		
	BAS-6				✓
	BAS-7		✓		
Brandy Lake	BDY-0	✓	✓		
	BDY-1				✓
	BDY-2				✓
	BDY-3				✓
	BDY-5				✓
	BDY-6				✓
	BDY-7				✓
	BDY-8				✓
	BDY-9				✓
	BDY-10				✓
	BDY-11				✓
Bruce Lake	BRU-0	✓	✓		✓
	BRU-1		✓		✓
	BRU-3		✓		✓
	BRU-4		✓		✓
	BRU-5		✓		✓
	BRU-6		✓		✓
Clear Lake	CLR-0	✓	✓		
	CLR-2		✓		✓
	CLR-4		✓		✓
	CLR-5		✓		✓
	CLR-7*		✓		✓
Gull Lake	GUL-0	✓	✓		
	GUL-1				✓
	GUL-2				✓
	GUL-3				✓
	GUL-4				✓
Leonard Lake	LEO-0	✓	✓		
	LEO-1				✓
	LEO-3				✓
	LEO-4				✓
Moon River	MOO-1		✓		
	MOO-4		✓		✓
	MOO-6		✓		✓
	MOO-9		✓		✓
	MOO-10		✓		✓

Sampling Area	Sampling Location	Water Quality Parameters Collected in 2013			
		Secchi Disk	TP	DOC	Bacteria
	MOO-11	✓	✓		
	MOO-12*		✓		✓
	MOO-13*		✓		✓
	MOO-14*		✓		✓
Muldrew Lake	MLD-4				✓
	MLD-5				✓
	MLD-6				✓
	MLD-7				✓
Silver Lake (GH)	SVR-0	✓	✓		
	SVR-1				✓
	SVR-2				✓
Silver Lake (TML)	SPC-0	✓	✓		
	SPC-2				✓
	SPC-4				✓
	SPC-5				✓
Star Lake	STR-0	✓	✓		
	STR-1				✓
	STR-2				✓
	STR-3				✓
	STR-4				✓
	STR-5				✓

*Note: ***** indicates a new station added in 2013*

2.3 General Methods

The WQI study area includes Lakes Muskoka, Rosseau, and Joseph and a number of smaller affiliate lakes. The study area is divided into sampling areas representative of lakes, bays, and rivers of interest. Each sampling area consists of one or more sampling sites. Most sampling areas have one reference site established in a central, deep-water location intended to exhibit “average” water quality conditions.

Sampling and Analytical Methods employed during the 2013 sampling program are provided in the Water Quality Initiative Methodology Report (Beacon, 2013).

2.4 Updates to 2013 Monitoring Program

Sampling sites are chosen and classified according to their local environment. The three site types are nearshore, deep-water, and watercourse. Nearshore sites are located adjacent to land where the water depth is generally between 50 cm and 150 cm as this is the depth at which most recreational use occurs. Deep-water sites are located in deeper, open water locales. Watercourse sites are

located in streams and creeks conveying flow to the larger waterbodies. Sampling methodologies differ based on the type of sampling site (see Water Quality Initiative Methodology Report).

Prior to each sampling season, a complete review of the sampling sites is conducted. Sampling sites generally remain consistent from year to year, as the main goal of the program is to discover the sources of phosphorus entering the lakes, while other objectives include providing additional data to support the protection of vulnerable areas, monitor Coliform and *E. coli*, and promote stewardship. However, site revisions are made as necessary based on analyses of previous data, volunteer availability, new information, and budget. Generally, bacteria monitoring is discontinued at sampling sites exhibiting chronically low bacteria levels (3+ consecutive years with average concentrations below 10 cfu/100mL). In sampling areas where bacteria monitoring is reduced, new nearshore sites are generally established as necessary.

The review of the historical data and planning for the 2013 program resulted in changes in sampling locations and water quality parameters sampled. Parameters changed include:

- Dissolved Organic Carbon was added to the parameter suite in six locations to better understand potential sources of natural phosphorus versus human impact.
- Calcium was not sampled during the 2013 program as it will be sampled at most on a biennial basis and will most likely be sampled during the 2014 program.
- As noted in the 2012 Water Quality Report, the use of a cork in the deep-water sampling protocol for TP was discontinued in 2013.

No new waterbodies were added to the sampling program in 2013, however a few sampling locations were removed or added. These are outlined in **Table 7** below:

Table 7. Summary of the 2013 Monitoring Program Revisions

Waterbody Name	Sampling Area	Sampling Location	Site Added	Site Restarted	Site Removed	Site Modified	Reason
Lake Joseph	Cox Bay	COX-5	✓				To investigate potential source of natural phosphorus.
	Gordon Bay	GNB-5			✓		Very low *E. coli* levels in 2011-2012.
	Hamer Bay	HMB-8				✓	To investigate potential source of natural phosphorus.
Lake Muskoka	Alport Bay	ALL-0	✓				Concern this may be a vulnerable area.
	Beaumaris	BMR-8			✓		Low results - drop this site for now.
	Browning Island	BWN-1	✓				Concern this may be a vulnerable area.
	Browning Island	BWN-2	✓				Concern this may be a vulnerable area.
	Eilean Gowan	ELG-1			✓		Low results - drop this site for now.
	Eilean Gowan	ELG-2			✓		Low results - drop this site for now.
	Muskoka Bay	MBA-9			✓		Low results - drop this site for now.
	Muskoka Sands	MSN-4				✓	To investigate potential source of natural phosphorus.
	North Bay	NRT-4			✓		Low results - drop this site for now.
	Stephen's Bay	STE-1	✓				Concern this may be a vulnerable area.
	Stephen's Bay	STE-2	✓				Concern this may be a vulnerable area.
	Whiteside Bay	WTS-3			✓		Low results - drop this site for now.
	Whiteside Bay	WTS-4			✓		Low results - drop this site for now.
	Willow Beach	WLB-2				✓	To investigate potential source of natural phosphorus.
Lake Rosseau	Brackenrig Bay	BRA-3				✓	To investigate potential source of natural phosphorus.
	Muskoka Lakes G&CC	MLG-0			✓		Low results - drop this site for now.
	Royal Muskoka Island	RMI-0			✓		Low results - drop this site for now.
	Skeleton Bay	SKB-4			✓		Low results - drop this site for now.
	Tobin's Island	TOB-0			✓		Low results - drop this site for now.
	Windermere	WIN-1		✓			Restarted to investigate potential source of natural phosphorus.
	Windermere	WIN-3			✓		Low results - drop this site for now.

Waterbody Name	Sampling Area	Sampling Location	Site Added	Site Restarted	Site Removed	Site Modified	Reason
Indian River	Indian River	IND-1			✓		Low results - drop this site for now.
	Indian River	IND-4			✓		Low results - drop this site for now.
	Indian River	IND-7	✓				Concern this may be a vulnerable area.
Moon River	Moon River	MOO-12	✓				Concern this may be a vulnerable area.
	Moon River	MOO-13	✓				Concern this may be a vulnerable area.
	Moon River	MOO-14	✓				Concern this may be a vulnerable area.

3. 2013 Monitoring Results and Sampling Analysis

Based on the long term data acquired to date, the water quality in the sampling locations remains very good to excellent. The results from each sampling area are presented in the Area Summary Sheets (**Appendix A**). Each sheet describes the specific sampling area and provides a summary of the 2013 data, as well as graphical results of phosphorus and E. coli results, if sampled for. Each area description from 2012 was taken from the previous year's report while any new sampling area is described based upon first-hand knowledge, historical and up to date aerial photography, as well as file information from the Ministry of Natural Resources and the District Municipality of Muskoka.

The Area Summary Sheets summarize mean Secchi Disk depth, spring turnover phosphorus and yearly mean phosphorus concentrations, and *E. coli* and total coliform yearly means. In each summary section a visual indication of the overall water quality at each area is presented at the bottom left by means of a traffic light symbol as described below:

Green Light - water quality remains consistently good.

Yellow Light – further investigation recommended to maintain good water quality.

Red Light – Remedial action recommended to improve water quality.

3.1 Mean Secchi Depth Measurements

Secchi depth is a measurement of water clarity, providing water quality information. A decrease in water clarity in these sampling locations is most likely either a result of increased dissolved organic carbon (DOC) levels or increased levels of nutrients from the watershed. DOC inputs originate in wetlands and cause a naturally brown or tea colour in a water body. A decrease in water clarity can also result from increased levels of suspended sediments in turn leading to algal growth, decreasing clarity.

Water clarity can change in the short term as a result of weather, shoreline development or seasonal changes. A long term decrease in water clarity is generally an indication of an increase in nutrient (phosphorus and nitrogen) levels and therefore a decrease in water quality. Lakes with a Secchi depth >5 m are considered oligotrophic or unenriched. Lakes with a Secchi depth between 3 and 5 m are considered mesotrophic or moderately enriched. Finally, lakes with a Secchi depth <3 m are considered eutrophic or enriched.

Secchi depth values are determined by averaging the "up" and "down" measurements recorded by the volunteers using a Secchi disk. The mean Secchi Disk listed in the Area Summaries represents the arithmetic mean of values obtained from individual sampling sites throughout the season. The Area Summary Sheets provide the mean Secchi depth for each deep-water site sampled in 2013. Because water clarity in most lakes in Muskoka is affected by dissolved organic carbon (DOC), which results in tea coloured water, and not just by algal concentrations, the Secchi depths alone cannot be considered an indicator of nutrient (phosphorus) status; however, this data remains important for monitoring long-term water quality trends.

That said, the Secchi depths recorded in 2013 remain consistent with the depths reported historically.

3.2 Phosphorus

As noted in the District of Muskoka 2012 Lake System Health Monitoring Program Year End Report "Phosphorus is the nutrient that controls the growth of algae in most Ontario lakes. For this reason, an increase in phosphorus in a lake increases the potential for algal blooms. Algal blooms detract from recreational water quality and, in some cases, affect the habitat of coldwater fish species such a Lake Trout."

Several years of spring-turnover phosphorus data can be analysed to understand the nutrient status of the lake and understand trends through time which might indicate a change in the nutrient status of the lake.

Duplicate phosphorus samples collected in 2013 were analyzed for bad splits according to the DMM phosphorus data management protocol.

This summer, Beacon corresponded with the Ontario Ministry of the Environment (MOE) Dorset Environmental Science Centre (Andrew Paterson) regarding the interim protocol for removing bad splits. The MOE Lakeshore Capacity User Manual (November 2011) states that if duplicate samples that differ by the higher being 30% more than the lower, or >5mg/L than the lower, then the higher sample should be deemed as a bad split and should be removed from the analysis. Since the 2012 Water Quality Report recommended that "if the two measurements making up the duplicate sample have a variance of greater than 40%, the higher value is removed", Beacon has since reanalyzed the data to remove any of the bad splits from the analysis as per the present MOE interim approach. All of the raw data will remain in the database should it be required for future consideration if for example the MOE interim protocol for bad splits is revised.

Following the analysis for bad splits, an outlier analysis was undertaken for all spring turnover data using the District Municipality of Muskoka (DMM) protocol. There are various approaches to outlier detection depending on the objective of outlier detection and the number of observations in the data set. The DMM uses the Grubb's Test recommendation for outliers contained in the 2008 Gartner Lee report *Review of Long Term Water Quality Data for the Lake System Health Program*. The Grubb's Test for outliers (extreme studentized deviates) was used in previous MLA water quality reports and continues to be used to analyze the 2013 data. Following the analysis, no further data points were removed in 2013.

The spring phosphorus data that passed the statistical analysis are plotted and presented in the Area Summary Sheets. It must be noted that in 2012, the 2012 deep-water total phosphorus data were deemed unreliable and were removed from the analysis.

Spring turnover and yearly mean total phosphorus data have been provided for all sites monitored in 2013. Current and historical total phosphorus data for deep-water control sites within each sampling area are presented in a graph to show long-term trends. Where appropriate, graphs show MLA data in relation to the threshold concentration set by the DMM or Seguin Township.

Nearshore and watercourse yearly mean total phosphorus concentrations in 2013 were calculated as the arithmetic mean of all four measurements from an individual sampling site within the sampling season, including duplicate sample measurements, where available.

On the graphs illustrating long-term phosphorus levels, threshold concentrations have been represented by a single black dashed line. For sampling areas in the DMM, the threshold values are those in previous year's reports, previously verified by the DMM. Sampling areas without graphed threshold lines have not been modelled and are not comparable to other areas as previously confirmed through consultation with the DMM. Spring turnover and yearly mean total phosphorus as measured by the MLA is shown in µg/L on the y-axis and sampling year is indicated on the x-axis. Spring turnover total phosphorus concentration was calculated as the arithmetic mean of the spring or mid-May duplicate sample measurements, where available. Historical spring turnover total phosphorus concentrations for the deep-water reference sites have been represented graphically as a blue line with diamonds or as single blue diamonds, if consecutive years of data were not available. Note that in previous years, duplicate spring turnover samples were not consistently collected at some sites and for these sites, a single spring turnover sample has been reported. Historical deep-water yearly mean total phosphorus concentrations have been represented graphically in the area summaries as a red line with circles or as single red circle, if consecutive years of data were not available.

As noted previously, the spring of 2013 brought with it extreme flooding conditions and most likely larger than normal nutrient inputs to the lakes and rivers within the sampling program. Elevated 2013 spring phosphorus concentrations were recorded at Gordon Bay (GNB-0), Lake Joseph Main Basin (JOS-1), Little Lake Joseph (LLJ-0), Stanley Bay (STN-0), Muskoka Main Basin (MUS-3), Morgan Bay (MGN-0), Indian River (IND-0), Joseph River (JOR-0), and Mirror Lake (MIR-0).

Water level fluctuations can significantly affect lake water's quality. High water levels can increase the concentration of nutrients from runoff and flooded lakeshore soils. Older septic systems, located near lakes, may flood when groundwater levels are high. Yet another consequence of fluctuating water levels is shoreline erosion. Each of these scenarios can increase the concentration of phosphorus in a receiving water body.

The average length of time water remains in a lake is called the retention time or flushing rate. The lake's size, water source, and watershed size primarily determine the retention time. Rapid water exchange rates allow nutrients to be flushed out of the lake quickly, or conversely, nutrients may remain within a waterbody for years.

Nutrients that accumulate over a number of years in lakes with long retention times can be recycled annually with spring and fall mixing. Reserve nutrients in lake sediments can continue to recirculate, even after the source of nutrients in the watershed has been controlled. Thus, the effects of the flooding in the spring of 2013 may not be apparent for a number of years. The stations with elevated spring phosphorus concentrations should be closely monitored in the spring of 2014.

3.3 Bacteria

Total coliform and *E. coli* data have been summarized in the tables on each Area Summary Sheet for all sites monitored in 2013. Current and historical *E. coli* data continue to be presented graphically. *E. coli* concentrations are reported as the number of colony forming units (cfu) observed in 100 mL of lake water (cfu/100 mL) on the y-axis and sampling sites are indicated on the x-axis. On the *E. coli* graphs, each sampling site is represented as a cluster of bars that represent different sampling seasons (years). Each year is represented by different coloured bars. Each graph also compares *E. coli* levels to the MLA upper limit, which is represented by a black dotted line. The upper limit value (10 cfu/100 mL) was established as a reasonable limit for maintaining existing water quality in Muskoka for the WQI and is based on advice provided previously by Dr. Karl Schiefer (2003). The Ministry of Environment notes that a "potential health hazard exists if the fecal coliform geometric mean density for a series of water samples exceeds 100 cfu/100 mL" (MOE 1984).

3.3.1 Total Coliforms

Total coliform data is summarized for areas where bacterial monitoring was conducted in 2013. Total coliform concentrations are reported as yearly averages calculated as the geometric mean of all available measurements, including follow-up measurements, for an individual sampling site. Total coliform measurements of < 3 cfu/100 mL were assigned a value of 1 cfu/100 mL for the purpose of calculating means. Geometric means presented in the area summaries were rounded to the nearest colony forming unit.

3.3.2 E. coli

E. coli data is summarized for areas where bacterial monitoring was conducted in 2013. *E. coli* levels are presented as yearly averages calculated as the geometric mean of all available measurements, including follow-up measurements, for an individual sampling site. Current and historical *E. coli* levels are also illustrated graphically in area summaries. *E. coli* measurements of <3 cfu/100 mL were assigned a value of 1 cfu/100 mL for the purpose of calculating means. For the E. coli graphs in the area summaries, every site that was sampled has a minimum value of 1 cfu/100 mL; where no bar is shown for a particular site/year, no data was collected. Geometric means presented in the area summaries were rounded to the nearest colony forming unit.

The MLA WQI includes a field protocol that requires volunteers to re-sample a site if E. coli levels were found to be greater than 50 cfu/100mL. This cautious approach allows the MLA to monitor sites that demonstrate potential for ongoing concern. Following this protocol, E. coli levels exceeded 50 cfu/100 mL at 17 of 118 bacteria sampling sites (14%) in 2013, up from nine of the 112 bacteria

sampling sites (8.0%) in 2012. Two of the sites that continue to exhibit high bacteria levels (MBA-12 and MSN-4) are watercourses sites.

4. Conclusions

This Water Quality Report presents the most recent data collected in 2013 and compares it to data collected from 2002 to the present survey. The 2013 water quality program follows the well-established methodology that continues to be fine-tuned each year.

This year Beacon Environmental has become the primary consultant to assist the MLA with the data analysis. Consultation was undertaken in the spring to look at the data from each sampling area and location and to assess each site to decide if continued sampling was necessary, or if sites should be discontinued and new sites added. The changes undertaken in 2013 are detailed in **Table 7** and include 15 sites being removed, 8 sites being added and 4 sites being modified.

One substantial change to the monitoring program was the addition of sampling for dissolved organic carbon (DOC). DOC compounds in Precambrian Shield waters are formed by the decomposition of organic plant matter in wetland areas and concentrations in lake waters are determined by the amount of wetland in the catchment of a lake (GLL 2005). Natural total phosphorus concentrations in lakes in Muskoka increase with DOC concentration.

Dissolved organic carbon was sampled at 6 site locations during the 4 sampling events in 2013. DOC was collected in Cox Bay (COX-5), Hamer Bay (HMB-8), Muskoka Sands (MSN-4), Willow Beach (WLB-2), Brackenrig Bay (BRA-4), and Windermere (WIN-1). Each of these nearshore sites was selected based on their proximity to potential sources of natural phosphorus.

DOC samples obtained in 2013 and 2014 will be analysed in 2014 to look for trends in natural phosphorus concentrations (DOC and phosphorus levels remain consistent with each other) versus potential human inputs (higher phosphorus concentrations without higher DOC levels). There will be no DOC analysis for 2013.

Each of the 2013 spring phosphorus duplicates was analyzed for bad splits. The MOE Lakeshore Capacity User Manual (November 2011) states that if duplicate samples that differ by the higher being 30% more than the lower, or >5mg/L than the lower, then the higher sample should be deemed as a bad split and should be removed from the analysis. Since the 2012 Water Quality Report recommended that “if the two measurements making up the duplicate sample have a variance of greater than 40%, the higher value is removed”, Beacon has since reanalyzed the data to remove any of the bad spits in the data base as per the present MOE interim approach. In the 2013 spring phosphorus duplicates, 56 of 422 samples (13%) were deemed to be bad splits. This percentage is reasonable as it is related to a citizen-science based sampling program.

E. coli levels in 2013 varied. Trouble locations in previous years were below the MLA upper limit in 2013 and locations with consistently low levels suddenly becoming hot spots in 2013. A number of locations require further analysis in 2014; each location proposed for additional analysis is noted

within the Area Summary Sheets, including Beaumaris (BMR-5), Muskoka Bay (MBA-12), Minett (MIN-6), Brandy Lake (BDY-1), Gull Lake (GUL-4), Mirror Lake (MIR-2) and Moon River (MOO-6).

Following a thorough review of all data acquired since 2002, including deep-water, nearshore and watercourse total phosphorus concentrations, Secchi depths at deep-water stations and *E.coli* levels at nearshore and watercourse sampling locations, the monitored sites provide data that suggests that the water quality remains consistently good and very suitable for continued recreational use.

5. Recommendations

Although this is the first year of Beacon's involvement in this sampling program, we have had a chance to review the data and the methodology through the year and offer the following suggestions moving forward into the 2014 sampling season:

5.1 Training

All team leaders must attend the annual training session held in the spring prior to sampling. Team leaders should actively be encouraging new members to join the sampling team. Minor changes are made each year and each person must understand any revisions to the monitoring program.

All team leaders and samplers must ensure that they understand the required number of samples for each station for each sampling date. A number of samples were missed and not acquired in 2013.

5.2 Methods

The Water Quality & Environment Committee should continue to review sites each winter and understand where sites should be added or discontinued. Sites sampled for DOC in 2013 should also be sampled for DOC in 2014 to establish a database to determine phosphorus outliers.

The Field Coordinator is a great asset to maintain continuity between the Water Quality Initiative Committee and the volunteers. Having the Field Coordinator continue to compile the yearly results will continue to keep the year end data analysis costs lower.

Emphasis should be placed on understanding and performing the sampling using proper and sterile techniques. Proper sampling will decrease the amount of bad splits that occur each year.

If the Lake Partner Program data will continue to be used in the MLA analysis, the MLA should discuss with the MOE their intended sampling locations. This discussion should happen early in the year, prior to the early stages of preparation for the coming year.

5.3 Education

Education to improve water quality should consider the integration of land use, aquatic vegetation and waterfowl. It is important that everyone contribute to the goal of improving water quality and aesthetics of their lakes, while raising public awareness about healthy lake systems. Below are recommendations that may be implemented by individual landowners and supported by the MLA to improve water quality. In addition, there are a variety of landowner resources available on the MLA website which provide steps landowners can take to reduce their impact.

The main water quality issues identified are nutrient enrichment and high bacteria concentrations. Local management includes activities that can be completed in the area in and immediately surrounding each of the lakes in the WQI program. The alternatives listed below are lower in cost, and can be implemented in the short term. Due to their scale, watershed-scale management activities are generally more costly than local management activities. These are, however, activities that will benefit the watershed over the long-term, and leave a positive legacy for future generations.

Public education
Each of the individual lakes provides unique recreational and aesthetic enjoyment for its residents. As part of achieving healthy lakes, communicating the "health" of the lake to residents, and changing the perception of the lake quality is paramount. Raising awareness of basic lake and wetland ecology can empower lake residents. Public education regarding the role of aquatic vegetation in healthy lake ecosystems is important and should be considered.

Shoreline Buffers
Buffer strips help to filter runoff from adjacent land use as water flows through a vegetative buffer. Contaminants and sediment are removed by filtration and settling in the network of plants and plant residue. Soluble contaminants, including nutrients, are taken up by the plant roots or consumed by microbes in the soil. The width of a buffer and its vegetation type, however, influence the effectiveness of a buffer. Native plants typically have denser, deeper root structures, (than conventional turf grass) which improve the infiltration of runoff. Shoreline residents in the areas of concern may benefit from shoreline buffer education.

Deter use by waterfowl
Waterfowl feces can be a significant source of nutrients and bacteria to lakes. In addition to active management, visitor education on the influence of waterfowl on water quality is essential to reduce waterfowl populations in and around each the lakes. Steps to reduce waterfowl include:

- Encourage shoreline naturalization as described above as waterfowl are attracted to large grassy areas; and
- Encourage a no waterfowl feeding policy.

Implement a "Stoop and Scoop" program
Similar to waterfowl, dog feces contain large concentrations of nutrients and are a major source of bacteria and pathogens. When dog feces are left on the grass, runoff carries it into the lake itself, or

storm sewers and watercourse that discharge into the lake. An education program can be implemented for residents in areas of concern.

Septic Systems

Ensure septic systems are in good working condition, maintained and pumped on a regular basis. This is the responsibility of the individual landowners.

5.4 Area Specific Recommendations

Area specific recommendations were developed through the analysis of the 2013 water quality data. These recommendations are provided in the Area Summary sheets and summarized below.

