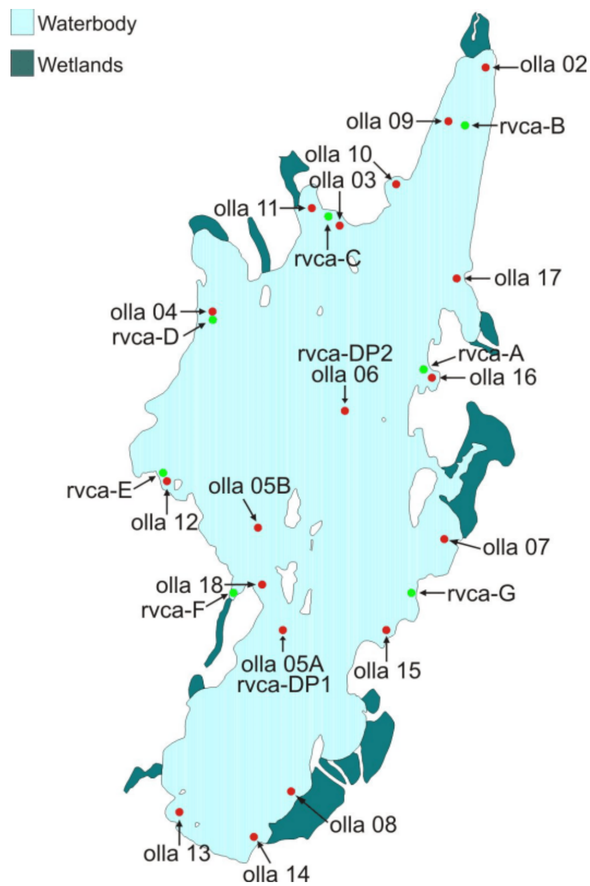
LAKE STEWARD'S REPORT - 2014

Water quality testing is an important diagnostic tool to help residents of Otter Lake determine the health of the lake. We need early warnings to predict important changes in the lake's ecological process. By systematic testing and monitoring over time, it is possible to evaluate if water quality is improving or declining. By selective testing at strategic sites, water quality indicators can help determine the source or cause of contamination. The ecological and trophic status of a lake is generally determined by the levels of nutrients it contains.



As in previous years OLLA was fortunate to have the assistance of the Rideau Valley Conservation Authority (RVCA) in testing the water quality of Otter Lake. Thanks are due to Sarah MacLeod, Kaitlin Brady and their qualified team of technologists for allowing us to include their data in this report. Both RVCA and OLLA test at least 3 times per year but at different sites. The map on the right indicates the location of all the current OLLA and RVCA test sites. These sites have been chosen to be representative of the whole lake. Sites 05A, O5B and 06 represent the 3 deepest water sites (more than 90ft). Sites 04, 07, 08, 11 and 18 are in areas where there are known inflows from streams and wetlands into the lake. Other sites are in shallow bays where there is an increased tendency for weed and algae growth.

NUTRIENTS & BACTERIA

Recreational water quality can be expressed in terms of how clear the water appears. Water clarity is influenced by the amount of soil sediment and phytoplankton, or microscopic algae, present in the water. Clarity is measured by a simple visual test using a Secchi Disk, a 20 centimeter black and white disk attached to a measured line. The disk is then lowered into the lake until it is no longer visible and the depth recorded.

Additional information on water quality is gained through analysis of samples for nutrients, specifically phosphorus and nitrogen, which gives an indication of how much nutrient and energy is available for the growth of algae and aquatic plants.

Nitrogen is an important and essential nutrient in aquatic ecosystems. In addition to fertilizers, agricultural waste and wastewater contribute nitrogen into lakes. In large amounts, ammonia and nitrates can be toxic to aquatic organisms. Total Kjeldahl Nitrogen (TKN) which is what we measure, determines the concentration of all forms of nitrogen in the lake. While there currently are no guidelines for acceptable levels of TKN, according to RVCA, TKN in water bodies not influenced by excessive organic inputs typically range from 100 to 500 µg/L.