1. High phosphorus readings were observed at nearshore in Wallace Bay (MIN-6) through 2013. Beacon recommends further investigation of this source in 2014.
2. High phosphorus readings were observed in the watercourse at Muskoka Sands (MSN-4 and MSN-5) through 2013. Beacon recommends further investigation of this source in 2014.
3. High spring phosphorus readings were observed at the nearshore at Beaumaris (BMR-4 and BMR-6) in 2013. Beacon recommends further investigation of this source in 2014.
4. High spring phosphorus readings were observed at the nearshore at the outlet of Clarke's Pond (WIN-1) in 2013. Beacon recommends further investigation of this source through 2014.
5. The historical database acquired by the Bruce Lake Family Association should be included in further analysis, the results from BRU-3 be carefully tracked in 2013 and that sampling continue to monitor long-term trends.
6. Spring samples should be taken in 2014 and a discussion undertaken regarding the removal of one of the deep water stations at either Stills Bay or Foot's Bay.
7. Further investigation of Gull Lake (GUL-4) in 2014.
8. A reconnaissance survey of the area associated with MIR-2 be undertaken in 2014.
9. Further investigation of MOO-6 in 2014.
10. The sampling program at the Muldrew Lakes sites be modified in consultation with the Muldrew Lakes representatives prior to the 2014 sampling season.
11. An investigation of the source(s) of elevated levels of E. coli at MBA-12 is recommended.
12. Sampling be continued to monitor long-term trends at WAK-0 and that the E. coli levels at WAK-5 be analysed at the end of 2014 with the potential of discontinuing this site if levels remain low.
13. Particular attention should be paid to the nearshore sites at Willow Beach in 2014.
14. A reconnaissance of the area associated with WIN-5 be undertaken in 2014.

5.5 Overall Study Recommendations:

1. The MLA can rely on the Lake Partner Program data when it is available in locations such as Arthurlie Bay.

2. Sampling should continue to build a robust database and to monitor long-term trends.
3. When high nutrient and bacteria results are observed, look at other factors such as the local weather the day of sampling and 72 hours prior.

5.6 Next Steps

Beacon believes that there are opportunities to take the WQI program one step further, beyond the in-scope services provided to date, and introduce the MLA to a number of fresh approaches. Examples of new ideas that can be discussed with the Water Quality Committee include:

1. Photographic records of shoreline use and structures abutting the sampling sites at Focus Areas;
2. Remedial plans for Focus Areas;
3. Long term monitoring plans linked with property development;
4. Membership involvement to direct more detailed Official Plan policies or community plans. It is very important to keep the membership knowledgeable by building on the existing database, as well as keeping them engaged by providing new ideas for discussion and active involvement.
5. Look at long term phosphorus trends at nearshore sites.
6. Look at Secchi trends over the long term program.
7. Consider rain event sampling to determine how much influence surface water runoff impacts the water quality of the lakes.
8. Meet with the District of Muskoka to review the updated District Modelling to understand changes (if any) in the threshold values, or additional threshold values in new bays/areas.

6. Definitions

Arithmetic mean: This type of average is calculated by adding together a group of numbers and dividing the sum by the number of numbers.

E. coli: Escherichia coli is one of several types of bacteria that normally inhabit the intestine of humans and animals. *E. coli* is exclusively associated with fecal waste making it a good indicator of faecal contamination. There are many different strains of ***E. coli***; most waterborne strains are themselves not harmful, but some (such as ***E. coli*** O157:H7) can cause serious illness.

Geometric mean: This type of average is calculated by multiplying together a group of *n* numbers and then taking the n^{th} root of the resulting product. The geometric mean is used to indicate the central tendency or typical value of a set of numbers. It is typically used to calculate average bacteria counts because as a living organism, bacteria counts are highly sporadic and inconsistent.

Sampling Area: A geographic location encompassing a group of WQI monitoring sites.

Sampling Site: The discrete and unique location where samples are to be collected and measurements are to be taken.

Secchi Depth: A measure of **water clarity**, measured using a Secchi disk - a small disk attached to a rope. Alternating quarters of the top side of the disk are coloured white and black. The Secchi depth is the depth of water whereby the sampler can no longer distinguish the white and black quarters of the disk.

Spring Turnover Total Phosphorus: A single phosphorus concentration measurement taken in a typically stratified lake during the spring turnover period. This measurement has been shown to adequately represent the overall phosphorus concentration in a lake (Clark, 2010). Spring turnover typically lasts for a few days following ice out when the temperature of the entire water column is consistent (usually 4˚C) allowing the water column to mix. Ontario's Ministry of the Environment experiments have indicated that there is `no appreciable difference in the P means` in long-term data derived using April (true turnover) and May (mixed layer) data. In practice, measurements taken anytime in May are considered to be adequate.

Total Coliform: Coliform includes a variety of bacteria. In practice, detectable coliform are usually enteric, found in the intestinal tracts of humans and other warm-blooded species.

Total Phosphorus: Phosphorus is a chemical element that is essential for all living cells. Total phosphorus is a measure of both inorganic and organic forms of phosphorus. Phosphorus can be present as dissolved or particulate matter. It is an essential plant nutrient and is often the most limiting nutrient to plant growth in fresh water.

Water Clarity: Water clarity is a measure of how much light penetrates through the water column. The clarity of water is influenced both by suspend particulate matter (sediment and plankton) and by coloured organic matter (tea coloured lakes). Clarity can provide some indication of a lake's overall water quality, especially the amount of algae present.

Yearly Mean Total Phosphorus: The arithmetic mean of phosphorus concentration measurements taken above a stratified water column's thermocline over the ice-free period. Note: yearly mean phosphorus concentration as reported by the WQI is for spring and summer months only.

Note: several of these definitions have been taken from previous years Water Quality Reports, including the WQI Summary Report - Citizens Environment Watch, 2009.

7. References

Acres International Limited. 2006.
Muskoka River Water Management Plan. Available at: http://www.muskokawaterweb.ca/water-101/water-quantity/mrwmp

Ontario Geological Survey. 2003.
Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128.

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The Muskoka River Watershed Inventory Project – Final Report.

Appendix A

Area Summaries

Area Description:

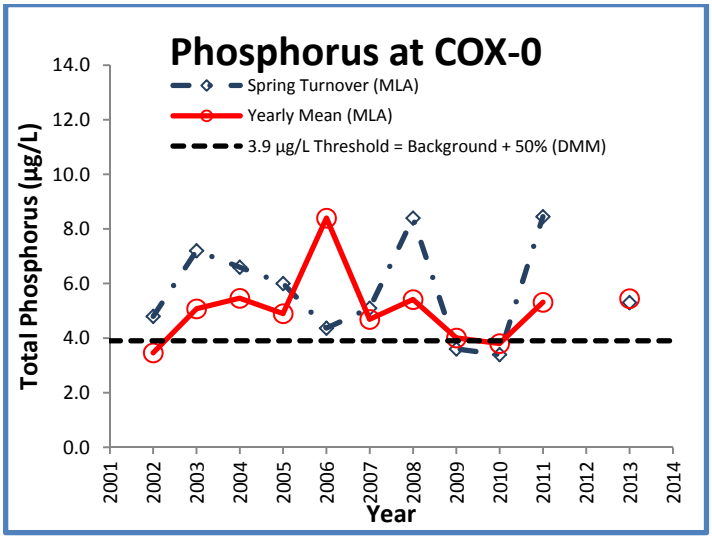
Cox Bay is the southernmost bay of Lake Joseph. The bay is 1.84 km² in area and is up to 12 m in depth. A large resort and golf course are located adjacent to the lake, along with a marina and a canal crossing into Lake Rosseau at Port Sandfield. Most of the shoreline area is developed, but many residences maintain forested cover on their properties. More than 15% of the shoreline is open lawn, pavement or is intensely landscaped. The Cox Bay Stewardship Initiative group has identified ten permanent watercourses that drain into the bay. Cox Bay is classified as moderately sensitive and over-threshold by the DMM. Monitoring started in 2002.

Volunteer Recognition: **Gord Ross**

Cox Bay (COX)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (ug/L)		E.coli Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
COX-0	5.19	5.3	5.5		
COX-2		6.0	5.0		
COX-4		5.5	4.3		
COX-5		10.3	6.4		



Summary and Recommendations:

Phosphorus results remain consistent over the sampling years; however concentrations remain over the DMM threshold of 3.9 µg/L. COX-5 was added in 2013 and analysis of DOC to better understand the potential sources of natural phosphorus versus human impacts will be undertaken in 2014. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

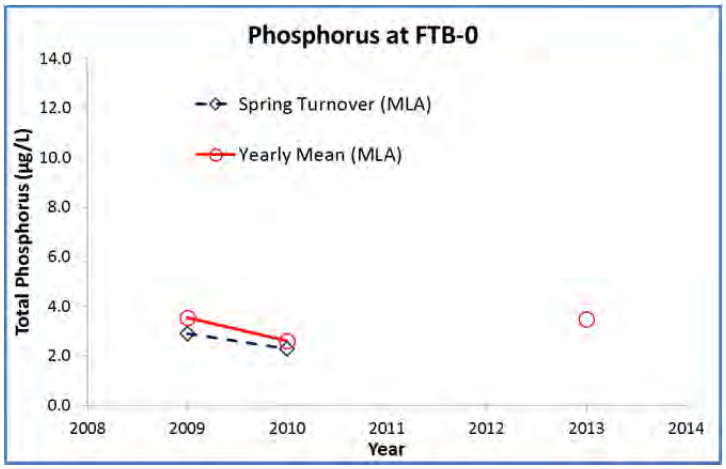
Foot's Bay is located in the south-eastern portion of Lake Joseph. Foot's Bay has a higher intensity of development in the southern section, with areas that are adjacent to the highway and a marina. There are still large areas of shoreline with mostly intact forests. The main basin of Lake Joseph is classified as highly sensitive by the DMM. Monitoring started in 2009.

Volunteer Recognition: **Joanne Brown, Neil Shaw** and Jane Craig.

Foot's Bay (FTB)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
FTB-0	3.5		3.5		
FTB-3			3.6		



Summary and Recommendations:

Phosphorus results remain low over the sampling years. No spring samples were acquired in 2013. The yearly mean is based on values obtained in July and August 2013. Beacon recommends that spring samples are taken in 2014 and a discussion be undertaken regarding the removal of one of the deep water stations at either Stills Bay or Foot's Bay. Sampling to continue to monitor long-term trends.

Area Description:

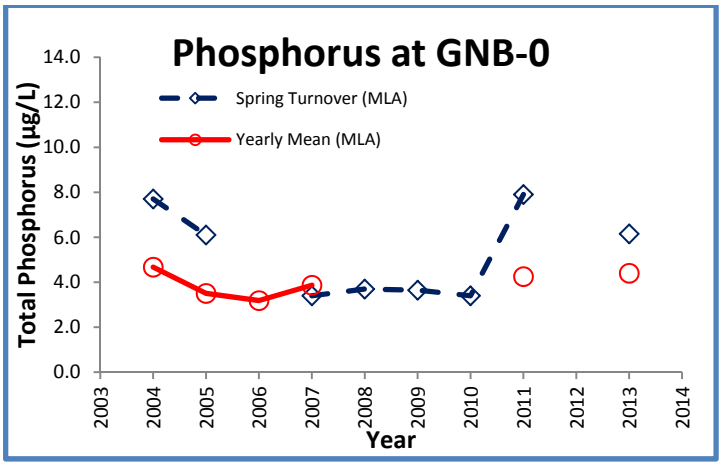
Gordon Bay is in the northwestern part of Lake Joseph. This bay is moderately developed and highway 169 follows along the shoreline for a large portion of the bay. There is a large marina in the northern part of the bay where one of three creeks discharges into the bay. The main basin of Lake Joseph is classified as highly sensitive by the DMM. Monitoring started in 2004.

Volunteer Recognition: **Andrew Watson**, John Offutt, Cecil Hayhoe, Charlotte Dempcey, Liam Davies and Trevor Davies.

Gordon Bay (GNB)

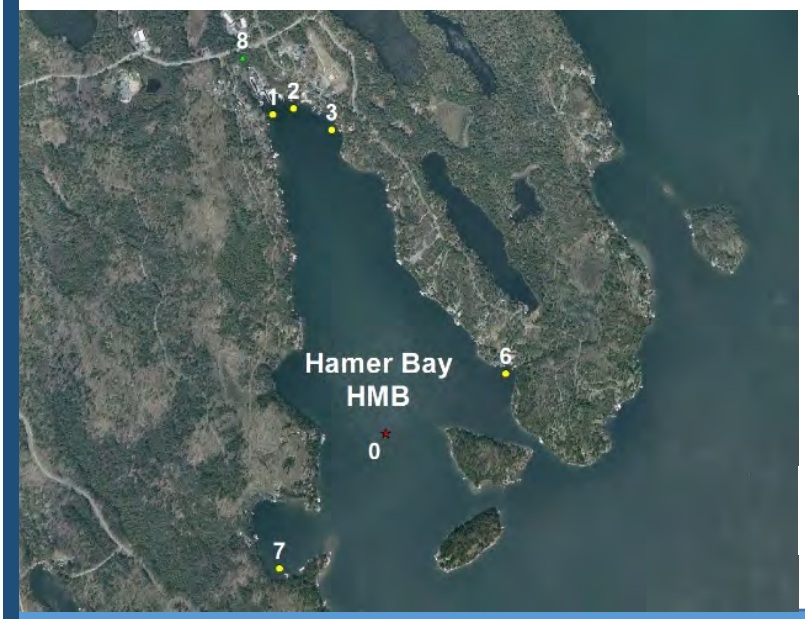
2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean (cfu/100 ml)	Total Coliforms Yearly Mean (cfu/100 ml)
		Spring Turnover	Yearly Mean		
GNB-0	6.3	6.2	4.4		



Summary and Recommendations:

GNB-5 was removed from the sampling program in 2013. Phosphorus results remain consistent over the sampling years. Spring turnover phosphorus results are generally higher than the yearly mean. Beacon recommends sampling continue to monitor long-term trends.



Area Description:

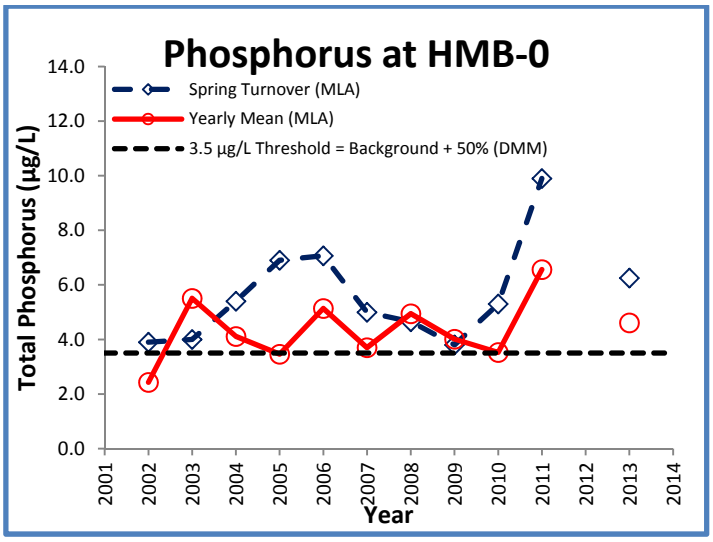
Hamer Bay is a large bay in the northern part of Lake Joseph. This bay receives drainage from a variety of natural and anthropogenic sources. There are three creeks that outlet into the bay, one flows through a large golf course and wetland in the north, and the others through smaller lakes and wetlands. There is a large marina with several parking lots, a resort, and many residential properties along most of the available shoreline. The main basin of Lake Joseph is classified as highly sensitive by the DMM.

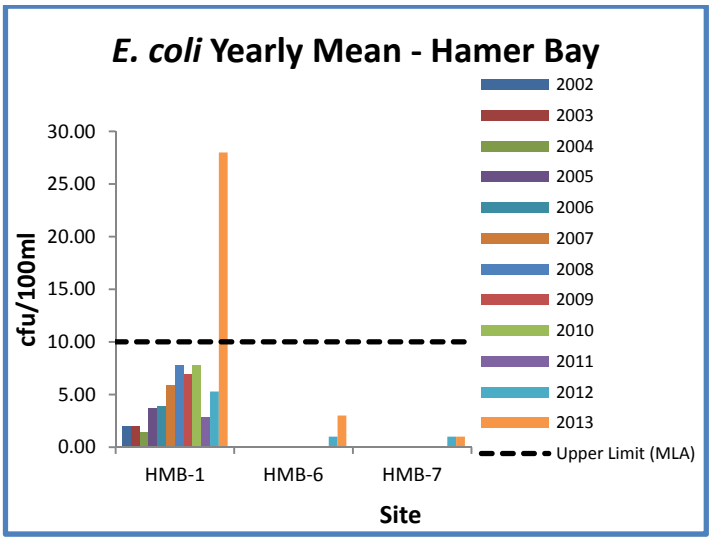
Volunteer Recognition: **Andrew Watson**, Cecil Hayhoe and John Offut.

Hamer Bay (HMB)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliforms
		Spring Turnover	Yearly Mean		
HMB-0	5.93	6.3	4.6		
HMB-1		20.7	8.6		263
HMB-2		6.5	5.6		
HMB-3		6.3	4.8		
HMB-6					77
HMB-7				3	48
HMB-8		21.9	36.1	1	





Summary and Recommendations:

Monitoring started in 2002. HMB-8 was modified to include sampling for DOC to better understand the potential sources of natural phosphorus versus human impacts. DOC analysis will be undertaken in 2014. Phosphorus results remain consistent over the sampling years, however concentrations continue to exceed the DMM threshold of 3.5 µg/L. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

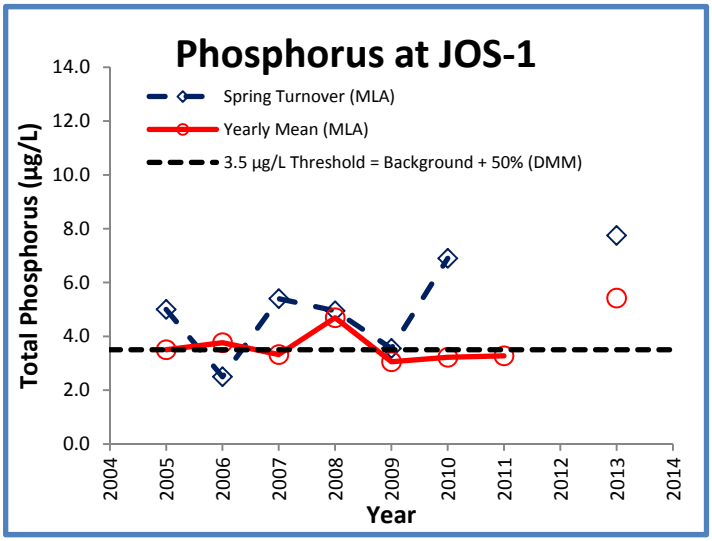
Lake Joseph is a large lake with a surface area of 50.9km² and water depths of up to 60 m. Wetlands account for a small portion of the lake area at about 5%. The lake has various points of inflow and outflow, with drainage from north to south. The Lake Joseph watershed area is 55 km² and has a coldwater fishery. The DMM has classified the main basin of the lake as highly sensitive. Monitoring started in 2005.

Volunteer Recognition: **Andrew Watson**, Cecil Hayhoe and John Offut.

Lake Joseph (JOS)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* (cfu/100 ml) Yearly Mean	Total Coliform (cfu/100 ml)
		Spring Turnover	Yearly Mean		
JOS-1	5.78	7.8	5.4		



Summary and Recommendations:

Phosphorus results remain consistent over the sampling years. That said, the spring turnover and yearly mean phosphorus concentrations are elevated in 2013. No additional analysis was considered in 2013. Particular attention will be paid to the spring results in 2014. Beacon recommends sampling continue to monitor long-term trends. As part the 2014 analysis, data should be obtained from the MOE Lake Partner Program and compared to the MLA results.

Area Description:

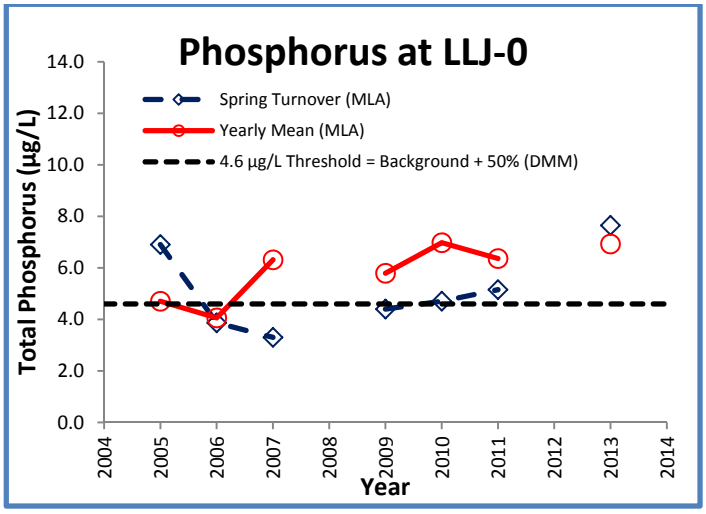
Little Lake Joseph is an isolated arm 2.8 km² in size off the eastern side of Lake Joseph. This is a deep bay with depths of up to 40 m. Most of the shoreline is in a natural state despite many cottages. Three small wetlands outlet into the bay and the DMM has classified Little Lake Joseph as moderately sensitive. Monitoring started in 2005.

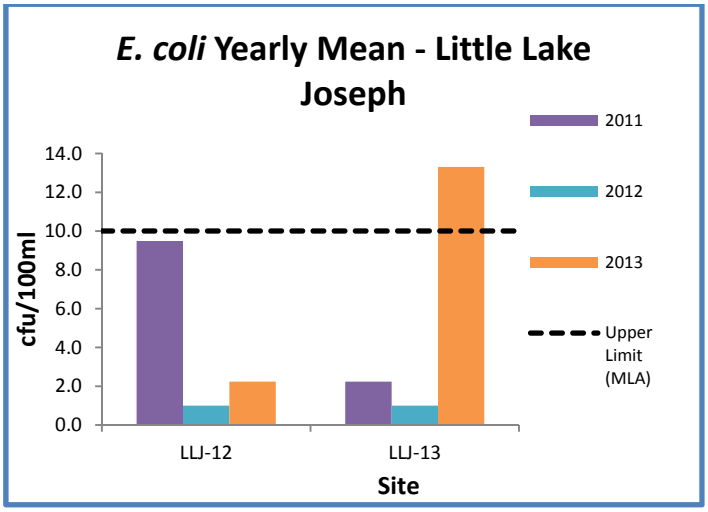
Volunteer Recognition: **Dirk Soutendijk**, Denis Jean-Marie and Westley Begg.

Little Lake Joseph (LLJ)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

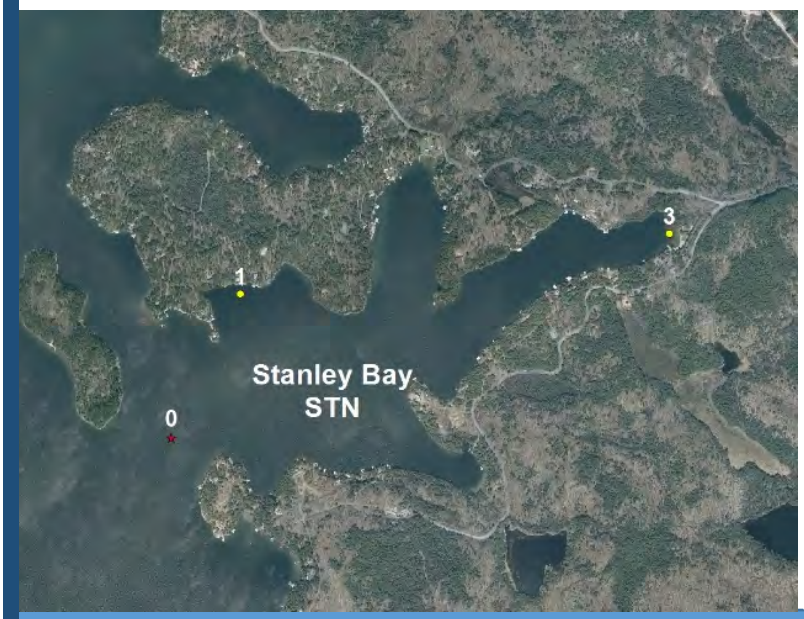
Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
LLJ-0	4.03	7.7	6.9		
LLJ-12				2	18
LLJ-13				13	47





Summary and Recommendations:

Phosphorus concentrations remain consistent over the sampling years, however yearly mean phosphorus levels are over the DMM threshold of 4.6 µg/L in all but two years sampled to date (2005 and 2006). Although *E.coli* results for LLJ-13 in 2013 are above the MLA upper limit, the mean is elevated due to one single sampling result. As a result Beacon recommends continued sampling to monitor long-term trends.



Area Description:

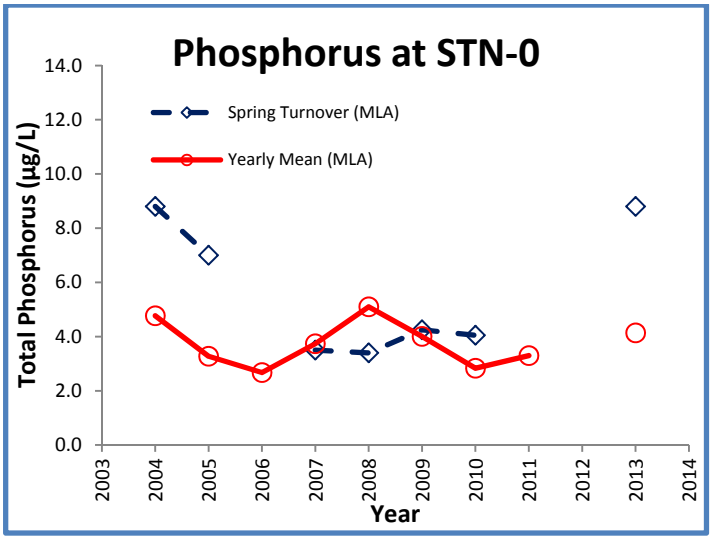
Stanley Bay is located on the north-east side of Lake Joseph. This deepwater bay has evenly distributed development with largely intact forest cover along the shoreline. STN-3 is located in a shallow, sandy area at the end of a small bay where a creek outlets. There are several roads around this bay and a moderate level of residential development, but no marinas, large resorts, commercial development, or agricultural development which could negatively impact water quality.

Volunteer Recognition: **Andrew Watson**, John Offut and Cecil Hayhoe.

Stanley Bay (STN)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
STN-0	6.31	8.8	4.1		
STN-1		6.3	3.5		
STN-3		4.5	3.6		



Summary and Recommendations:

Monitoring started in 2004. Although phosphorus results remain consistent over the sampling years, the 2013 spring phosphorus concentrations is elevated potentially due to spring flooding. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

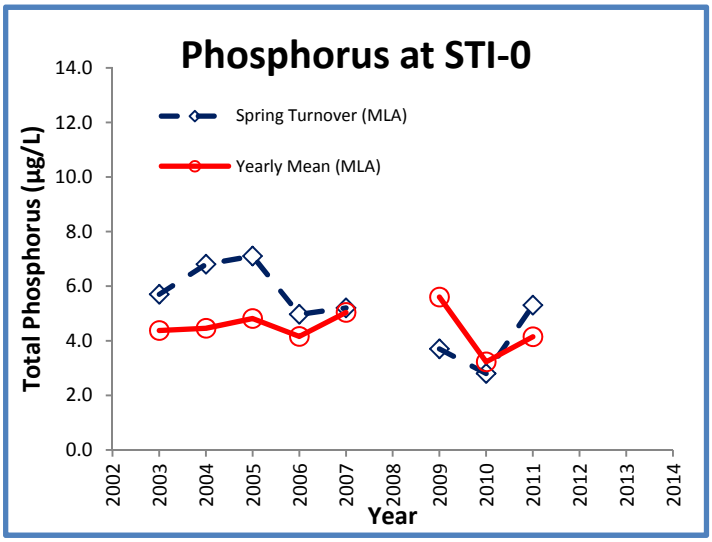
Stills Bay is located in the south-eastern portion of Lake Joseph. Stills Bay is long, narrow, and moderately developed. The southern end of the bay is directly adjacent to highway 169. This bay receives drainage from watercourses that are adjacent to a golf course. There are still large areas of shoreline with mostly intact forests. The main basin of Lake Joseph is classified as highly sensitive by the DMM. Monitoring started in 2003.

Volunteer Recognition: **Joanne Brown, Neil Shaw** and Jane Cragg

Stills Bay (STI)

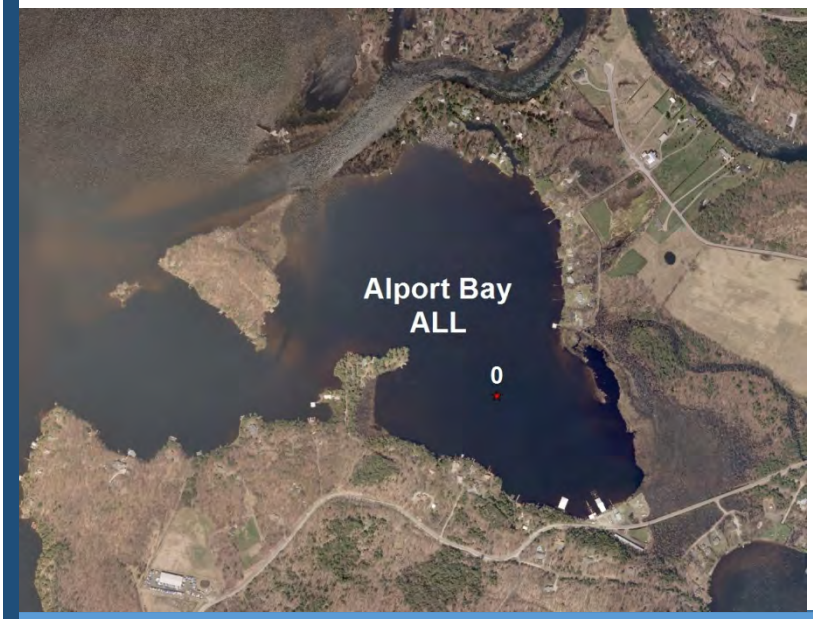
2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
STI-0	3.89		2.9		
STI-2			2.9		



Summary and Recommendations:

No spring samples were acquired in 2013. Phosphorus results were only obtained in 2013 during the August sampling event at both STI-0 and STI-2; both averaged 2.9 µg/L. The results obtained to date are consistently low across the sampling years. Beacon recommends that spring samples be taken in 2014 and a discussion be undertaken regarding the removal of one of the deep water stations at either Stills Bay or Foot's Bay. Beacon further recommends sampling continue to monitor long-term trends.



Area Description:

Alport Bay (also known as Alport Lake) is a small bay in the central part of eastern Lake Muskoka, at the mouth of the Muskoka River. The water quality in Alport Bay is influenced by several natural and man-made features, including a marina in the south, a large wetland as well as agriculture in the east, and inflow from the mouth of the Muskoka River. The inflow from the River is highly influenced by a larger portion of the upstream catchment. Much of the shoreline is developed with a high proportion of the residential properties maintaining manicured lawns and minimal vegetation along the shoreline. Monitoring started in 2013.

Volunteer Recognition: **John Wood**, Chris Blaymires and Rayma Blaymires.

Alport Bay (ALL)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
ALL-0	2.4	8.1			

Summary and Recommendations:

Monitoring started this year as there was concern that this may be a vulnerable area. This first year of baseline data will allow for results to be analyzed for trends in 2014. Beacon recommends sampling continue to establish a database and to monitor long-term trends.

Area Description:

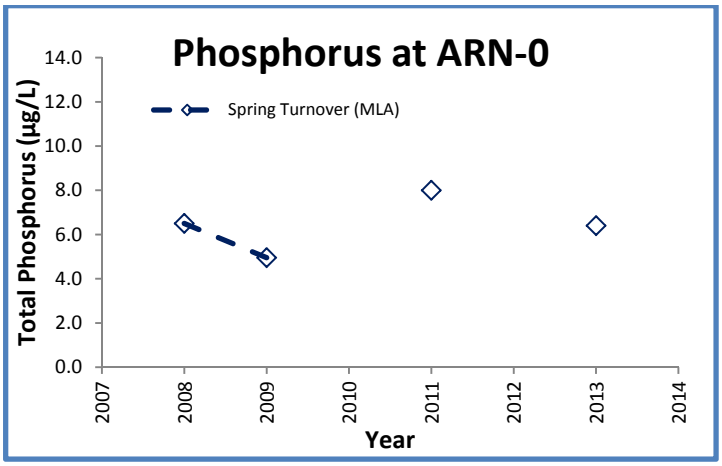
The Arundle Lodge sampling area is in south-central Lake Muskoka, east of Hardy Lake Provincial Park and south of Walker's Point. ARN-0 is located in Skinner Bay, adjacent to Miller Island and Firebrand Island. A creek draining three wetland areas runs along part of Arundle Lodge Rd. and outlets northeast of this site. Monitoring started in 2008.

Volunteer Recognition: **Susan Murphy**, Doug Tate, Stephen Sims and Alistair Sims

Arundle Lodge (ARN)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
ARN-0	3.2	6.4			



Summary and Recommendations:

With only spring phosphorus data, yearly trends and seasonality are difficult to rationalize. Beacon recommends discussions with MLA committee regarding additional sampling through the year.

Area Description:

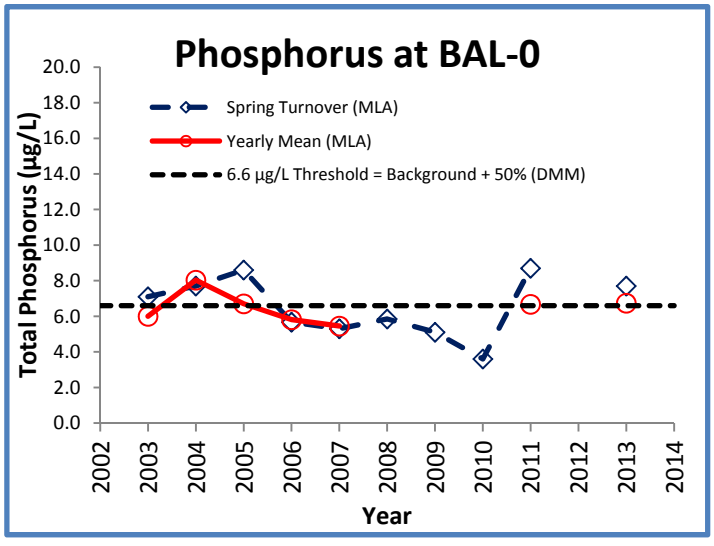
Bala Bay is a large isolated bay in the eastern part of Lake Muskoka. Most of the bay is densely developed but there is intact forest cover along most of the shoreline area. Drainage from the village of Bala does enter the bay along the western shore. The entire Muskoka River Watershed drains through Bala Bay into the Moon River System. There are also two small wetlands that drain into the bay. Monitoring started in 2003.

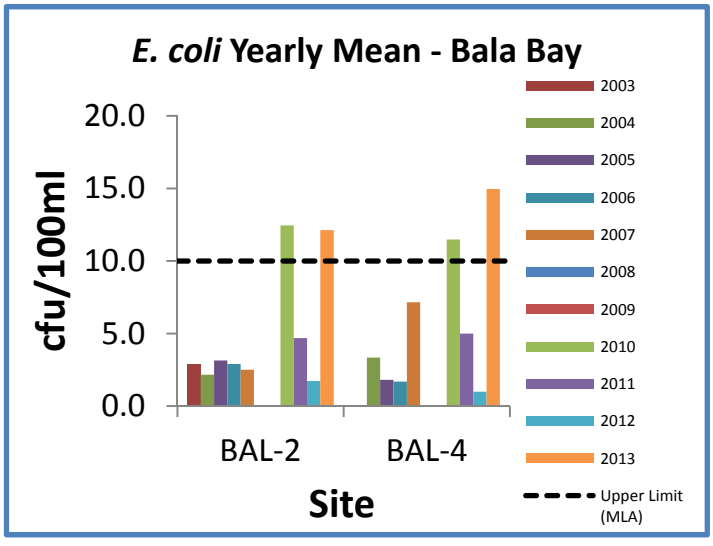
Volunteer Recognition: **Peter Joel** and Alan Hutton.

Bala Bay (BAL)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
BAL-0	3.5	7.7	6.7		
BAL-2				12	131
BAL-4				15	78





Summary and Recommendations:

Phosphorus results remain consistent over the sampling years and generally in the range of the DMM threshold of 6.6 µg/L. The *E.coli* results were elevated in 2013 during the June sampling event, therefore causing the elevated mean values. The *E.coli* counts in the remainder of the year were all below the MLA upper limit. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

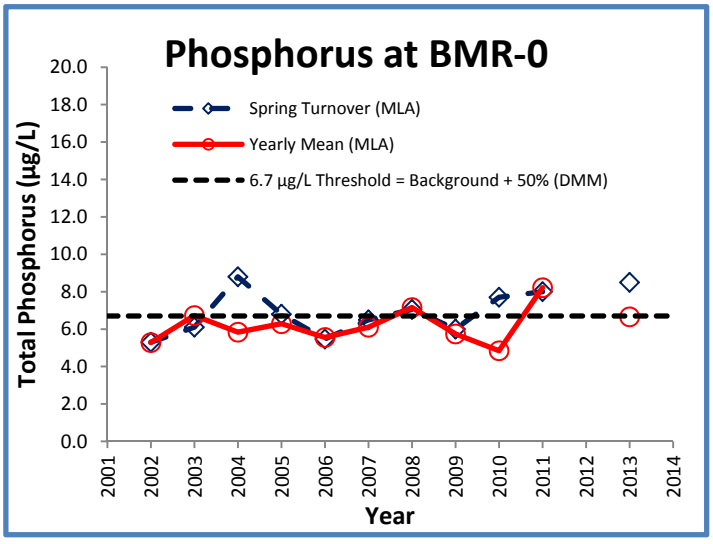
This island is in the Milford Bay area of northeastern Lake Muskoka is approximately 132 ha in size. A golf course takes up much of the island, which is associated with a small private club and marina. Most of the natural shoreline vegetation is intact, but there are many large boathouses in this area. There is a large wetland to the east where the causeway links mainland and the island. Monitoring started in 2002.

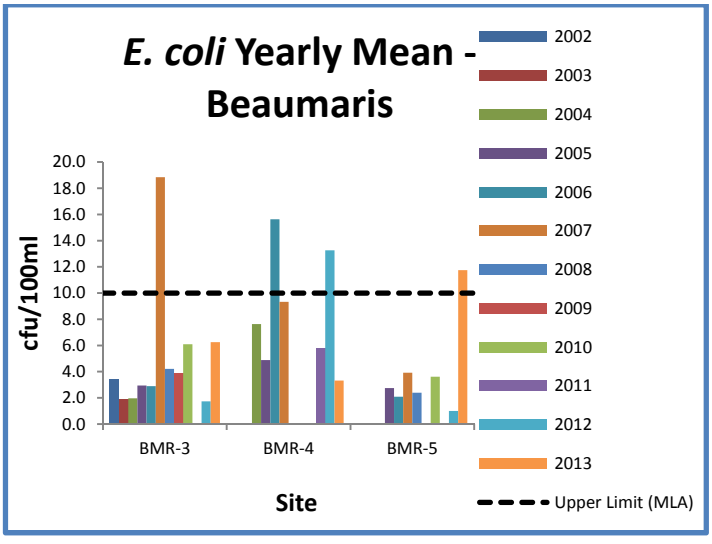
Volunteer Recognition: **Louise Cragg**, Chris Cragg, Allan Flye, Don Furniss and Eliza Nevin.

Beaumaris (BMR)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
BMR-0	2.98	8.5	6.7		
BMR-2		7.3	5.9		
BMR-3				6	107
BMR-4		10.2	7.5	3	97
BMR-5				12	86
BMR-6		20.0	10.8		





Summary and Recommendations:

Phosphorus results remain consistent over the sampling years, and the yearly mean is at or below the DMM threshold of 6.7 µg/L with the exception of 2011. Spring turnover phosphorus at BMR-4 and BMR-6 were elevated, potentially due to spring flooding of the golf course. The *E.coli* were elevated during the June 2013 event at BMR-5, otherwise results were below the MLA upper limit. Beacon recommends sampling continue to monitor long-term trends and further investigations be undertaken in 2014 to understand the elevated levels of bacteria.

Area Description:

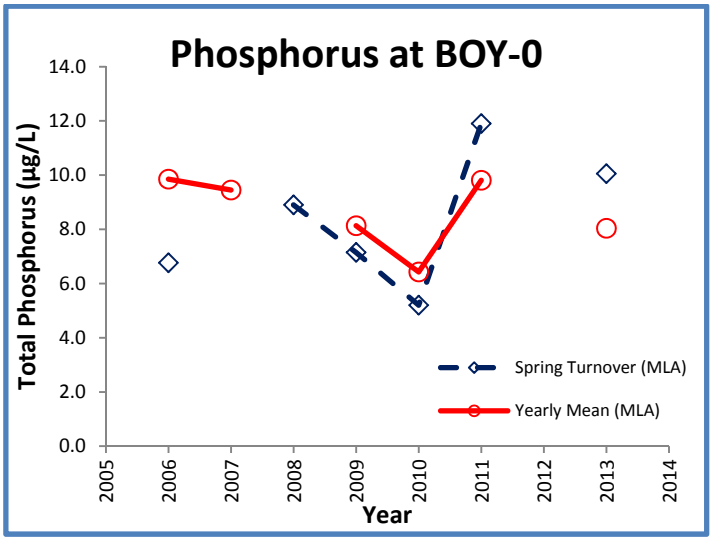
Boyd Bay is a small bay in the central part of eastern Lake Muskoka. The water quality in Boyd Bay is influenced by several natural and man-made features, including a marina in the southeast, a large wetland in the north, Highway 118 to the east and several inflowing creeks. The creeks that drain into the bay are potentially influenced by agricultural areas. Much of the shoreline is developed and many residential properties have manicured lawns along the shoreline. Monitoring started in 2006.

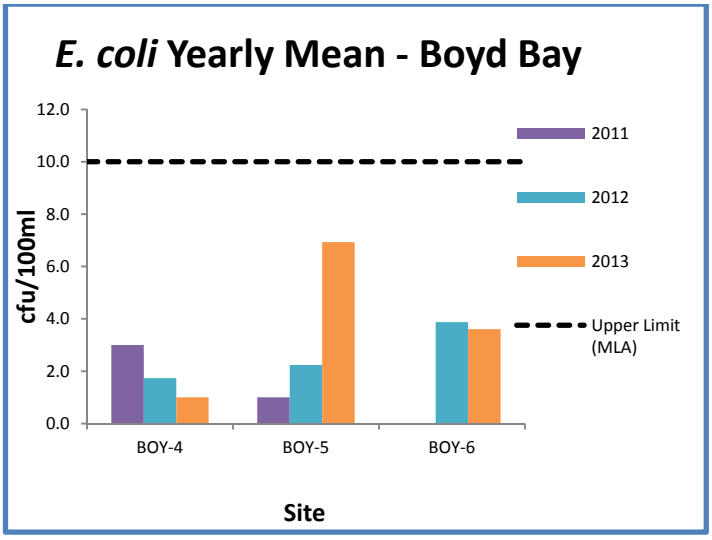
Volunteer Recognition: **John Wood**, Chris Blaymires, Rayma Blaymires, Lynn Langford and Dave Langford.

Boyd Bay (BOY)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
BOY-0	2.65	10.1	8.0		
BOY-3		12.0	8.9		
BOY-4		10.0	7.7	1	23
BOY-5		9.6	7.3	7	75
BOY-6				4	57





Summary and Recommendations:

Phosphorus concentrations fluctuated in 2010 and 2011 and in 2013 returned to a similar level to those recorded in 2006, 2007 and 2009. The mean *E. coli* levels continue to be well below the MLA upper limit of 10 cfu/100ml. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

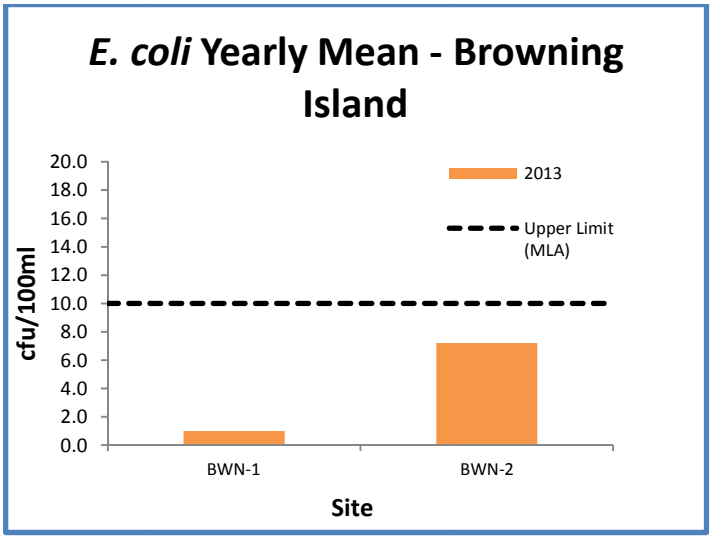
Browning Island is one of the largest islands in the Muskoka Lakes. In the late 1800s the island was stripped of its white pine. Portions of the island were then farmed (cattle, sheep and crops). The central portion of the island remains undeveloped. Through a number of donations, 338 acres of the island consists of the Browning Island Nature Reserve. Two of the sheltered bays were added to the MLA sampling program in 2013 due to concern that they may be vulnerable areas.

Volunteer Recognition: **Heather Ryder**, Stephanie Ryder and Courtney Ryder.

Browning Island (BWN)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
BWN-1				1	4
BWN-2				7	25



Summary and Recommendations:

Monitoring started in 2013. *E.coli* results will be analyzed in 2014. Beacon recommends sampling continue to establish a database and to monitor long-term trends.

Area Description:

Dudley Bay is located in eastern Lake Muskoka, and is approximately 3.6 km² in size with a maximum depth of 20 m. It is considered moderately developed, with primarily residential properties and several roads, including Highway 169, that are in close proximity to the shoreline. Several creeks and wetlands drain into the bay, including that from the cranberry marsh. Dudley Bay is classified as moderately sensitive by the DMM. Monitoring started in 2005.

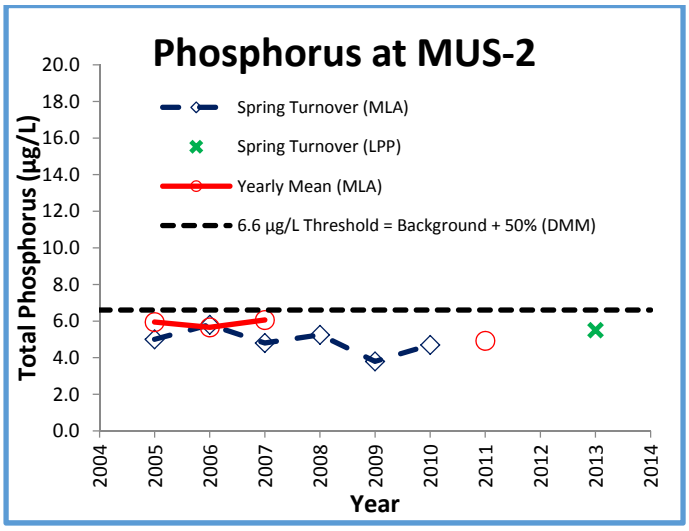
Volunteer Recognition: **Eleanor Lewis, Jim Lewis and Benjamin Butler.**

Dudley Bay (MUS-2)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MUS-2*		5.5			

*Data from Lake Partners Program (MOE)



Summary and Recommendations:

Phosphorus results are continually below the 6.6 µg/L DMM threshold. The MLA relied on the Lake Partner Program for the spring phosphorus concentrations in 2013. Beacon recommends that the MLA rely on the Lake Partner Program data when it is available, otherwise the MLA should continue to monitor this location to analyse long-term trends.