Phosphorous is generally recognized as the limiting nutrient in freshwater ecosystems and the major nutrient contributing to eutrophication in lakes. Since phosphorous is the principal source of energy for all living organisms the amount of phosphorous in the environment will determine how fast an organism grows and proliferates. Phosphorus is therefore the principal limiting factor in the growth of algae, meaning that algae growth will occur in greater amounts as more phosphorus is added to a lake. It should be born in mind that a conventional septic system cannot do much with phosphorous. Any phosphorous that enters a septic system from phosphorous containing detergents will emerge intact, enter the water table and eventually the lake. Phosphorus levels below 5 µg/L are typical of **oligotrophic** lakes that generally are clear and deep with few nutrients. Such lakes are typically found in the northern regions of Ontario. Phosphorous levels above 20 µg/L are typical of **eutrophic** lakes that are laden with nutrients which lead to excessive algae and plant growth. **Mesotrophic** lakes are in between these two extremes and are typical of the lakes found in our region of Ontario.

Bacteria are present in all lakes, they will be found in the faeces of the wildlife (fish, waterfowl, beavers, etc.) that inhabit the lake. Coliforms are bacteria found in the large intestine of humans and other mammals and are usually present in soil. While some strains of coliforms do produce toxins, most are not harmful to humans. Some such as *Escherichia coli* (*E. Coli*) do produce pathogenic toxins. Therefore levels of *E. Coli* are often used as indicators of possible contamination by fecal matter. Thus high *E. Coli* levels in lakes or rivers can be an indication of septic pollution. The recommended safety level of *E. Coli* in a lake for recreational safety is not more than 100 colony-forming units (cfu) per 100ml of water. *E.coli* at any level is unacceptable for drinking water, therefore some form of treatment and purification is necessary for anyone who draws water from the lake for drinking purposes.

RESULTS FOR 2014

The table on the following page indicates the results of all the water quality testing done in 2014 by OLLA and RVCA. *E. Coli* levels were low or undetectable at all sites tested except at OLLA 07 in May. Site 07 is close to Barker's Creek, the major inflow into the lake and high *E. Coli* levels at this site are not uncommon since Barker's Creek drains an extensive wetland and farming area west of highway 15. E. coli was not detectable when site OLLA 07 was retested in June. Total Kjeldahl Nitrogen levels were generally in the acceptable range of between 200 - 500 µg/L at all sites tested. Phosphorous levels were all between 5 µg/L and 15 µg/L except for a very high reading at site 04 in May which was probably an analysis error. A reading of 22 µg/L was obtained by RVCA at site 06 in July, but this was a deep water sample and may have contained bottom sediment which would be rich in phosphorous. Secchi depth readings were generally between 4 and 7 metres indicating that the lake remains very clear. Increased water clarity means that sunlight can penetrate deeper and may often result in algae blooms over the summer months however there were no really significant algae blooms last summer. Therefore with an average phosphorous level of 10 µg/L and an average Secchi depth of 5.5 metres the lake remains on the borderline between oligotrophic and mesotrophic. The low *E. coli* values at virtually all sites tested indicates that the overall health of the lake is excellent.

Water Quality Test Results - 2014 (OLLA + RVCA)

RVCA ID	OLLA ID	E. Coli (cfu/100 ml)			Total Kjeldahl nitrogen (µg/l)				Total Phosphorous (µg/l)				Sechi Disk (meters)			
		Jun	Jul	Aug	May	Jul	Aug	Oct	May	Jul	Aug	Oct	May	Jul	Aug	Oct
	OLLA 02															
RVL-26C	OLLA 03		2	2		470	500			14	6					
RVL-26D	OLLA 04	0			290	470			39	11						
RVL-26DP1	OLLA 05A				620		480	400	8		5	10	6.25	4.25	4.75	5.50
	OLLA 05B															
RVL-26DP3	OLLA 06				430	430	470		10	22	6		7.45		5.50	5.25
	OLLA 07	50	0		480	480			13	12						
	OLLA 08															
RVL-26B	OLLA 09		2	2	510	470	460			13	5					
	OLLA10				550				18							
	OLLA 11															
RVL-26E	OLLA 12				340	490			11	10						
	OLLA 13					420				9						
	OLLA 14															
	OLLA 15															
RVL-26A	OLLA 16															
	OLLA 17					560				12						
RVL-26F	OLLA 18		2	2		440	480			13	6					
Average		**1.50**			**476.96**				**10.11**				**5.56**			
Std. Error		**0.35**			**31.06**				**0.77**				**0.39**			