Area Description:

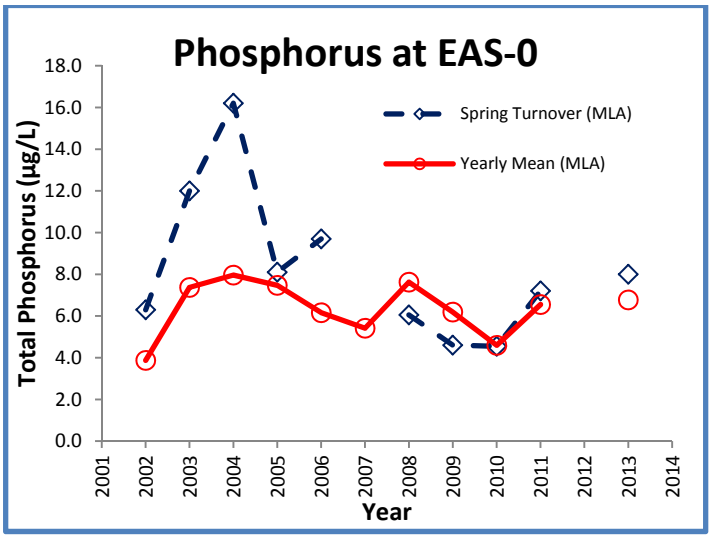
East Bay is in the western portion of Lake Muskoka and is part of Hardy Lake Provincial Park. This is a low development area with very few cottages/residences and no access roads. Several long narrow bays form the drainage area where five creeks outlet into the main bay from the park. These creeks also drain wetland areas into East Bay. Monitoring started in 2002.

Volunteer Recognition: **Louise Cragg**, Jan Getson, Lloyd Walton and Gary Getson.

East Bay (EAS)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
EAS-0	4.14	8.0	6.8		
EAS-1		6.7	6.2		
EAS-2		10.7	8.7		
EAS-3		7.3	6.7		



Summary and Recommendations:

Phosphorus concentrations at EAS-0 generally remain low over the sampling years and relatively static in the last 7 years. Beacon recommends continued sampling to monitor long-term trends.

Area Description:

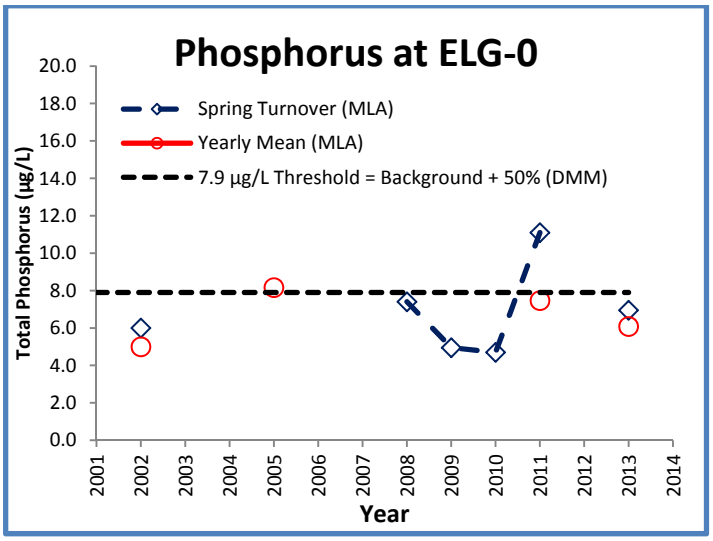
Eilean Gowan Island is located in the eastern part of Lake Muskoka and is largely developed with residential cottages. Most of these properties appear to retain a well-vegetated shoreline with the exception of a few lawns and tennis courts directly adjacent to the lake. The interior of this island is completely forested and a small stream outlets from the upland area at sampling site ELG-1. Monitoring started in 2002.

Volunteer Recognition: **Susan Murphy**, Doug Tate, Stephen Sims, Alistair Sims and Beth Tate.

Eilean Gowan Island (ELG)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
ELG-0	3.1	7.0	6.1		



Summary and Recommendations:

Phosphorus results are a bit sporadic at this location. Although scheduled, no bacteria samples were acquired in 2013 at ELG-4. Beacon recommends that spring samples are taken in 2014 and a discussion be undertaken regarding the consistency of this long-term sampling program.

Area Description:

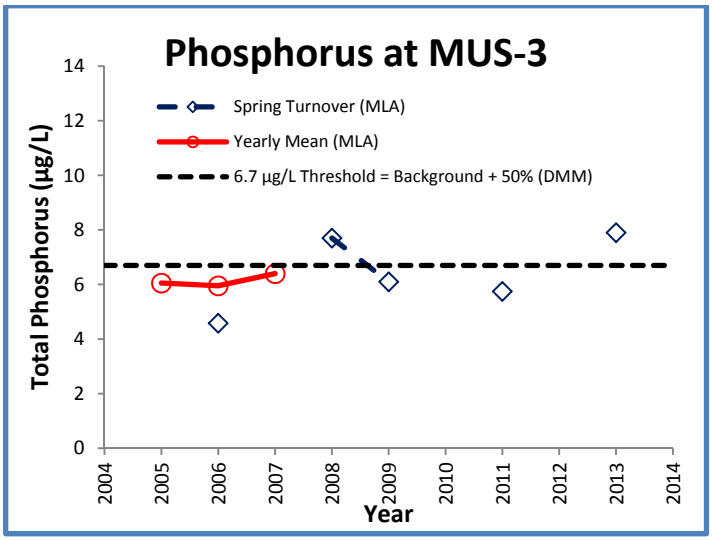
With a surface area of approximately 121 km^2 and water depths of up to 73 m, Lake Muskoka is the largest inland lake within the District of Muskoka. The Lake Muskoka watershed area is 4600 km^2 and approximately 10.5% of the watershed is covered by wetlands. The lake has various points of inflow and outflow, most notably being the outflow into the Moon River. Monitoring started in 2005.

Volunteer Recognition: **John Wood**, Chris and Rayma Blaymires.

Lake Muskoka (MUS-3)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MUS-3	3.1	7.9			



Summary and Recommendations:

Phosphorus results remain consistent with the DMM threshold over the sampling years. Only spring phosphorus samples were acquired in 2013. Beacon recommends that spring sampling continue to monitor long-term trends.

Area Description:

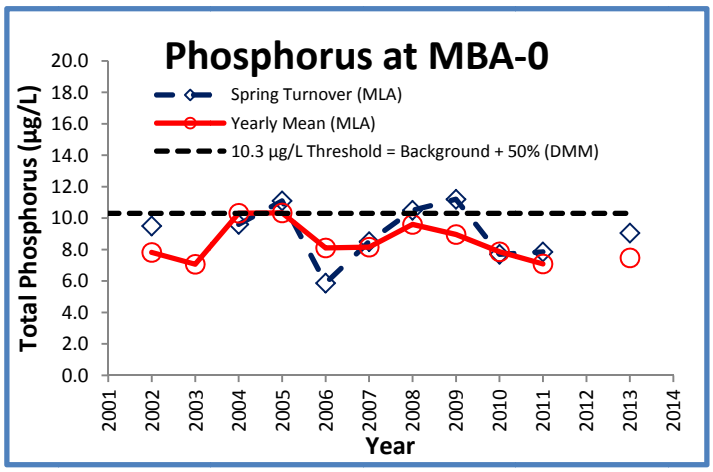
Muskoka Bay is the southernmost bay in Lake Muskoka. The bay has a long history of industrial uses and nutrient issues. While water quality in the bay has improved dramatically since the 1970s, it is still classified as moderately sensitive and over threshold by the DMM. Although the bay has a high intensity of development, 80% of the shoreline is presently in a natural state. The southern end of this bay includes a large commercial development and is the receiver of most of Gravenhurst's urban storm water. Several creeks outlet into the bay and wetlands account for 9.4% of the shoreline. Monitoring started in 2002.

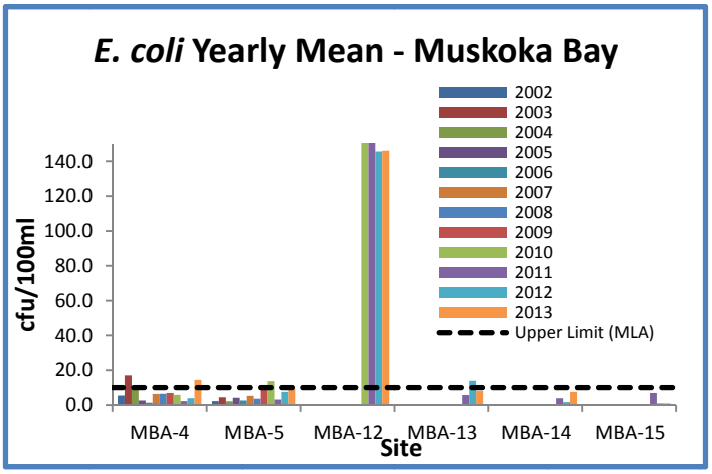
Volunteer Recognition: **Brian Yeates**, George Genereux, Diane Yeates, Karen Abell and Matthew Mammoliti.

Muskoka Bay (MBA)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MBA-0	4.1	9.1	7.5		
MBA-4				14	92
MBA-5				9	678
MBA-12		15.0	15.0	146	876
MBA-13		8.4	7.3	8	93
MBA-14				8	123
MBA-15				1	31





Summary and Recommendations:

Monitoring started with the original program in 2002. Phosphorus concentrations generally remain below or at the DMM threshold level through the sampling years. Although elevated levels of E. coli are expected at MBA-12, an investigation of the source(s) is recommended. Beacon further recommends that all sampling be continued to monitor long-term trends.

Area Description:

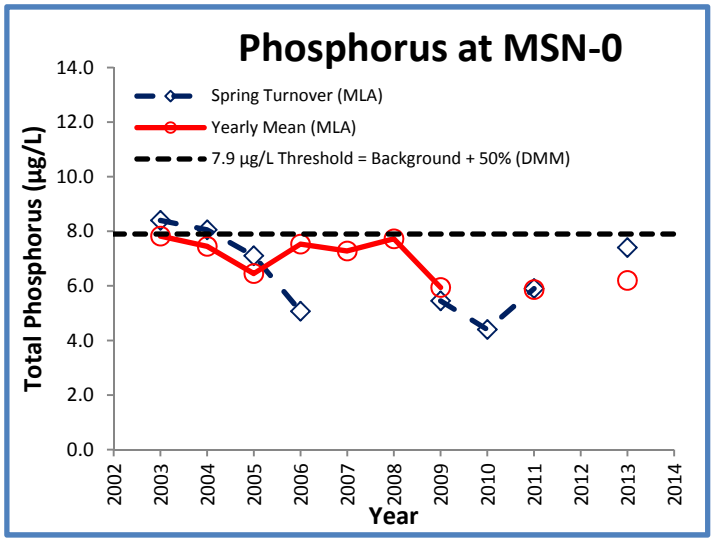
The Muskoka Sands sampling area is located in southeastern Lake Muskoka at the confluence with the Hoc Roc River. This area has a high intensity of development with a large resort and golf course, along with a high density of residential properties and roads adjacent to the lake. The Hoc Roc River flows through agricultural, industrial, residential, and natural wetland areas before it drains into a shallow bay. Dominant northwest winds and a considerable fetch would subject this area to heavy onshore wave action. Monitoring started in 2003.

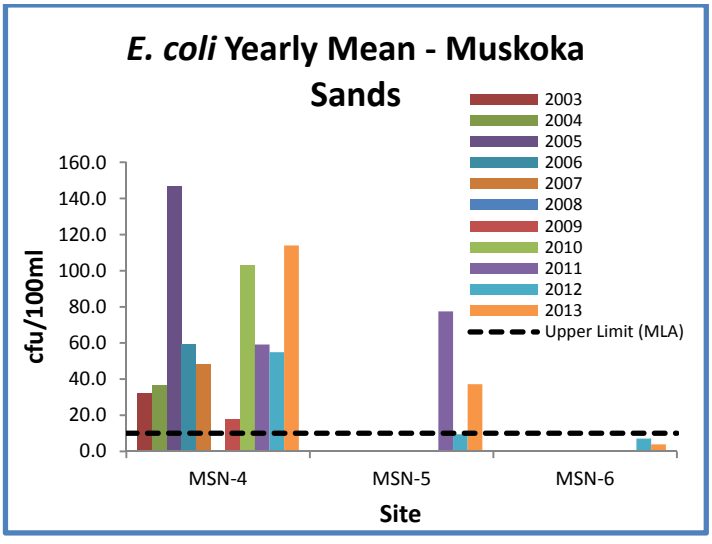
Volunteer Recognition: **Al Ward** and Carol Ward

Muskoka Sands (MSN)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MSN-0	3.54	7.4	6.2		
MSN-4		44.9	28.4	114	136
MSN-5		17.8	22.4	37	116
MSN-6				4	38





Summary and Recommendations:

Phosphorus results at the deep-water station remain generally at or below the DMM threshold through the sampling years. Nearshore sampling locations have consistently higher levels of phosphorus through 2013. MSN-4 and MSN-5 continue to have high *E. coli* results while MSN-6 remains below the MLA upper limit. Beacon recommends that sampling continue to monitor long-term trends.

Area Description:

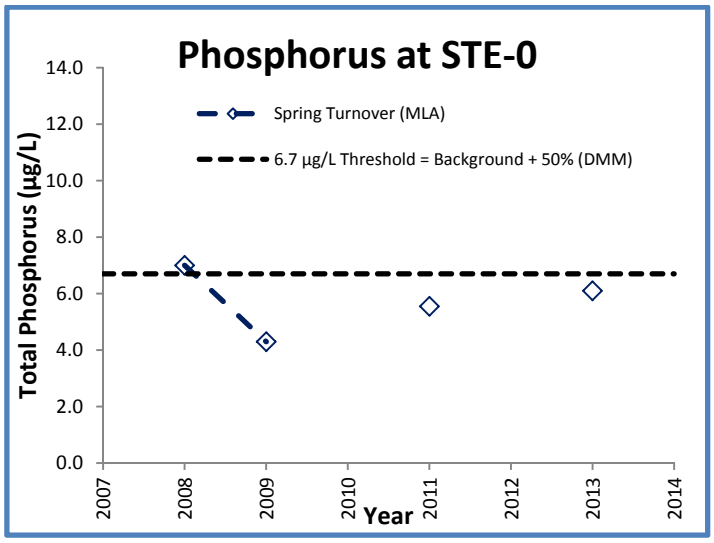
Stephen's Bay is a small bay in the central part of eastern Lake Muskoka, south of the mouth of the Muskoka River. The water quality in Alport Bay is influenced by input from adjacent wetlands as well as agriculture in the east, and public beaches (Strawberry Bay and Kirby's). Much of the shoreline is developed. Monitoring started in 2013 due to concern this may be a vulnerable area.

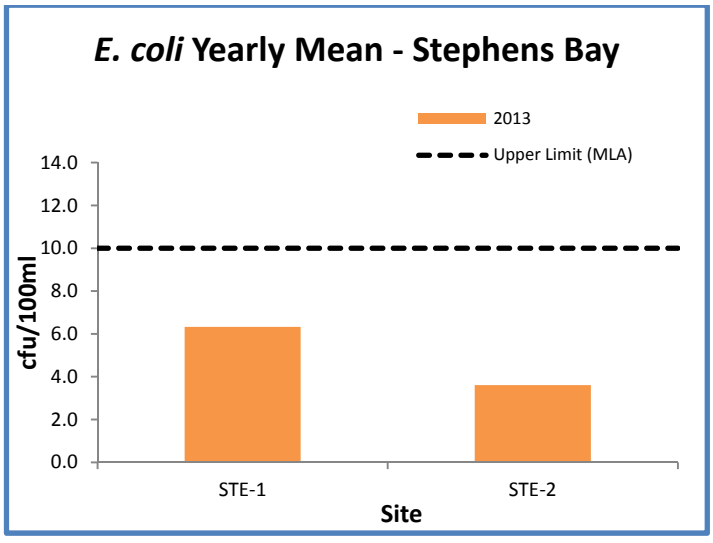
Volunteer Recognition: **John Wood**, Chris Blaymires, Rayma Blaymires, Bob Kerton, Bari Kerton, Rob Kerton and Derek Kerton.

Stephens Bay (STE)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	July 2013 Mean		
STE-0	2.65	6.1			
STE-1			5.7	6	164
STE-2			3.7	4	98





Summary and Recommendations:

Monitoring started in 2008. Spring phosphorus results at the deep-water location remain at or slightly below the DMM threshold over the sampling years. The STE-1 and STE-2 sampling locations are new in 2013 and Beacon recommends that sampling continue to establish and monitor long-term trends.

Area Description:

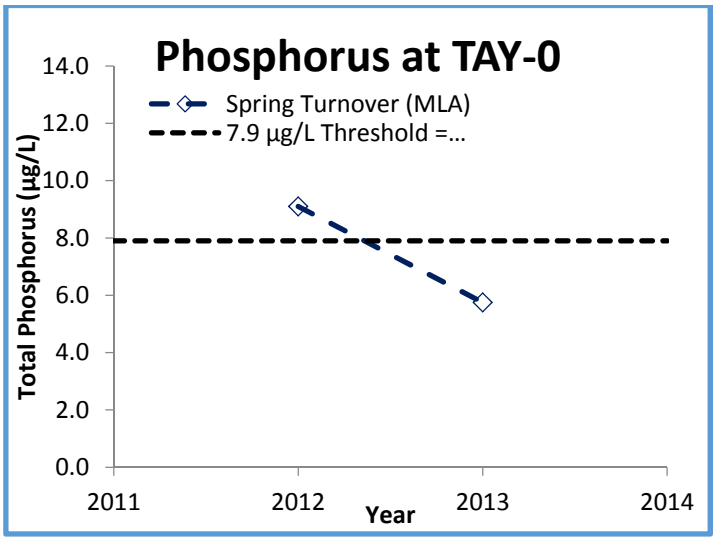
Taylor Island is in the main basin of Lake Muskoka and is approximately 76 ha in size. Development intensity in this area is considered moderate to high; however, most of the natural shoreline vegetation appears to be intact. This area has few lacustrine wetlands. Two streams originating in wetlands, outlet into the lake in this area. TAY-2 is located adjacent to a marina. Monitoring started in 2012.

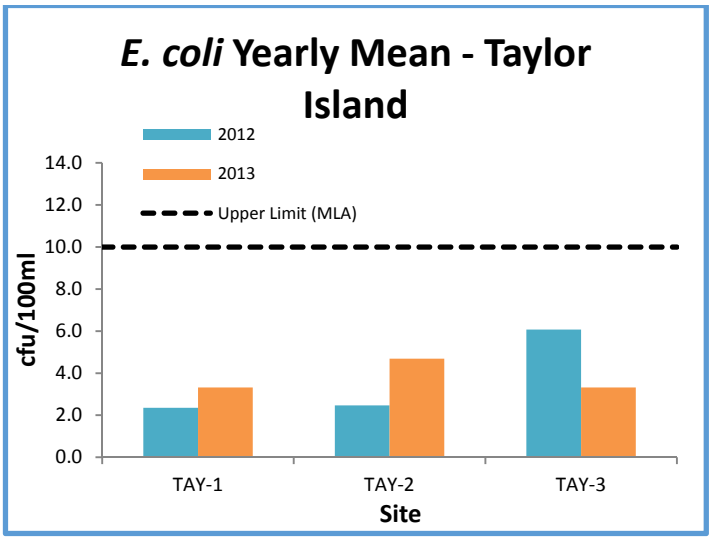
Volunteer Recognition: **Al Ward**, Brian Ruby, Matt Ruby, Sam Niebergall, Naomi Ruby and Jackson Ruby.

Taylor Island (TAY)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
TAY-0	3.71	5.8	5.4		
TAY-1				3	55
TAY-2		5.8	5.6	5	33
TAY-3				3	59





Summary and Recommendations:

Beacon recommends that sampling continue to establish a base to monitor long-term trends.

Area Description:

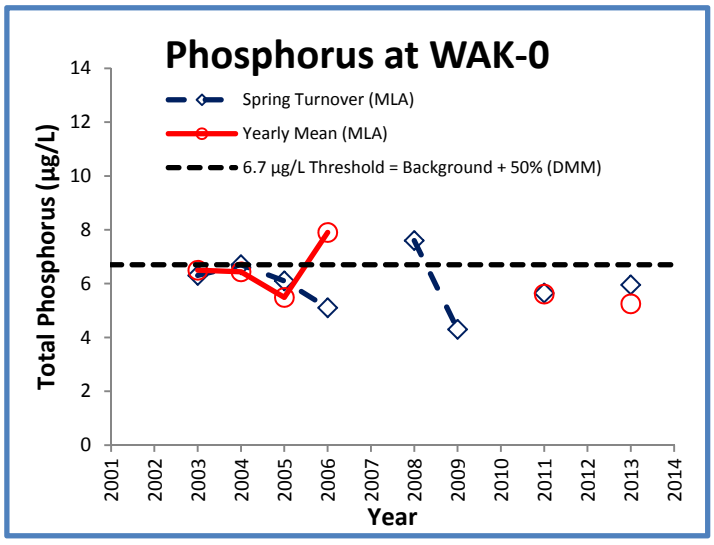
The Walker's Point sampling area is in south-central Lake Muskoka, East of Hardy Lake Provincial Park and west of Browning Island. WAK-0 is located off the tip of Walkers Point, near the mouth of Walkers Bay. A single creek outlets in Walkers Bay. The sampling area includes the bay to the north that contains the outlet of a creek which drain a series of wetlands.

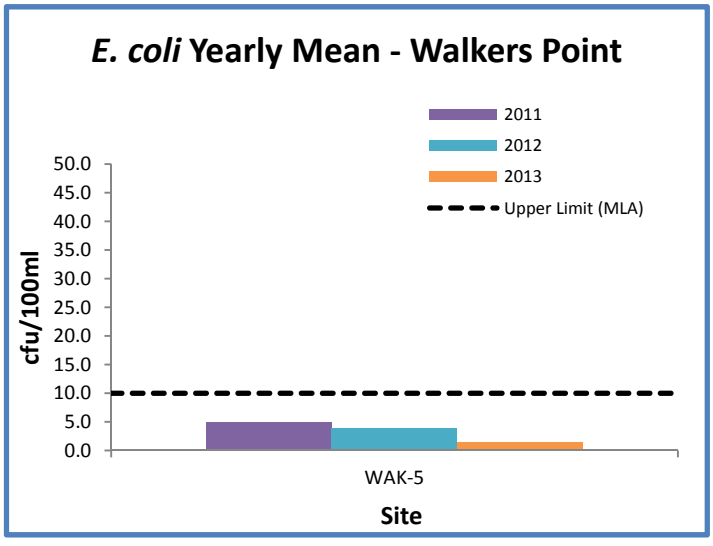
Volunteer Recognition: **Susan Murphy**, Doug Tate, Stephen Sims, Alistair Sims and Beth Tate.

Walker's Point (WAK)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
WAK-0	3.1	6.0	5.3		
WAK-5				1	39





Summary and Recommendations:

Monitoring started in 2003. Phosphorus results at the deep-water station remain generally at or below the DMM threshold over the sampling years. Nearshore sampling location WAK-5 continues to have low *E. coli* results through 3 years. Beacon recommends that sampling continue to monitor long-term trends at WAK-0 and that the *E. coli* levels at WAK-5 be analysed at the end of 2014 with the potential of discontinuing this site if levels remain low.

Area Description:

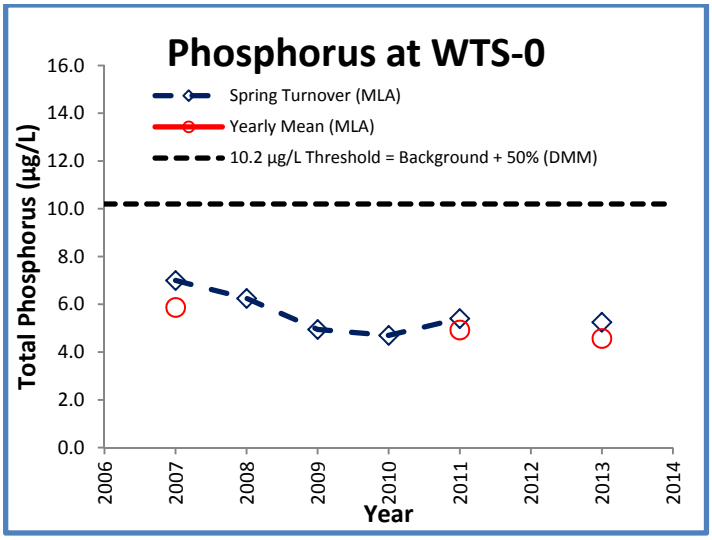
Whiteside Bay is a partially isolated bay in the northwestern portion of Lake Muskoka. It is moderately developed with cottage/residential properties and has roadways that come in close proximity to the shoreline in several areas. Inflow into the lake comes from two creeks, one of which originates in an extensive wetland complex to the north. Monitoring started in 2007.

Volunteer Recognition: **Eleanor Lewis**, Jim Lewis and Benjamin Butler.

Whiteside Bay (WTS)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
WTS-0	3.3	5.3	4.6		



Summary and Recommendations:

Phosphorus results at the deep-water station are consistently below the DMM threshold over the sampling years. Beacon recommends that sampling continue to monitor long-term trends.

Area Description:

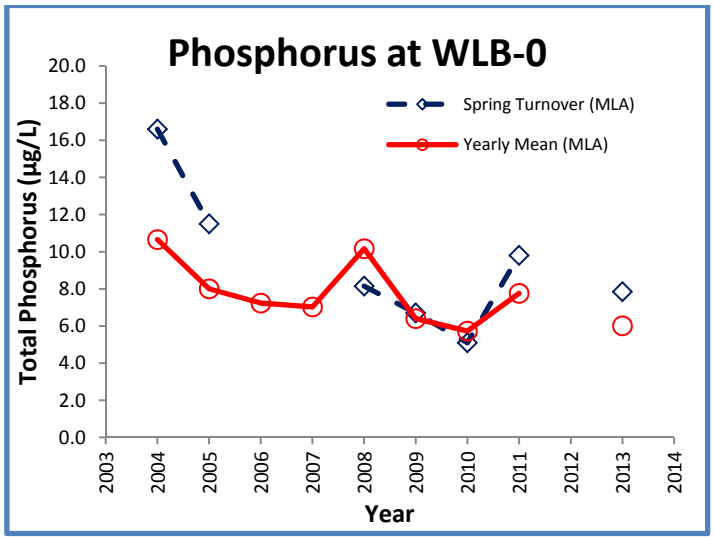
The Willow Beach sampling area encompasses a highly developed section of shoreline. There is a newly re-developed resort complex, a wetland with a creek flowing through a nine-hole golf course and several larger properties with limited retained forest cover. Highway 118 is in close proximity to the shoreline along much of this reach. Monitoring started in 2004.

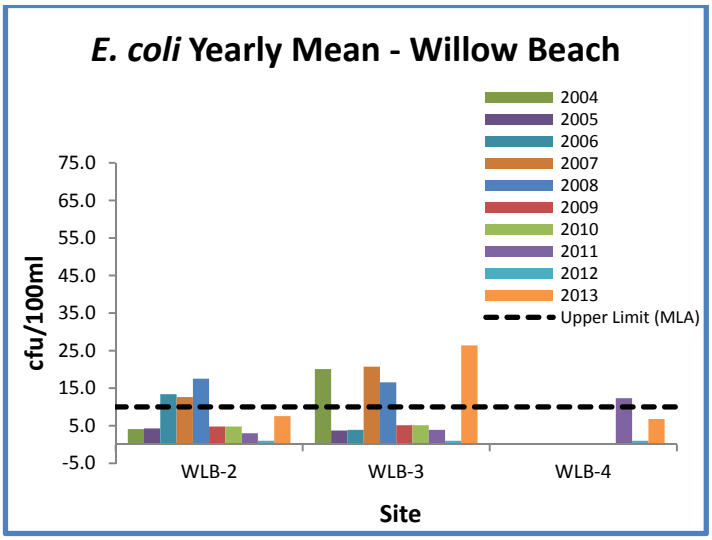
Volunteer Recognition: **John Wood**, Louise Cragg, Debbie Hastings, Chris Cragg and Rick Durst.

Willow Beach (WLB)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
WLB-0	3.59	7.9	6.0		
WLB-2		7.8	6.2	8	166
WLB-3				26	707
WLB-4				7	321





Summary and Recommendations:

Phosphorus concentrations at the deep-water station in 2013 remained low, consistent with the general yearly trend. Nearshore sampling at location WLB-3 on June 28 and July 26 resulted in very high levels (2424) of *total coliform* with the June retest results showing 206 cfu/100ml. The *E. coli* levels were elevated at the same time, although not as dramatically. Beacon recommends that particular attention be paid to these nearshore sites in 2014 and that sampling continue to monitor long-term trends.

Area Description:

Arthurlie Bay is in the southern basin of Lake Rosseau. The bay is quite shallow in the southern end. Development intensity is considered moderate to high, with some shoreline properties having extensive cleared areas. This bay has several lacustrine wetlands, some of which appear to be partially filled. One creek drains into the bay, flowing through agricultural land prior to entering the lake. Monitoring started in 2002.

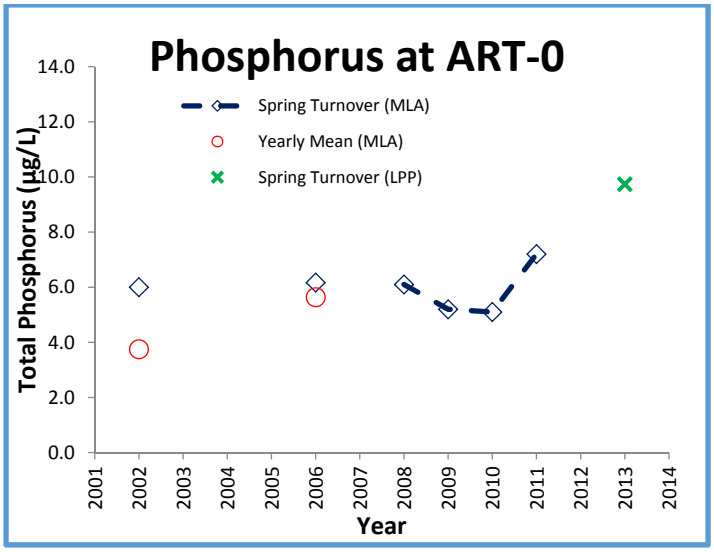
Volunteer Recognition: **Peter** and **Katherine Seybold**.

Arthurlie Bay (ART)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
ART-0*		9.7			

*Data from Lake Partners Program (MOE)



Summary and Recommendations:

Phosphorus results remain generally low, although visually are trending upward. Beacon recommends that the MLA rely on the Lake Partner Program data when it is available, otherwise because of the increasing development pressure in the bay, the MLA should continue to monitor this location to analyse long-term trends.

Area Description:

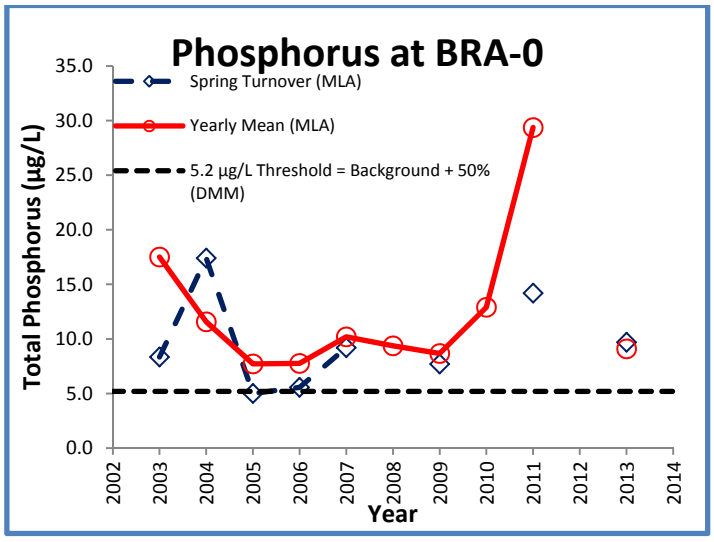
Brackenrig Bay is located in southern Lake Rosseau, is approximately 0.44 km² in area and has a maximum depth of 3 m. This isolated bay is moderately developed with residential properties. Approximately 20% of the immediate shoreline has been altered with over 60% of backlot areas cleared of natural forest. Four creeks drain into the bay, one of which flows through an agricultural area adjacent to a garden center before entering the lake. Brackenrig road comes in close proximity to the lake along the northeast shoreline. Brackenrig Bay has been classified as moderately sensitive and over-threshold by the DMM. Monitoring started in 2003.

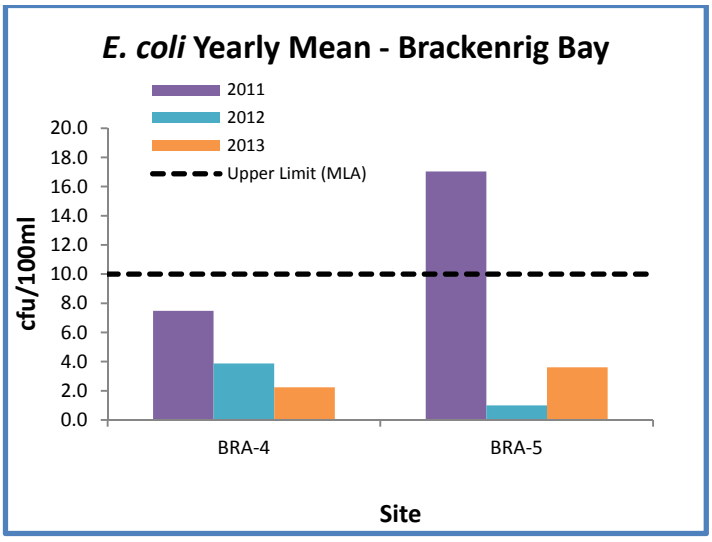
Volunteer Recognition: **Judy Stephens-Wells** and Ross Wells.

Brackenrig Bay (BRA)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
BRA-0	2.62	9.7	9.1		
BRA-3		9.5	9.0		
BRA-4				2	85
BRA-5				4	200





Summary and Recommendations:

Phosphorus results remain consistently high over the sampling years, and the yearly phosphorus mean continues to be above the DMM threshold of 5.2 µg/L each year. The *E.coli* levels were below 4 cfu/100ml at both BRA-4 and BRA-5 in 2013. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

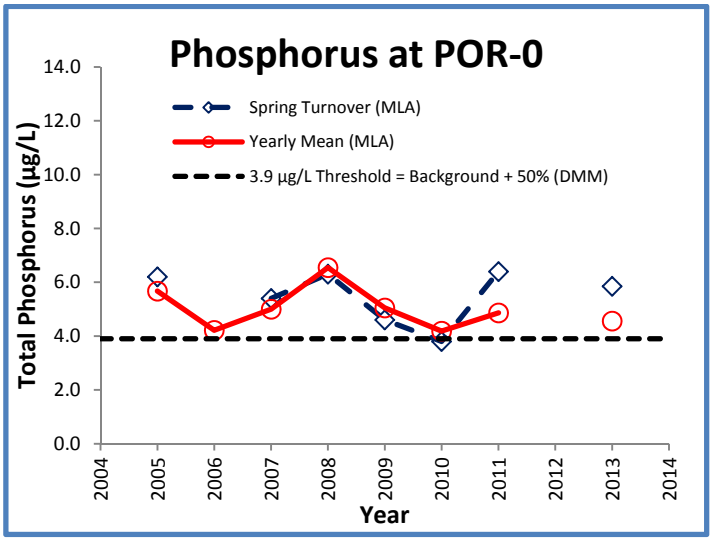
East Portage Bay is located in eastern Lake Rosseau, has an area of approximately 1.33 km², and reaches a maximum depth of 12 m. This moderately developed bay has many roads, with several areas directly adjacent to the shoreline. There is also a large agricultural area adjacent to the northern shoreline of the bay. No creeks outlet into the bay and there are no wetlands draining from the upper watershed. East Portage Bay has been classified as highly sensitive and over threshold by the DMM. Monitoring started in 2005.

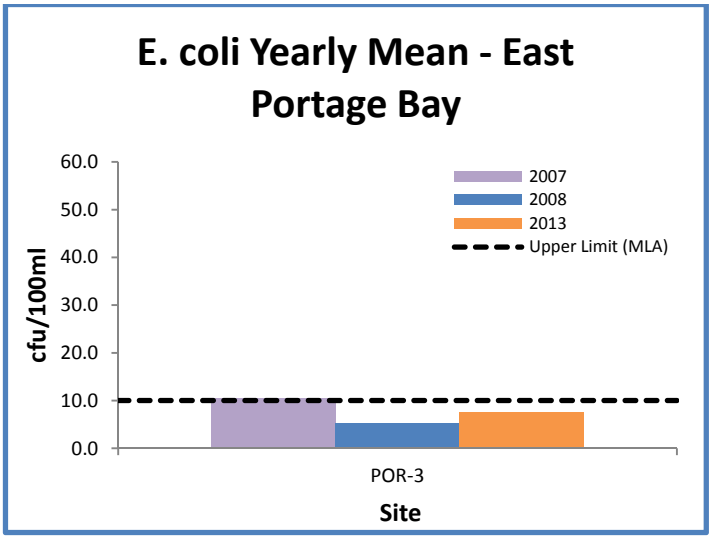
Volunteer Recognition: **Lawton Osler, Katherine Seybold,** Marjorie Henke, Catherine LeBoeuf and Bill Harvey.

East Portage Bay (POR)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
POR-0	4.36	5.9	4.6		
POR-1		5.9	4.5		
POR-2		5.7	4.5		
POR-3		7.0	6.5	8	50
POR-4		6.7	5.1		
POR-5		6.7	5.1		





Summary and Recommendations:

Phosphorus concentrations remain consistently above the DMM threshold of 3.9 µg/L over the sampling years. The yearly mean *E.coli* levels at POR-3 remain below the MLA upper limit. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

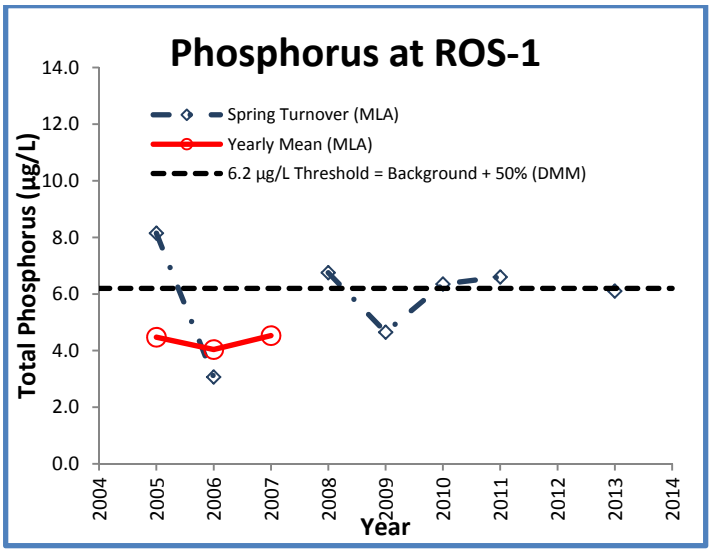
The main basin of Lake Rosseau is approximately 55.5 km² in area with a maximum depth of 60 m. The lake is classified as a coldwater lake, and supports a naturally reproducing population of Lake Trout. Wetlands account for 5% of the upper watershed. The Lake Rosseau watershed, excluding the lake itself is 204.5 km². The DMM has classified the lake as moderately sensitive. Monitoring started in 2005.

Volunteer Recognition: **Katherine Seybold**, Peter Seybold, Drew Purdy and Cameron Purdy.

Lake Rosseau (ROS)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
ROS-1	3.8	6.1			



Summary and Recommendations:

Phosphorus concentrations remain consistent with the DMM threshold over the sampling years. Only spring phosphorus samples were acquired in 2013. Beacon recommends that spring sampling continue to monitor long-term trends.

Area Description:

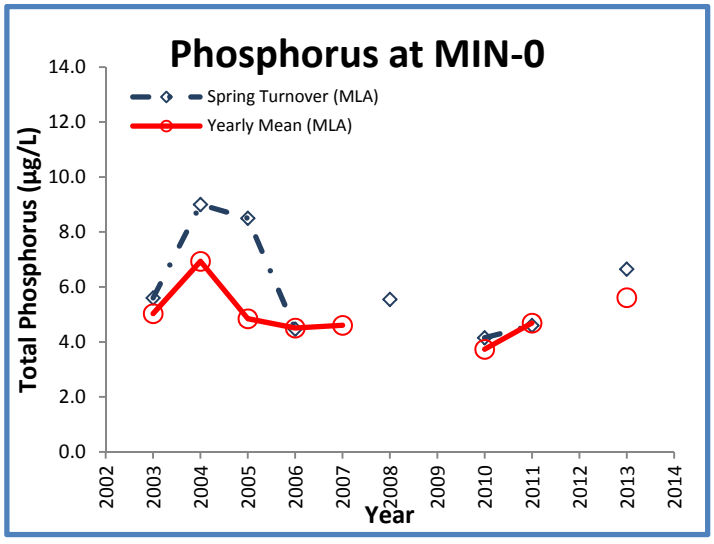
The village of Minett is located in western Lake Rosseau, and has four sampling sites. Sampling sites were selected with the intention of monitoring the potential effects of high intensity development in this bay. The area contains two large resorts with golf courses, several roads, a marina, and many private residential properties. There is one wetland adjacent to the lake and several other small ones in the area of the bay. Monitoring started with the original program in 2003.

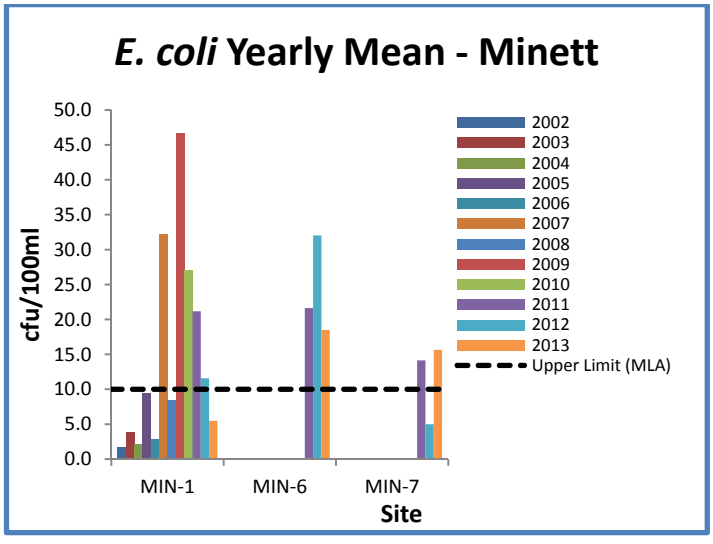
Volunteer Recognition: **Laurie Thomson**, Lauren Chisholm and Taylor Thomson.

Minett (MIN)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MIN-0	4.18	6.7	5.6		
MIN-1		7.4	5.7	5	81
MIN-6		13.8	18.2	18	106
MIN-7		10.1	6.5	16	81





Summary and Recommendations:

Phosphorus concentrations have remained generally consistent through the sampling years. Although the 2013 geometric *E. coli* yearly mean at MIN-6 is low, the August sampling and subsequent resampling resulted in E. coli counts exceeding 1,000 cfu/100ml. A reconnaissance of the area was undertaken. Beacon recommends further investigation of this source in 2014 and recommends that all sampling be continued to monitor long-term trends.

Area Description:

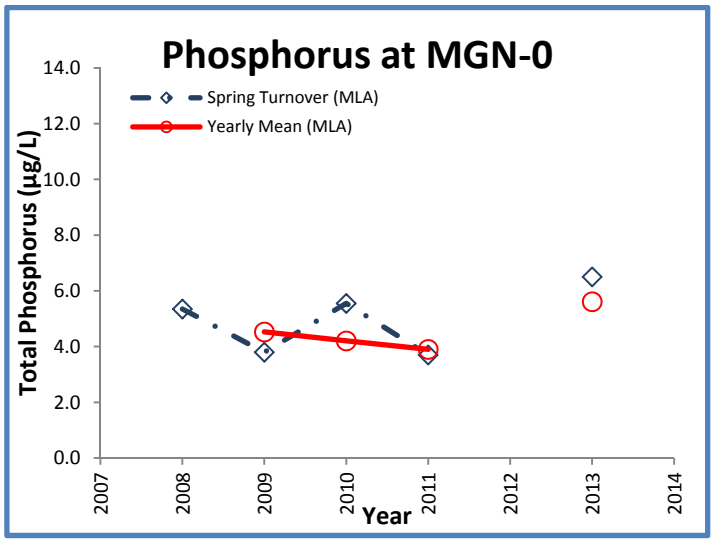
Morgan Bay is in the northernmost part of Lake Rosseau, and a series of small bays make up this large sampling area. Several creeks outlet into this bay close to the nearshore sampling sites and there is a wetland adjacent to the lake at MGN-3. Most of the shoreline area is developed with residential properties, but many retain natural riparian vegetation. Nearly the entire area has road access and several of these roadways come very close to the water. Monitoring started in 2008.

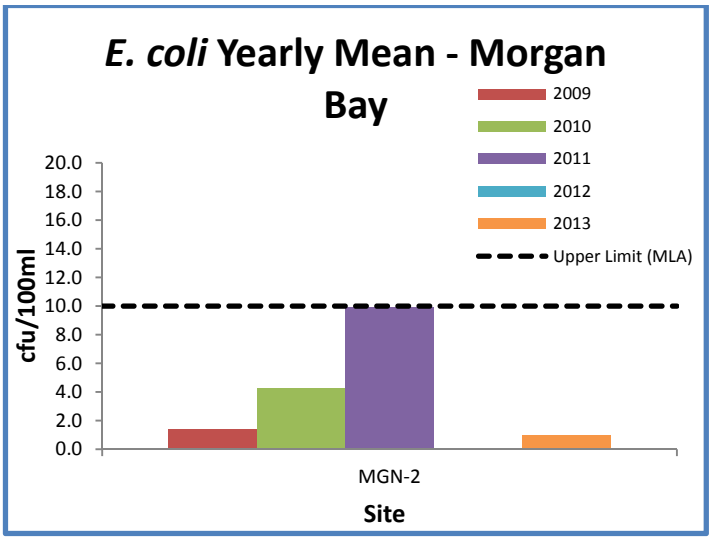
Volunteer Recognition: **David Peacock**, Mary Anne Peacock and Danny Chung.

Morgan Bay (MGN)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

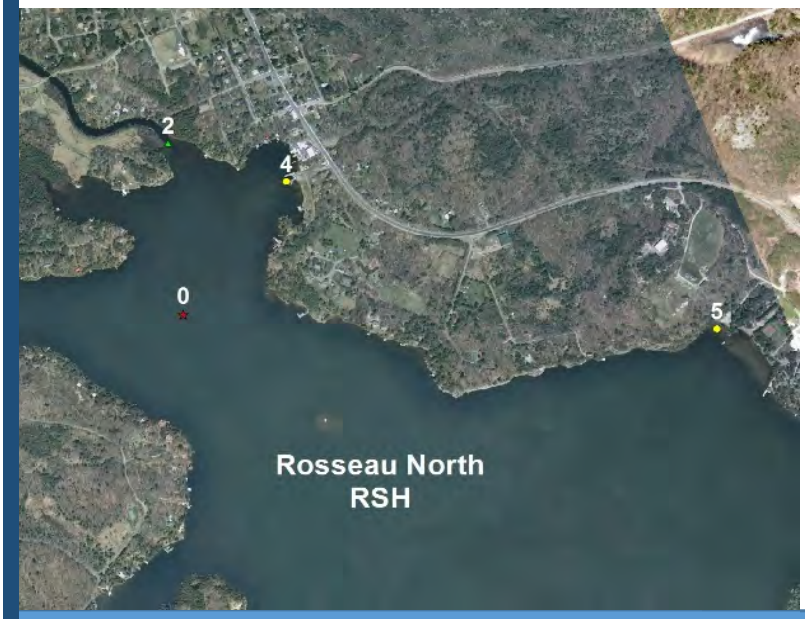
Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MGN-0	2.65	6.5	5.6		
MGN-1		6.4	5.8		
MGN-2				1	14
MGN-3		6.8	5.9		





Summary and Recommendations:

All phosphorus results remain consistent over the sampling years and levels of *E. coli* continue to remain below the MLA upper limit. Beacon recommends sampling continue to monitor long-term trends.



Area Description:

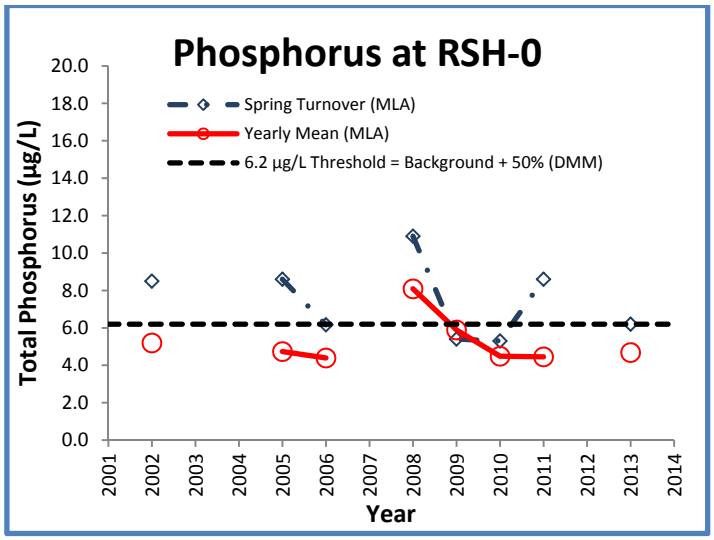
The Rosseau North sampling area is within the limits of the village of Rosseau, at the northern end of Lake Rosseau. Drainage from the village enters the lake at the sampling sites, as well as at the mouth of the Shadow River. Two creeks drain into the bay, one through a lacustrine wetland along the western shoreline and the other near Highway 141 to the east. There is a high level of development not only along the shoreline of the lake and Shadow River, but in much of the watershed area in the form of residential and agricultural properties. Monitoring started in 2002.

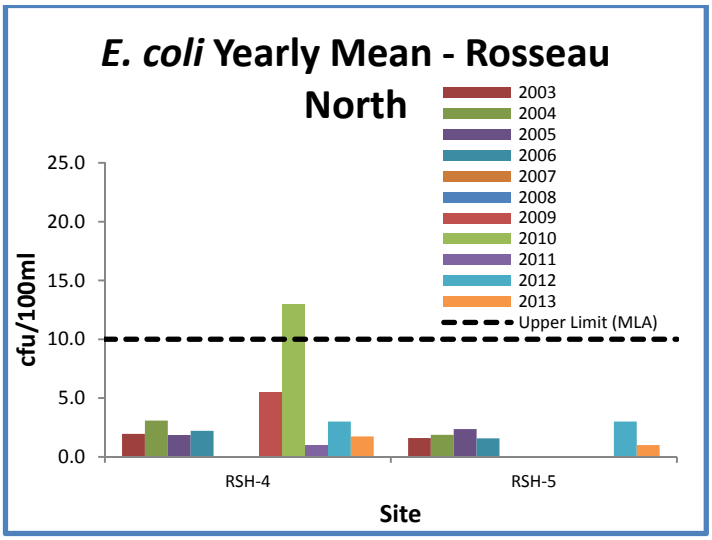
Volunteer Recognition: **David Peacock**, Mary Anne Peacock and Danny Chung.

Rosseau North (RSH)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
RSH-0	3.08	6.2	4.7		
RSH-2		7.6	5.4		
RSH-4		6.8	5.2	2	67
RSH-5				1	22





Summary and Recommendations:

Spring phosphorus concentrations tend to be slightly elevated and the yearly mean phosphorus levels generally remain consistent with the DMM threshold over the sampling years. Sampling for bacterial levels at RSH-2 was discontinued in 2013. Beacon recommends that spring sampling continue to monitor long-term trends.

Area Description:

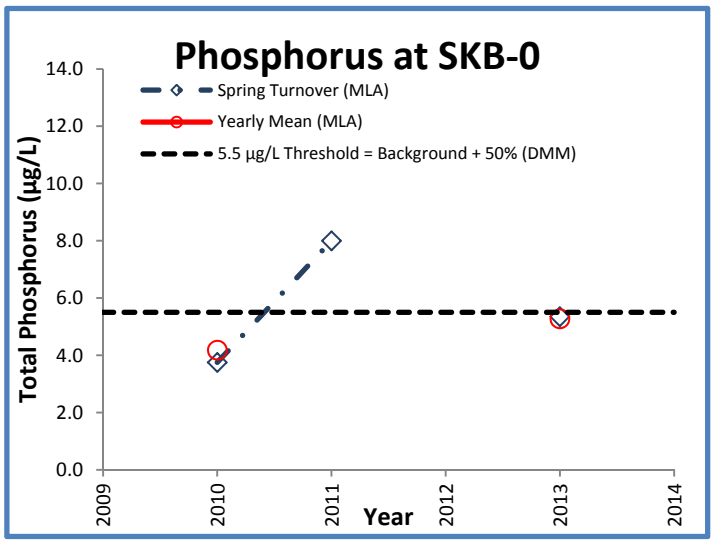
Skeleton Bay is located in the eastern portion of Lake Rosseau's north basin. It is approximately 1.7 km² in size with a maximum depth of 20 m. Highway 141 follows the shoreline in the northeast section of the bay, below a steep, cliffed area. This bay is fed by six watercourses including the Bent River which drains agricultural lands. Skeleton Bay is classified as moderately sensitive by the DMM. Monitoring started in 2010.

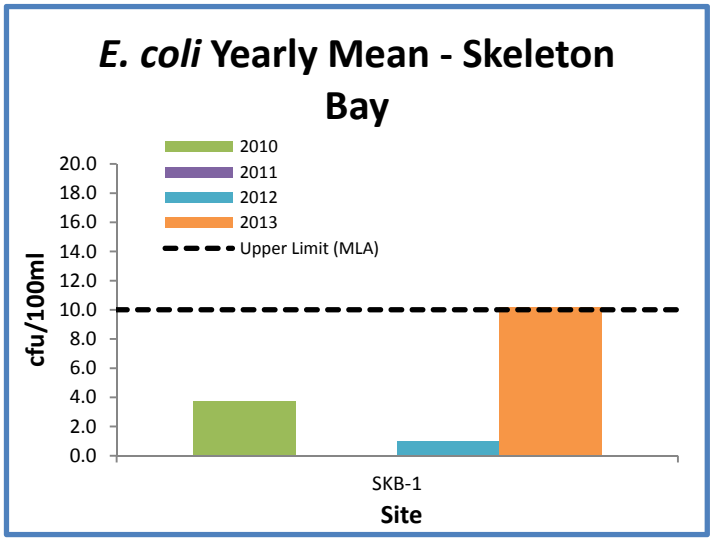
Volunteer Recognition: **David Peacock**, Jill Lavine, Judy Stephens-Wells, Steve Neil and Debbie Neil.

Skeleton Bay (SKB)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
SKB-0	3.16	5.4	5.3		
SKB-1		7.9	8.3	10	73
SKB-3		6.2	5.2		





Summary and Recommendations:

Monitoring started in 2010. Deep-water phosphorus results are limited to date at this location. Although scheduled, no bacteria samples were acquired in 2013 at SKB-3. Beacon recommends that all suggested 2013 samples are taken in 2014 and sampling continue to monitor long-term trends.

Area Description:

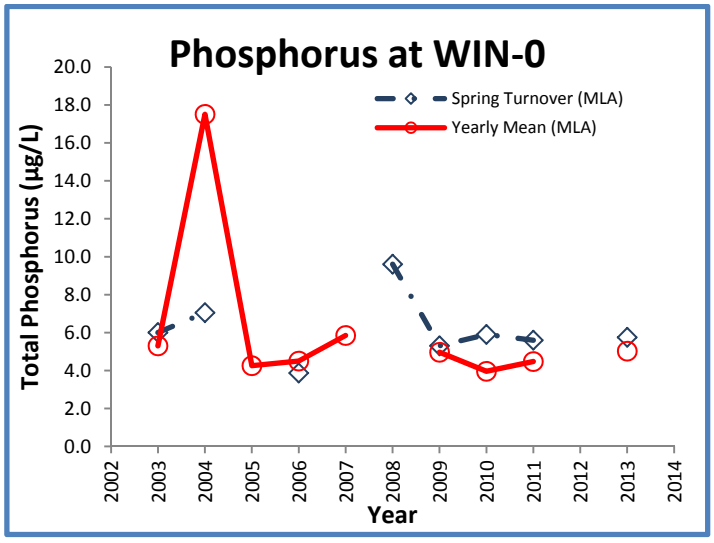
The Windermere village area in northern Lake Rosseau is a highly developed resort and residential area. There is a large resort complex, golf course, marina, and many residential properties. In addition, there is a significant amount of agricultural land near the sampling area. Several creeks outlet into this area, one of which flows through farms fields and wetlands and enters the lake at the marina. Monitoring started with the original program in 2003.

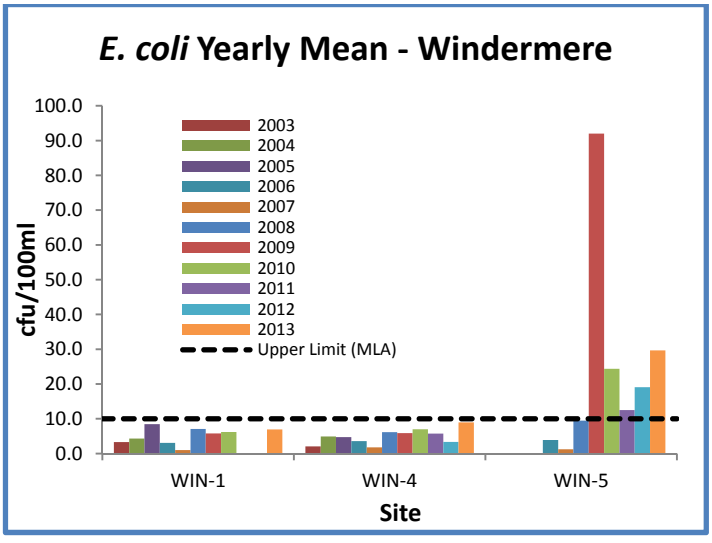
Volunteer Recognition: **Katherine Seybold**, Peter Seybold, Drew Purdy and Cameron Purdy.

Windermere (WIN)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
WIN-0	3.85	5.8	5.0		
WIN-1		19.8	15.1	7	56
WIN-4		6.3	5.2	9	60
WIN-5		7.8	10.8	30	129





Summary and Recommendations:

Phosphorus concentrations have remained generally consistent through the sampling years, with 2004 being an exception. *E. coli* counts remain low in WIN-1 and WIN-4 and levels are elevated at WIN-5 as they are most years. Beacon recommends a reconnaissance and discussion of the area associated with WIN-5 and WIN-1 and recommends that all sampling be continued to monitor long-term trends.

Area Description:

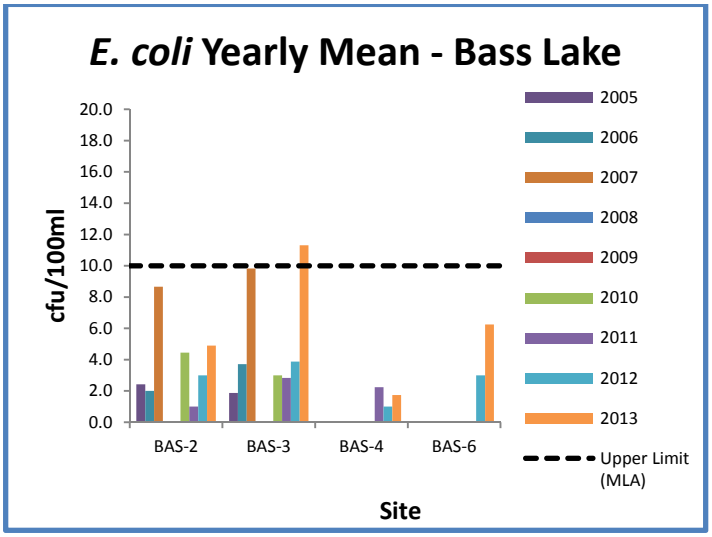
Bass Lake is a small, shallow, moderately developed lake located immediately southwest of Lake Joseph. It is 0.96 km^2 in area with a maximum depth of 8 m. Hwy 169 separates this lake from Lake Joseph at the north end. Bass Lake drains wetlands located to the south and water flows into Stills Bay via Stills Falls. Bass Lake has been classified as moderately sensitive by the DMM. Monitoring started in 2005.

Volunteer Recognition: **Bev Turney**, Chris Bodanis, Andrea Foss, Klara Oh and Chris Turney.

Bass Lake (BAS)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
BAS-2				5	38
BAS-3				11	57
BAS-4				2	65
BAS-5	2.81	7.9	7.5		
BAS-6				6	31
BAS-7		5.2	4.4		



Summary and Recommendations:

Deep-water phosphorus concentrations were acquired at BAS-5 for the second time in 2013 and will be analysed with the 2014 data. The 2013 spring turnover and yearly phosphorus mean are below the DMM threshold for Bass Lake of 9.15 µg/L. Beacon recommends all sampling be continued to monitor long-term trends.

Area Description:

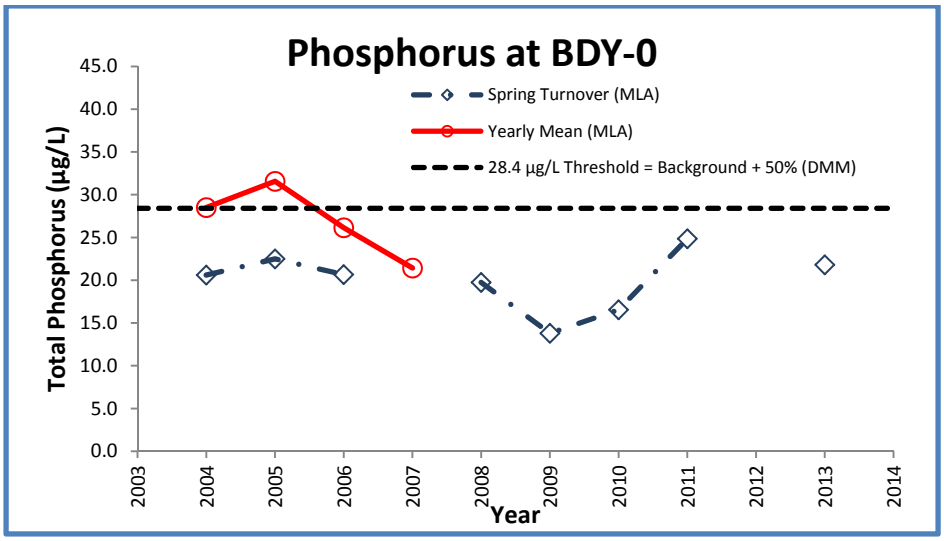
The shoreline of Brandy Lake is moderately developed with many residences and access roads. A large number of the properties maintain a natural shoreline but, there is close to 10% un-buffered lawn. Approximately 40% of the lake shoreline is natural wetland. In the eastern portion of the lake, there is a large wetland with a creek outlet. A second creek is located to the southeast. Brandy Lake is a dystrophic, or "tea-coloured" lake, which is naturally rich in carbon. Monitoring started in 2004.

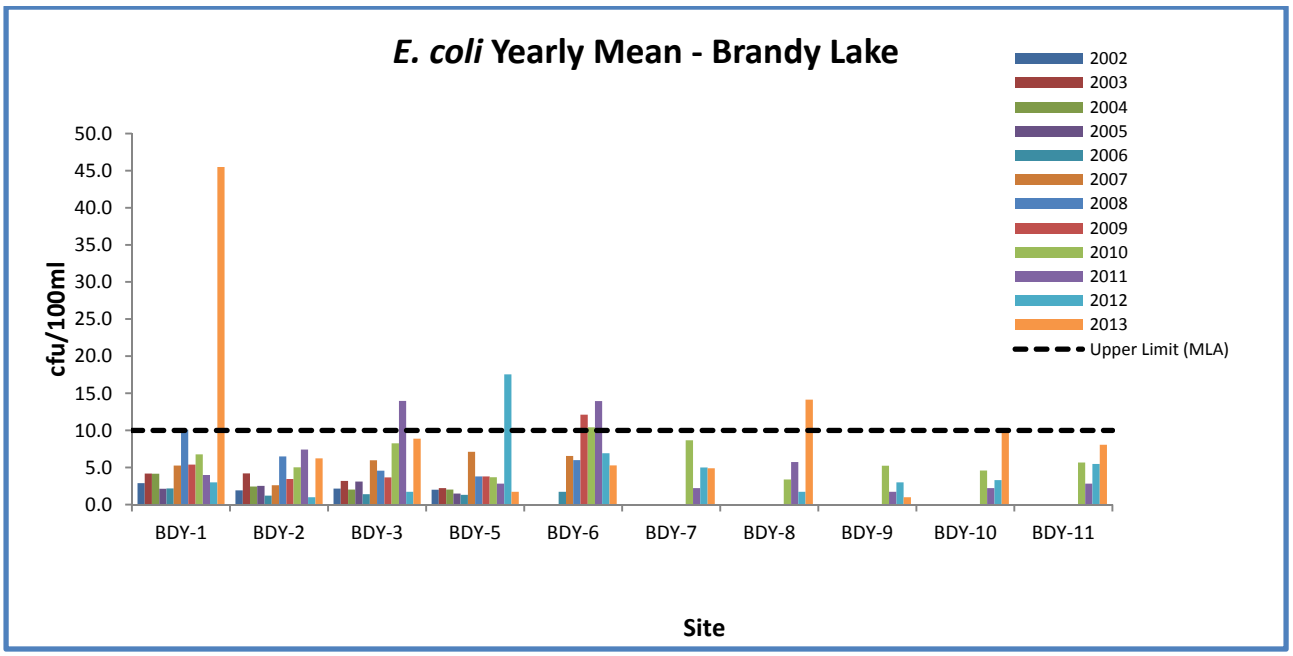
Volunteer Recognition: **Peter & Donna Sale**, Robert Hogg, and Fred Kelsey.

Brandy Lake (BDY)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
BDY-0	1.12	21.8			
BDY-1				45	202
BDY-2				6	63
BDY-3				9	64
BDY-5				18	65
BDY-6				5	57
BDY-7				5	59
BDY-8				14	67
BDY-9				1	50
BDY-10				10	62
BDY-11				8	138





Summary and Recommendations:

Spring phosphorus concentrations remain below the DMM threshold of 28.4 µg/L through all sampling years. Although the 2012 Water Quality Report recommended discontinuing bacteria sampling at BDY-3 and BDY-5, samples were acquired in 2013. At both locations *E. coli* levels were above the MLA upper limit and *E. coli* levels at BDY-1 were particularly high during 2013. Beacon recommends sampling continue to monitor long-term trends and should high E. coli levels continue at BDY-1 in the summer of 2014, further investigation should be undertaken.

Area Description:

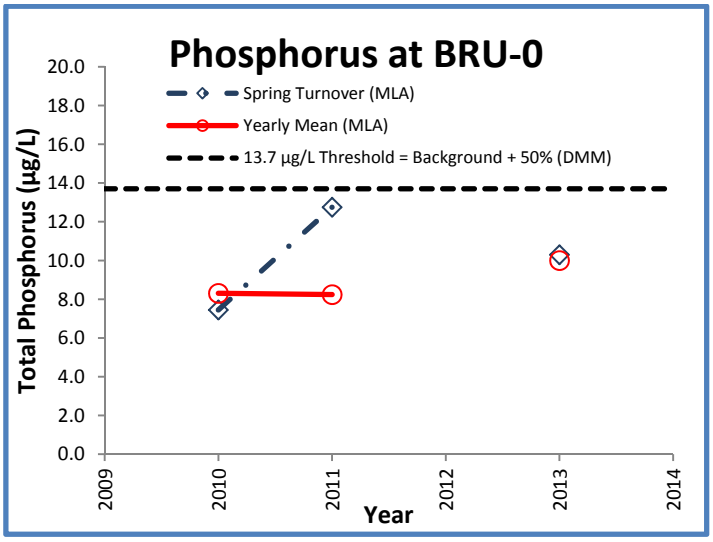
Bruce Lake is located east of Hwy 632, between Lake Joseph and Lake Rosseau. It is relatively small in size at 1.0km^2 and has a maximum depth of 6 m. Approximately 25% of the catchment area for this lake is made up of wetlands. The lake is moderately developed and there is a golf course located immediately to the south. Bruce Lake is classified as moderately sensitive by the DMM. Monitoring started in 2010.

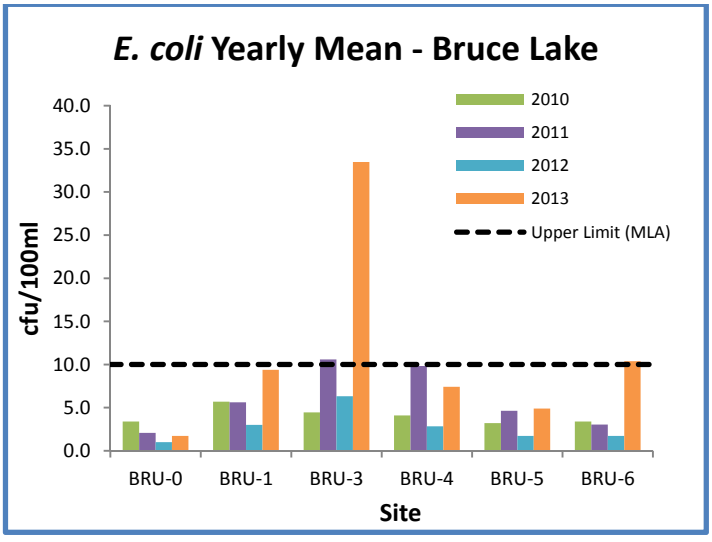
Volunteer Recognition: **Paul Hutchinson**, Cynthia Mercanti, Karen Weber, Bob Krieger, Robyn Mercanti and Michael Watt.

Bruce Lake (BRU)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
BRU-0	3.5	10.3	10.0	2	14
BRU-1		9.9	10.4	9	43
BRU-3		8.4	9.8	33	81
BRU-4		9.3	9.7	7	44
BRU-5		8.8	9.2	5	46
BRU-6		9.1	10.5	10	44





Summary and Recommendations:

Phosphorus concentrations remain consistently below the DMM threshold of 13.7 µg/L each year. The *E.coli* levels at BRU-3 were high during both summer samples in 2013. Beacon recommends that the historical database acquired by the Bruce Lake Family Association be included in further analysis, the results from BRU-3 be carefully tracked in 2013 and that sampling continue to monitor long-term trends.

Area Description:

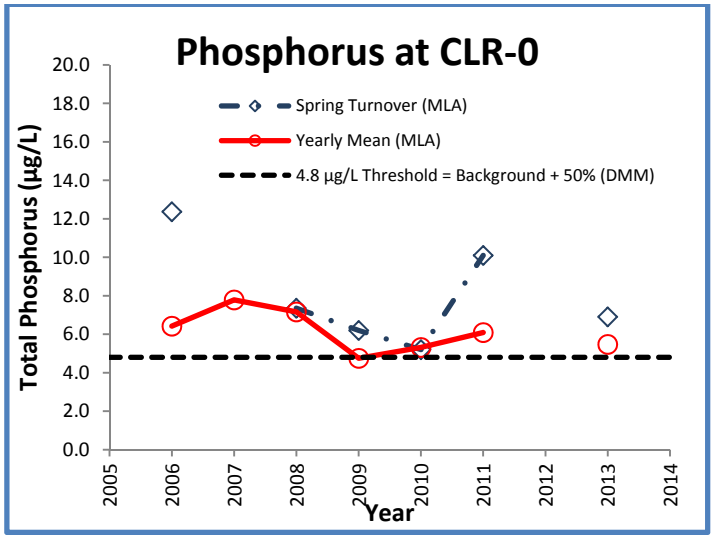
Clear Lake, also called Torrance Lake, is a moderately developed lake with much of the shoreline area converted into residential lots. It is also adjacent to highway 169. This lake is 152 ha in size, has a maximum depth of 16 m and has a very small watershed. There is limited inflow and outflow of water on this lake. Clear Lake has been classified as moderately sensitive and over threshold by the DMM. Monitoring started in 2006.

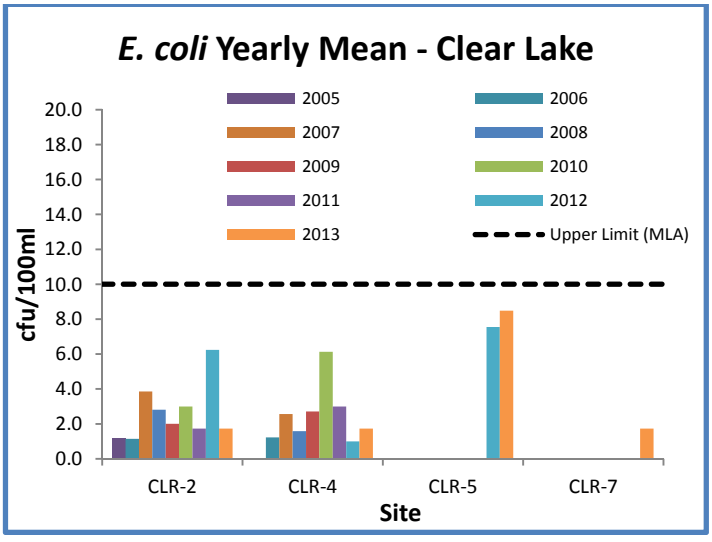
Volunteer Recognition: **Bob and Sharon Cleverdon**

Clear Lake (CLR)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
CLR-0	6.09	6.9	5.5		
CLR-2		8.0	6.1	2	42
CLR-4		7.9	5.8	2	65
CLR-5		10.5	6.7	8	138
CLR-7		6.9	5.7	2	65





Summary and Recommendations:

Phosphorus concentrations remain consistently at or above the DMM threshold of 4.8 µg/L each year. The *E.coli* levels at CLR-2 and CLR-4 continue to be well below the MLA upper limit in 2013, as do the newly established sites at CLR-5 and CLR-7. Beacon recommends that sampling continue to monitor long-term trends.

Area Description:

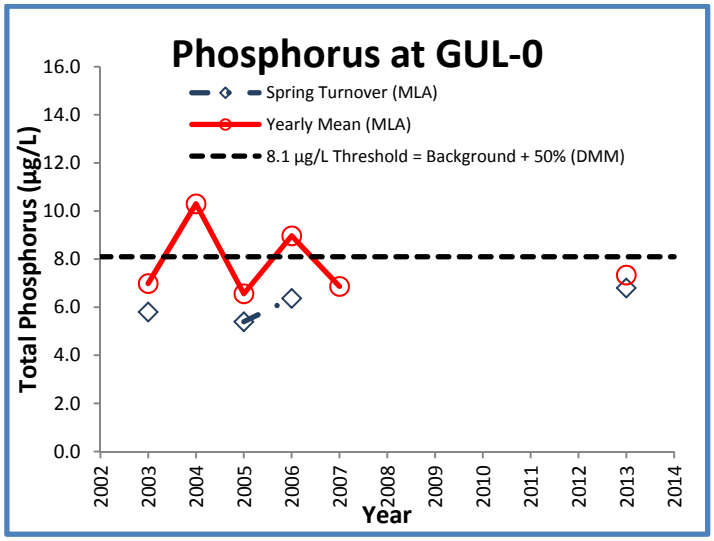
Gull Lake is located in the Town of Gravenhurst. Highway 11 crosses Gull Lake at its midpoint. The lake is approximately 1.35 km² in area, with a maximum depth of 7 m. Gull Lake is fed directly from Silver Lake at its south end with an additional nine creeks outletting into the lake. The Gull Lake watershed is approximately 3.6 km^2 in size. Gull Lake is classified as moderately sensitive by the DMM. Monitoring started with the original program in 2003.

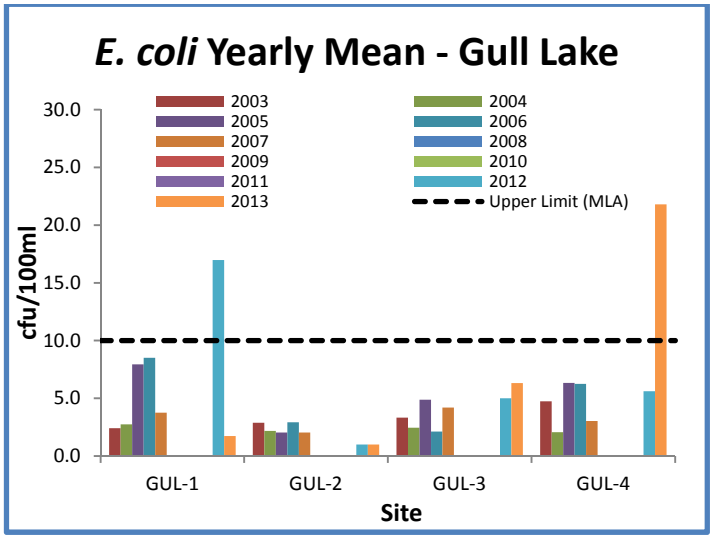
Volunteer Recognition: **Gregory Bertrand** and Roger Bertrand.

Gull Lake (GUL)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
GUL-0	3.4	6.8	7.3		
GUL-1				2	30
GUL-2				1	40
GUL-3				6	40
GUL-4				22	48





Summary and Recommendations:

The spring turnover and yearly phosphorus means are generally consistent with the DMM threshold of 8.1 µg/L. *E. coli* counts remain low at all nearshore sampling locations in 2013, except for GUL-4, an area associated with high recreational use. Beacon recommends attention be paid to this location in 2014 and that all sampling be continued to monitor long-term trends.

Area Description:

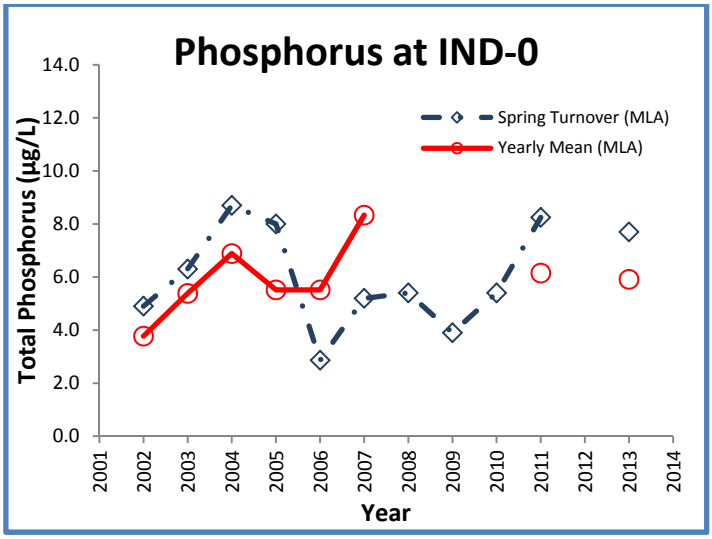
The Indian River flows from Lake Rosseau, through Port Carling and into Mirror Lake and Lake Muskoka. This highly developed area receives stormwater from the Port Carling urban centre. It also has high boat traffic, a locks system, marinas and many commercial and residential properties. A large lacustrine wetland is located adjacent to the river. Monitoring started in 2002.

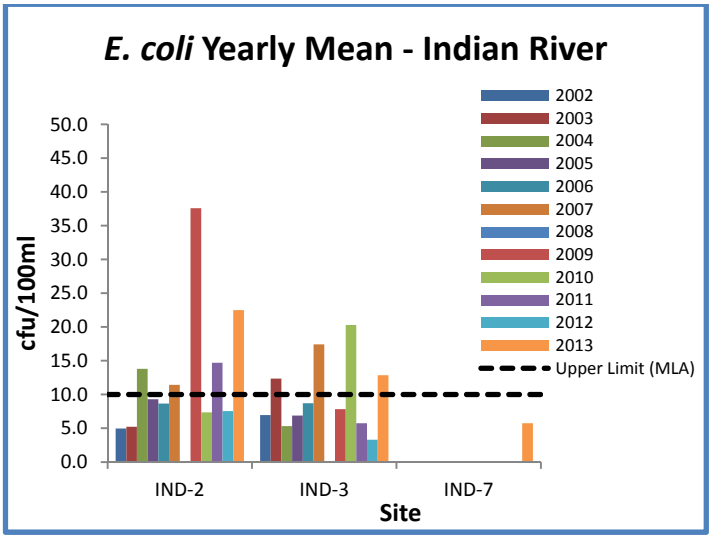
Volunteer Recognition: **Susan Carson**, Ian Turnbull, Sandy Tozer Spence and Carly Spence.

Indian River (IND)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
IND-0	4.13	7.7	5.9		
IND-2				22	126
IND-3				13	121
IND-7		7.5	7.2	6	61





Summary and Recommendations:

Spring phosphorus concentrations have a tendency to fluctuate likely as it relates to the amount of runoff in the spring that flows from Lakes Rosseau and Lake Joseph through this river. It is interesting to note that even with the extreme flooding in the spring of 2013, spring phosphorus concentrations remained consistent. Elevated *E. coli* levels are a result of higher readings in the July samples at IND-2 and IND-3. Conversely, this was not apparent at IND-7 in July. Beacon recommends that all sampling be continued to monitor long-term trends.

Area Description:

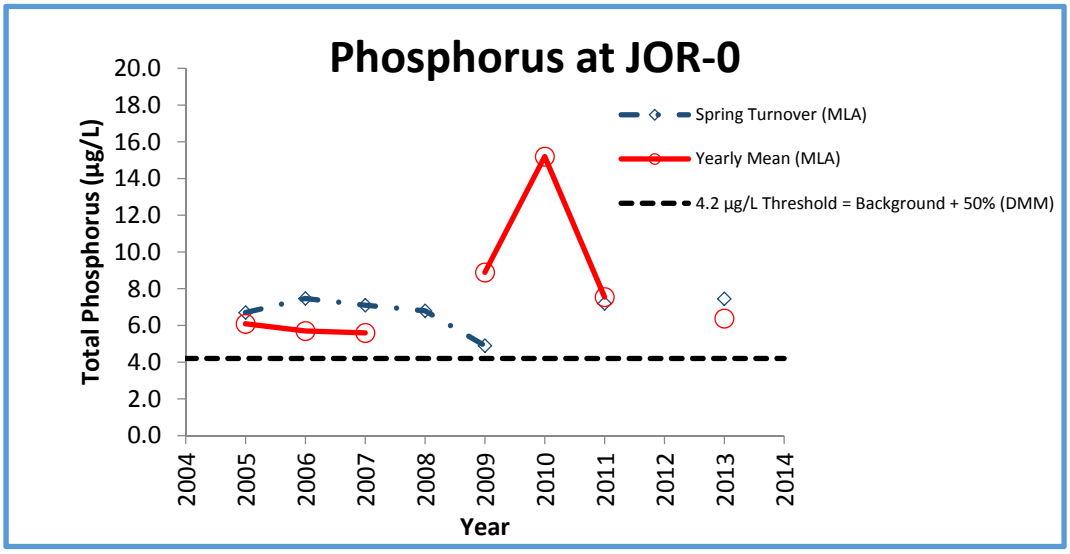
The Joseph River is the water body connecting Lake Joseph and Lake Rosseau. The river is 1.37 km² in size and up to 8 m deep. Direction of flow is from Lake Joseph into Lake Rosseau. A marina, a bridge crossing for Peninsula Road and two wetlands are located adjacent to the channel. This area receives significant boat traffic as the main navigable waterway between the two large lakes. The Joseph River is classified as moderately sensitive by the DMM. Monitoring started in 2005.

Volunteer Recognition: **Beth Guy** and Laurie Leiser.

Joseph River (JOR)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
JOR-0	3.47	7.5	6.4		
JOR-1		8.0	6.4		
JOR-2		7.3	6.3		



Summary and Recommendations:

Phosphorus results remain consistent over the sampling years, although the yearly mean phosphorus concentrations in 2010 is elevated resulting from a high value in August. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

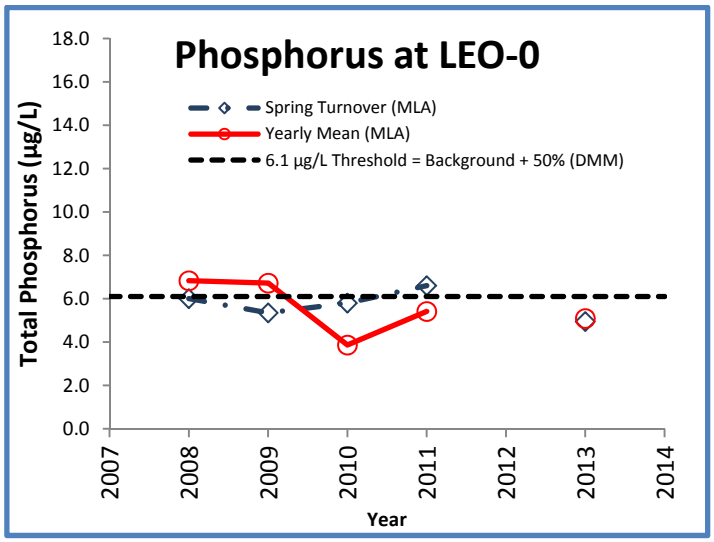
Leonard Lake is a medium sized lake at 1.52 km² in size and has a maximum depth of 16 m. This lake is moderately developed with primarily residential properties. Immediate shoreline alteration is limited to 9% but backlot clearing and forest thinning is found in 77% of properties. There is limited inflow and outflow of water on this lake, and few wetlands in the vicinity. Leonard Lake is classified as moderately sensitive and over-threshold by the DMM. Monitoring started in 2008.

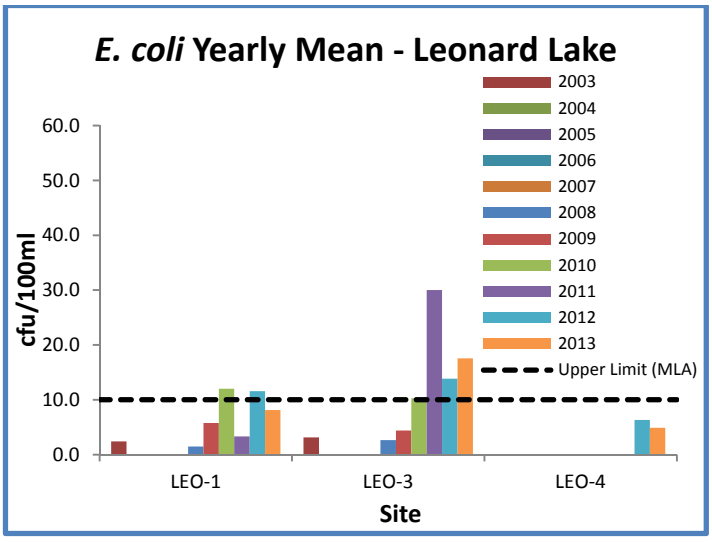
Volunteer Recognition: **Gordon Roberts, Betty Isbister,** Chris Lichty, Ryan Lichty, Madison Lichty, Eric Morgan and Susan Isbister.

Leonard Lake (LEO)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
LEO-0	3.6	5.0	5.1		
LEO-1				8	115
LEO-3				18	92
LEO-4				5	54





Summary and Recommendations:

The spring turnover and yearly phosphorus means are generally consistent with the DMM threshold of 6.1 µg/L. *E. coli* counts remain low at all nearshore sampling locations in 2013, except for an elevated mean at LEO-3. Beacon recommends that all sampling be continued to monitor long-term trends.

Area Description:

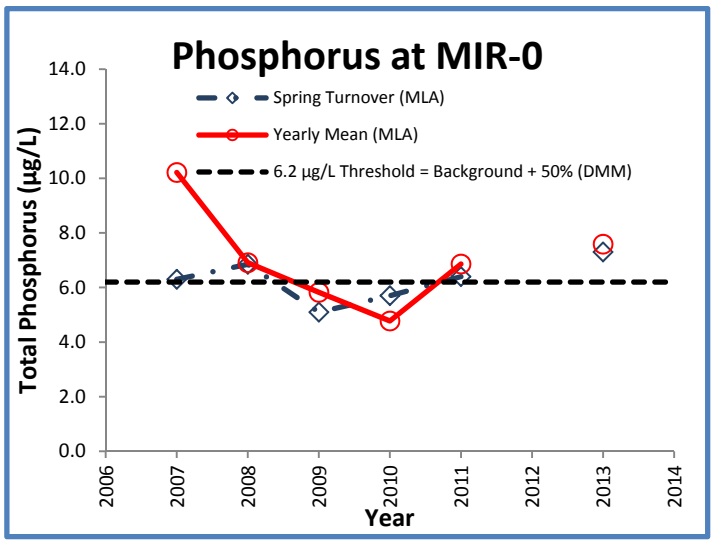
Mirror Lake is essentially a widening of the Indian River as it flows between Lake Rosseau to the north and Lake Muskoka to the south. The lake is approximately 0.46 km² in area, with a maximum depth of 8 m. Two small creeks outlet into the lake near sampling sites MIR-1 and MIR-2. Much of the lake is within the Town of Port Carling and receives drainage from the urban area. Mirror Lake has a small watershed, approximately 0.97 km², and is classified as moderately sensitive and over-threshold by the DMM. Monitoring started in 2007.

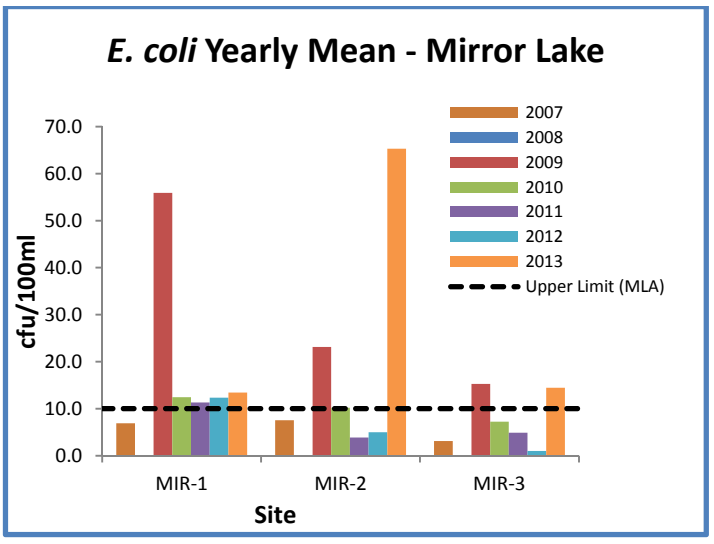
Volunteer Recognition: **Susan Carson**, Sandy Tozer-Spence, Rick Spence, Carly Spence and Jen Spence.

Mirror Lake (MIR)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MIR-0	2.76	7.3	7.6		
MIR-1				13	173
MIR-2				65	471
MIR-3		9.3	8.7	14	97





Summary and Recommendations:

Monitoring started in 2007. The spring turnover and yearly phosphorus means are generally consistent with the DMM threshold of 6.2 µg/L. *E. coli* counts were elevated at all nearshore sampling locations in 2013. These elevated *E. coli* levels were not experienced upstream of Mirror Lake (IND-7), but were recognized downstream (IND-3). Beacon recommends a reconnaissance of the area associated with MIR-2 and recommends that all sampling be continued to monitor long-term trends.

Area Description:

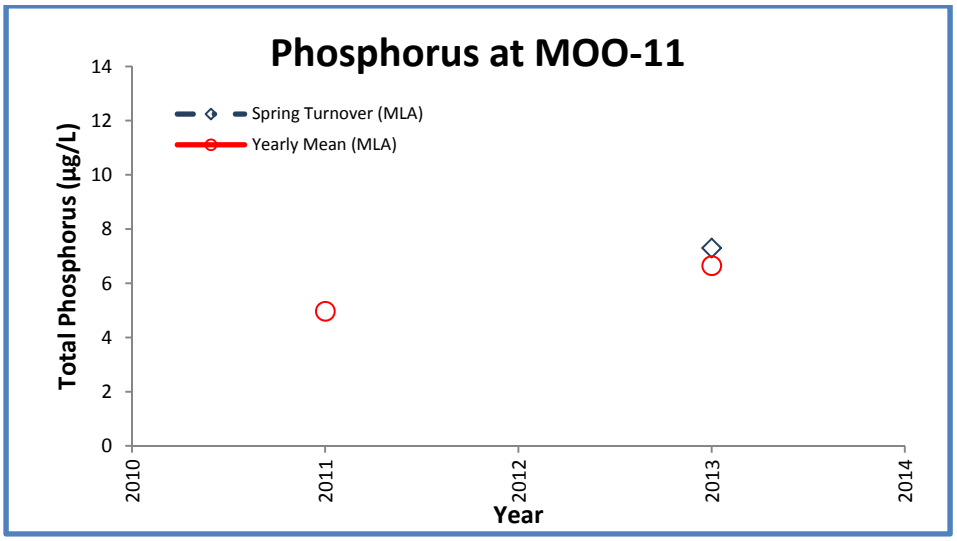
The Moon River is the main outlet of the Muskoka Watershed, flowing from Lake Muskoka to Georgian Bay. The river receives overland drainage from the Town of Bala and its urban area, including many roads and the developed shoreline. Approximately 12 creeks outlet into this sampling area, several of which drain wetlands.

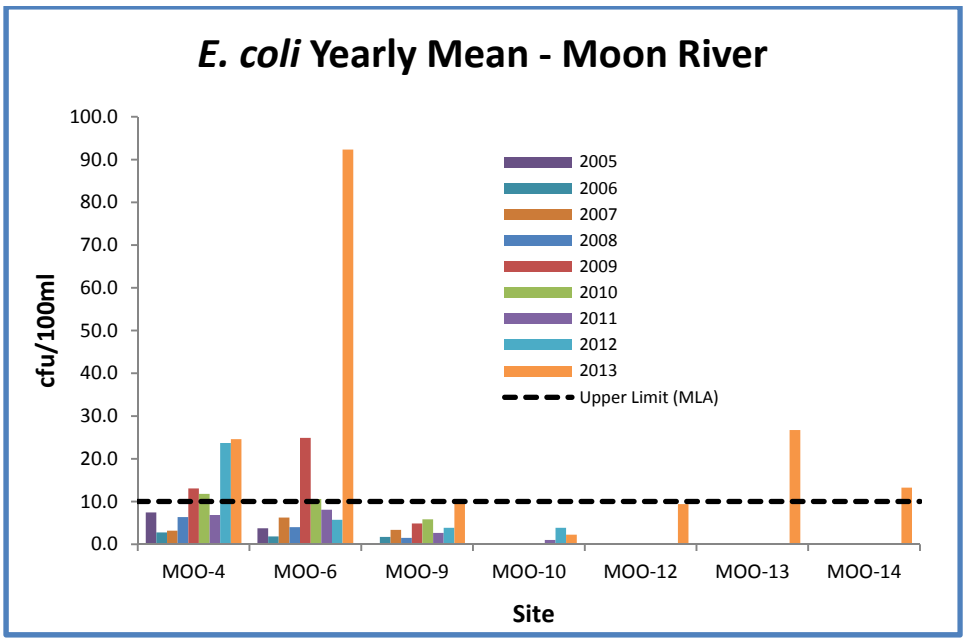
Volunteer Recognition: **Bruno Polewski**, Victoria Murphy, Tara Murphy, Anne Polewski and Bill Purkis.

Moon River (MOO)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MOO-1		12.0	8.3	5	22
MOO-4		9.3	7.8	25	78
MOO-6		12.3	8.7	92	171
MOO-9		7.4	6.9	9	41
MOO-10		7.3	6.1	2	35
MOO-11	3.2	7.3	6.7	3	13
MOO-12		11.3	9.4	9	80
MOO-13		9.1	8.4	27	119
MOO-14		7.4	7.1	13	53





Summary and Recommendations:

Monitoring of the deep-water location MOO-11 started in 2011. Phosphorus concentrations have remained generally consistent through the sampling years. Elevated *E. coli* levels above the MLA upper limit occurred at all nearshore sites in 2013 and retest results showed similarly high levels. MOO-6 encountered high levels at both sampling dates. It was noted in the 2012 Water Quality Report that MOO-6 had been equal to or below the MLA upper limit for three years and it was recommended that sampling should be considered at an alternative site. Beacon recommends further investigation of MOO-6 in 2014 and recommends that all sampling be continued to monitor long-term trends.

Area Description:

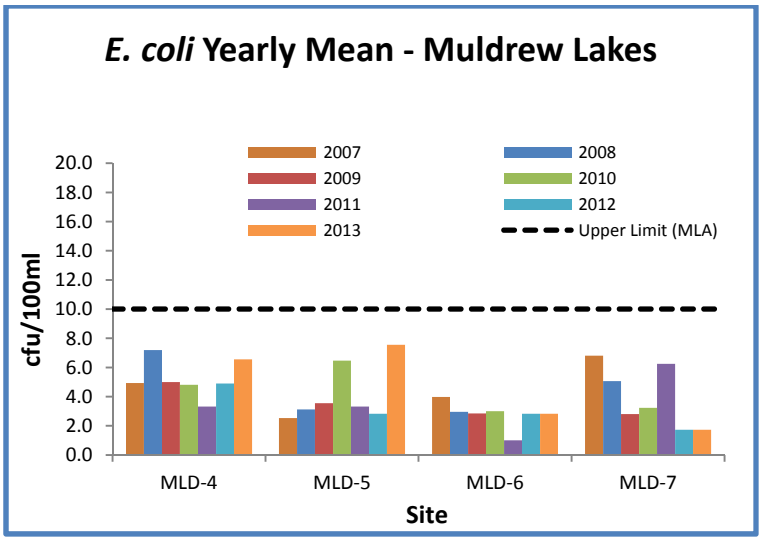
North and South Muldrew Lakes are oriented northwest to southeast, formed as a result of glacial retreat. North Muldrew Lake is approximately 1.52 km² in size, a maximum of 16 m deep and is considered moderately sensitive by the DMM. Several creeks and five wetland areas drain into the lake. There is a large resort area along the eastern shoreline and considerable residential development, most retaining a natural shoreline. South Muldrew Lake is approximately 2.7 km² in area, with a maximum depth of 18 m, and is also classified as moderately sensitive. South Muldrew Lake has less shoreline development than North Muldrew Lake, likely due to the extent of adjacent wetlands. Approximately ten wetland areas drain into the eastern portion of South Muldrew Lake.

Volunteer Recognition: **Janet Allen** and Heather Aberle.

Muldrew Lakes (MLD)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MLD-4				7	4
MLD-5				8	2
MLD-6				3	3
MLD-7				2	5



Summary and Recommendations:

Yearly E. coli mean levels at all sites have been equal to or below the MLA upper limit for the past four years. Beacon recommends that the sampling program be modified in consultation with the Muldrew Lakes representatives prior to the 2014 sampling season.

Area Description:

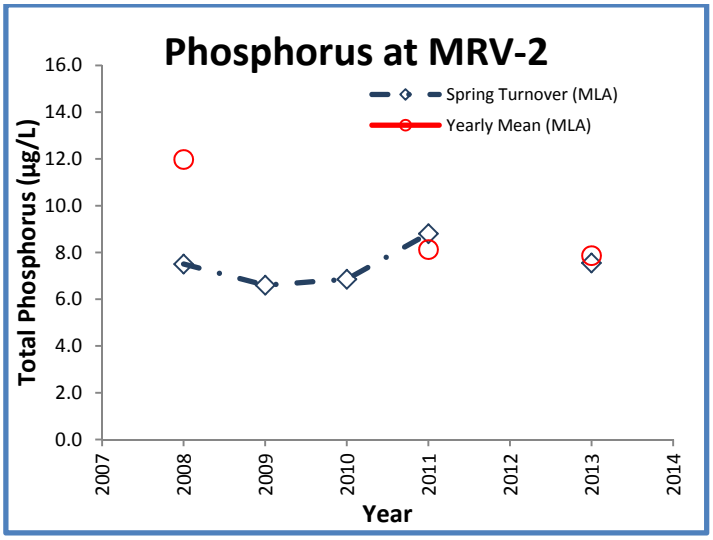
This sample area includes the most downstream reach of the Muskoka River where it flows from the Town of Bracebridge to Alport Bay, Lake Muskoka. This area is highly developed on both banks, and includes the Bracebridge urban area, large agricultural fields, and extensive residential properties along the entire reach of shoreline. Roads are located along both sides of the river for most of the reach length. Several creeks outlet into the river through this reach and there are limited wetland areas adjacent to the river. Monitoring started in 2008.

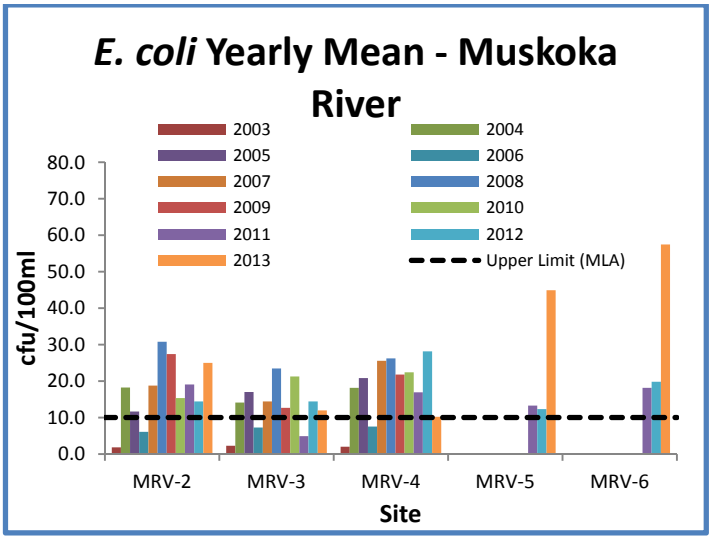
Volunteer Recognition: **John Wood**, Debbie Hastings and Bruce Mackenzie.

Muskoka River (MRV)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
MRV-2	3.53	7.6	7.9	25	143
MRV-3	4.02	7.0	7.7	12	83
MRV-4	2.99	9.4	8.5	10	91
MRV-5		23.8	16.6	45	206
MRV-6		25.0	24.3	57	150





Summary and Recommendations:

Phosphorus concentrations have remained generally consistent through the sampling years. The 2013 geometric *E. coli* yearly mean at MRV-5 and MRV-6 are substantially higher than previous years values and relate to high levels at the end of July. Comments suggest that bridge construction and heavy rainfall the previous day may have contributed to the high levels. Beacon recommends that all sampling be continued to monitor long-term trends and to monitor *E. coli* levels at MRV-5 and MRV-6 in 2014.

Area Description:

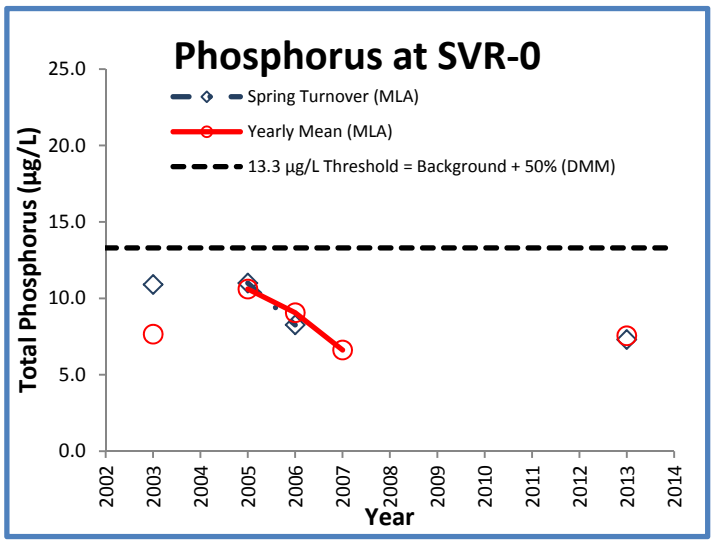
Silver Lake is located at the south end of Gull Lake. The lake is approximately 0.57 km² in area, with a maximum depth of 14 m. No fewer than 13 rivers and streams outlet into the lake. The northwestern portion of Silver Lake contains a navigable outlet into Gull Lake. The Silver Lake watershed is approximately 8 km^2 in size and contains a number of large lacustrine wetlands. Silver Lake is classified as moderately sensitive by the DMM. Monitoring started in 2003.

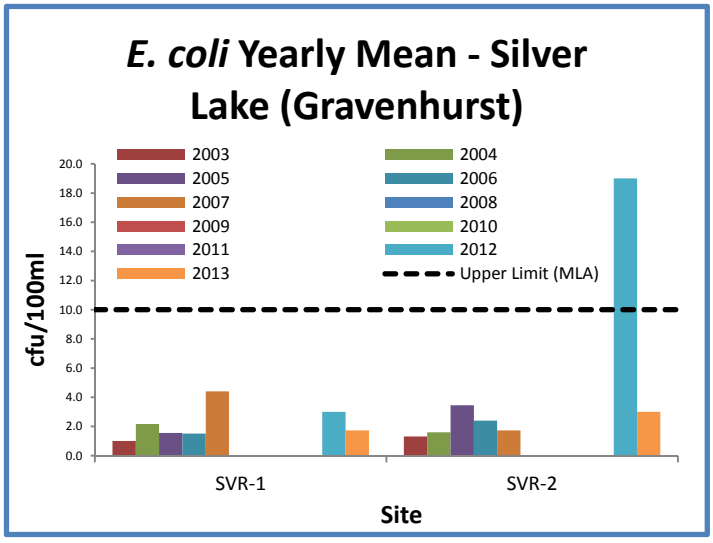
Volunteer Recognition: **Gregory Bertrand** and Roger Bertrand.

Silver Lake (SVR)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
SVR-0	2.7	7.3	7.6		
SVR-1				2	35
SVR-2				3	75





Summary and Recommendations:

Each spring turnover and yearly phosphorus mean continue to be below the DMM threshold for Silver Lake (13.3 µg/L). Similarly, all but one of the geometric *E. coli* yearly mean values for both SVR-1 and SVR-2 remain below the MLA upper limit. Beacon recommends sampling continue to monitor long-term trends.

Area Description:

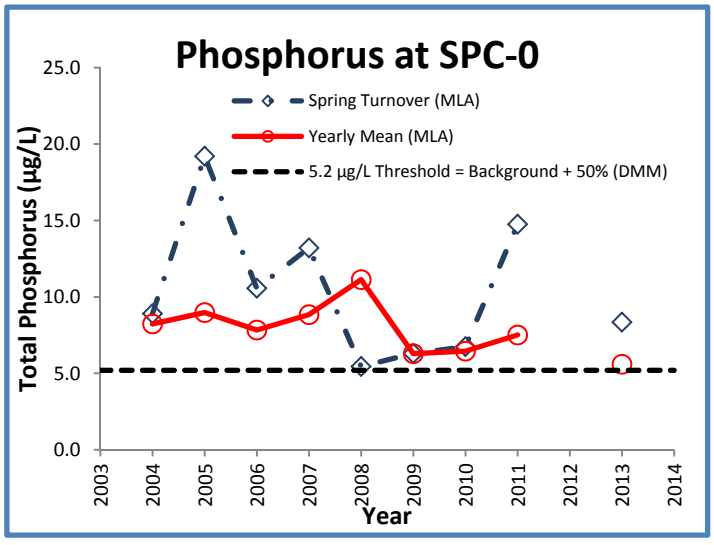
Silver Lake is immediately adjacent to Port Carling, with 0.57 km² in surface area and a maximum depth of 14 m. This lake has a moderate amount of shoreline residential development with alteration in the form of lawns and thinned forest occurring over approximately 50% of the upland area. The riparian area is well buffered with 90% of the immediate shoreline in a natural state. The southwestern portion of this lake receives drainage from part of the Port Carling urban area. There is limited flow into the lake with one identified outlet in the south. Silver Lake is classified as moderately sensitive by the DMM.

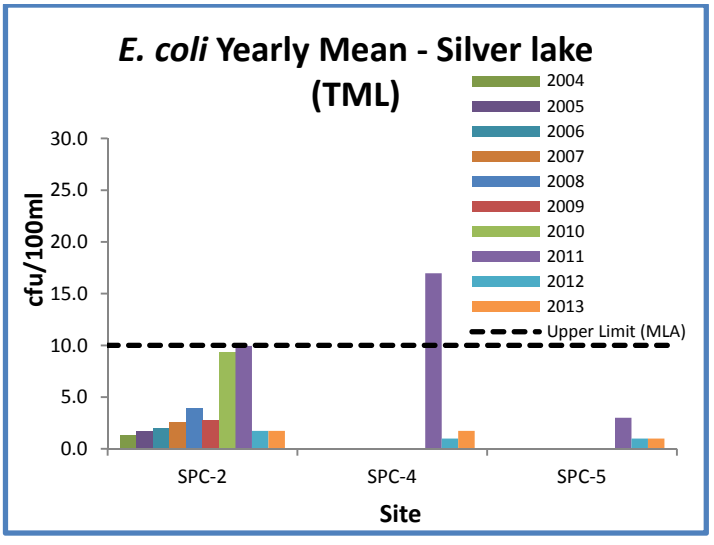
Volunteer Recognition: **Perry Bowker** and Jill Ross.

Silver Lake (SPC)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
SPC-0	5.06	8.4	5.6		
SPC-2				2	12
SPC-4				2	24
SPC-5				1	8





Summary and Recommendations:

Monitoring started in 2004. The spring turnover and yearly phosphorus means are generally elevated compared with the DMM threshold of 5.2 µg/L. *E. coli* counts remain low at all nearshore sampling locations in 2013. Beacon recommends that all sampling be continued to monitor long-term trends.

Area Description:

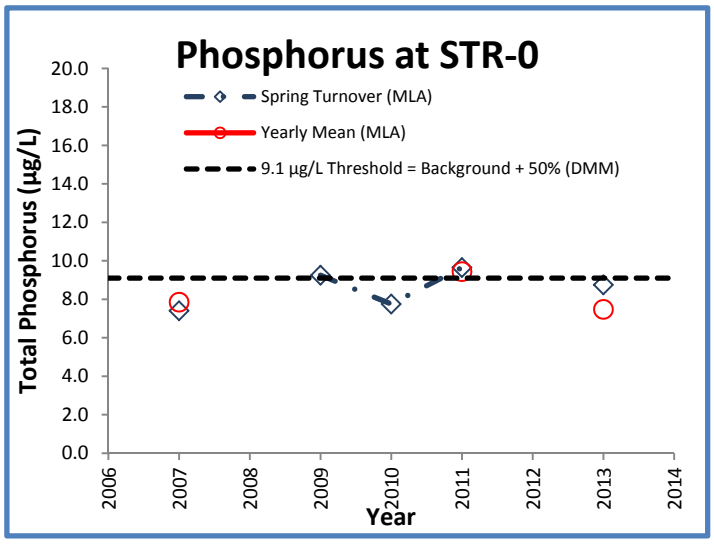
Star Lake is located in the Township of Seguin and is approximately 158 ha in area with a maximum depth of 23 m. This lake has a moderate to high level of shoreline development in the form of residential properties. Many of these properties maintain natural riparian vegetation along their shorelines, but some have extensive clearings and lawns. There is a large agricultural area adjacent to the northwestern shore and several roads located in close proximity to the lake. This lake has several inflow and outflow creeks, with limited wetland areas in the upper watershed. Monitoring started in 2007.

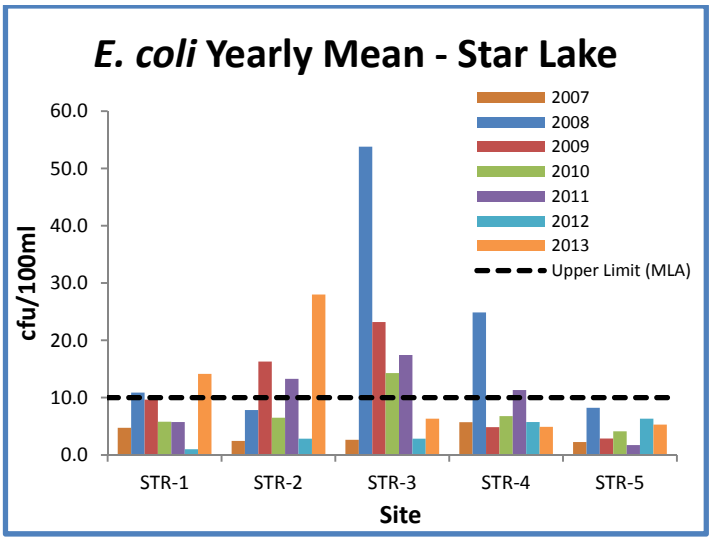
Volunteer Recognition: **Karen Gillies**, Sara Slater, Lauren Thurner and Emm Thurner.

Star Lake (STR)

2013 Water Quality Results: (**Note**: Hatched cell signifies not tested for in 2013)

Station	Mean Secchi Disk (m)	Total Phosphorus (µg/L)		*E. coli* Yearly Mean	Total Coliform Yearly Mean
		Spring Turnover	Yearly Mean		
STR-0	2.29	8.8	7.5		
STR-1				14	138
STR-2				28	185
STR-3				6	67
STR-4				5	116
STR-5				5	76





Summary and Recommendations:

The spring turnover and yearly phosphorus means are generally consistent with the DMM threshold of 9.1 µg/L. *E. coli* counts remain below the MLA upper limit at STR-3, STR-4 and STR-5, and exceed the limit at STR-1 and STR-2. Beacon recommends that all sampling be continued to monitor long-term trends.

Appendix B

MLA Partners With Muskoka Conservancy News Release

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Media Release

July 26, 2013

Muskoka Conservancy and Muskoka Lakes Association Join Forces to Protect Shorelines

Thanks to a two-year $113,000 OTF Grant

News:
Muskoka Conservancy and the Muskoka Lakes Association (MLA) are launching a new collaborative project to create a flagship shoreline stewardship program that will build community-wide awareness of water quality issues and shoreline management options. The collaborative announced a two-year $113,000 grant from the Ontario Trillium Foundation (OTF) today during MLA's Annual General Meeting with a plaque presentation from OTF representative Bill Roberts.

“I am so pleased that Muskoka Conservancy and the Muskoka Lakes Association are working together on this very important project. It is imperative that we all take responsibility and participate in the sustainable management of our precious water resources and wildlife habitat. The shoreline-stewardship program will help to encourage greater community involvement while researching, educating, and promoting sensible water practices. The quality of Muskoka’s lakes, rivers, and shorelines depends on what action we take today.”
Norm Miller, MPP, Parry Sound - Muskoka

Over the next two years, the funding will support the partners to help improve the quality of Muskoka's shorelines and wildlife habitat connectivity, reduce human impact on lake and river water quality, and empower landowners to undertake simple shoreline restoration projects.

"The Shoreline Stewardship Program is a multifaceted project that will provide solutions to a host of shoreline issues while also showing the link between shoreline issues and water quality issues. This collaboration with the MLA will allow us to join forces and share information, skills, and work together to find solutions for shoreline owners. We are very thankful for the Ontario Trillium Foundation's commitment to environmental programming in our community."
Kristie Virgoe, Executive Director, Muskoka Conservancy

"The Muskoka Lakes Association is very excited about this collaboration between the MLA and the Muskoka Conservancy thanks to the Ontario Trillium Foundation. We believe this program has the capability of providing real improvement to the areas of the lakes that our research has shown need special attention due to a variety of stressors. The key to maintaining, but ultimately improving, the quality of the water in our lakes is education . This initiative will provide us with a vehicle to inform shoreline owners on manageable ways to protect the quality of our lakes and rivers and encourage the preservation of natural water's edge habitats through site visits, seminars and local media."
Lisa Noonan, Office Manager, Muskoka Lakes Association

About the Muskoka Conservancy:
For over 25 years, the Muskoka Conservancy (formerly the Muskoka Heritage Foundation and Trust) has provided comprehensive environmental stewardship and outreach programs as well as land protection. With over 200 active volunteers, the organization keeps its operation costs low and dedicates most resources to stewardship projects, land conservation, and community outreach. The Technical Advisory Group (TAG) and property management teams provide Muskoka Conservancy with a high level of expertise in areas of biology, hydrology, geology, and even archeology. Today, the organization protects over 1,800 acres of sensitive wetlands, forests, rock barrens, and 34,000 feet of Muskoka's

shorelines. Muskoka Conservancy believes in working with community to build and support a resilient Muskoka that honours the natural environment and the traditions of the area.

About the Muskoka Lakes Association:
With more than 2,300 members, the Muskoka Lakes Association is Canada's oldest and one of the largest associations of waterfront property owners. The MLA serves members and area residents near the municipalities of Bracebridge, Gravenhurst, Muskoka Lakes and Seguin, Ontario – with an emphasis on protecting and promoting water quality, advocating for responsible government spending and fair taxation, promoting responsible land use and providing leadership on important Muskoka issues. The association's head office is located in Port Carling, Ontario.

About the Ontario Trillium Foundation:
A leading grant-maker in Canada, the Ontario Trillium Foundation strengthens the capacity of the voluntary sector through investments in community -based initiatives. An agency of the Government of Ontario, OTF builds healthy and vibrant communities.

Learn More:

- For more information about Muskoka Conservancy, visit www.muskokaconservancy.org
- For more information about the Muskoka Lakes Association, visit www.mla.on.ca
- For more information about the Ontario Trillium Foundation, visit www.otf.ca

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Contact: Kristie Virgoe, 1-705-706-2948 kvirgoe@muskokaconservancy.org
Lisa Noonan, 1-705-765-5723 lisa@mla.on.ca


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