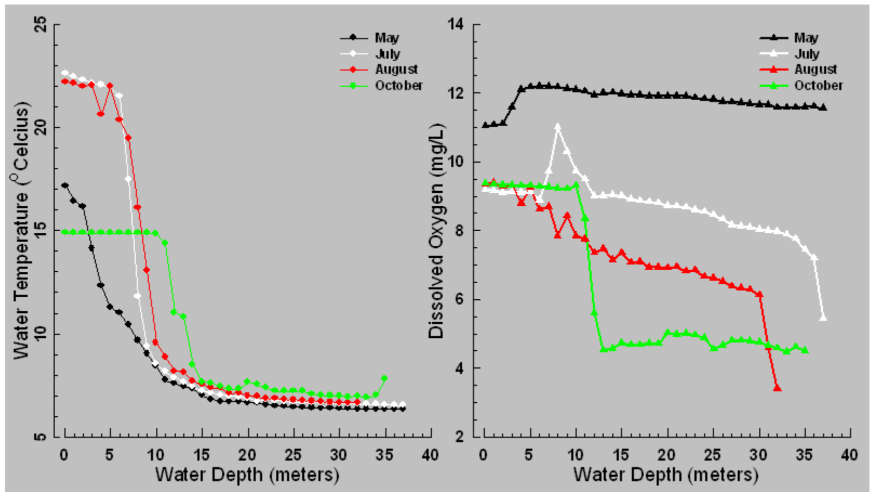
For comparison, the table on the right shows the water quality data for 2013 which is not very different from 2014 with the exception of slightly higher phosphorous levels.

Water Quality Test Results - 2013 (OLLA + RVCA)

RVCA ID	OLLA ID	Total Coliform (cfu/100 ml)		E. Coli (cfu/100 ml)			Total Kjeldahl nitrogen (µg/l)				Total Phosphorous (µg/l)				Sechi Disk (meters)			
		May	Jun	Jun	Jul	Aug	May	Jul	Aug	Oct	May	Jul	Aug	Oct	May	Jul	Aug	Oct
	OLLA 02																	
RVL-26C	OLLA 03				0	2		730	350			20	14					
RVL-26D	OLLA 04		3	0	0	2		440	550			9	25					
RVL-26DP1	OLLA 05A						380	390	450	380	6	8	8	7	4.50	5.75	5.75	12.50
	OLLA 05B																	
RVL-26DP2	OLLA 06							370	380	400	9	9	9	8	3.75	5.50		12.50
	OLLA 07		37	2	0	0		430	590			12	17					
	OLLA 08					0			730				25					
RVL-26B	OLLA 09				0	2		330	380			11	12					
	OLLA10		1	0														
	OLLA 11																	
RVL-26E	OLLA 12				0	0		340	440									
	OLLA 13				0	0		310	500			15	14					
	OLLA 14		12	0														
	OLLA 15																	
RVL-26A	OLLA 16				0	0		330	400			7	12					
	OLLA 17		1	0	0	0		420	530			10	21					
RVL-26F	OLLA 18		3	0	0	4		530	520			11	22					
Average		**3.63**		**0.48**			**446.15**				**12.84**				**7.18**			
Std. Error		**5.75**		**0.20**			**42.28**				**2.16**				**1.40**			

Dissolved oxygen (DO) and temperature profiling are important for lakes because both parameters affect all aquatic organisms and the chemistry of the lake environment. The life cycle of many fish and other aquatic organisms are dictated by water temperature and the amount of DO, which is why RVCA performs DO and temperature profiling 4 times a year. Since water temperature determines the concentration of DO in water temperature and DO are always measured together.

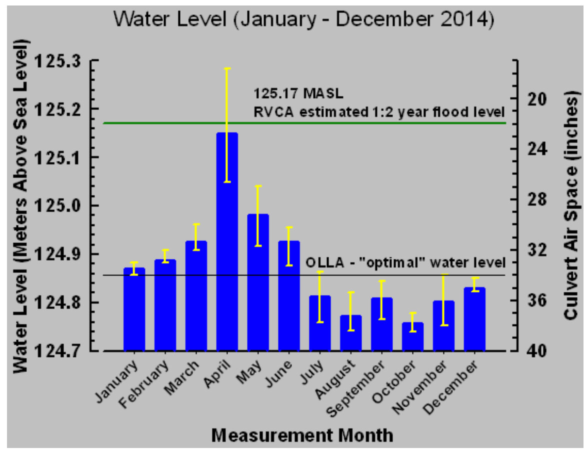
The primary source of oxygen in aquatic systems is the atmosphere with wind action constantly recharging the surface waters with oxygen. Lake water can also gain some oxygen as a byproduct of photosynthesis by algae and macrophytes. However, cold water can hold more DO than warm water. Therefore as the lake becomes thermally stratified during the warm summer months, oxygen cannot be replenished in the cold water below this warm layer known as the hyperlimnion. As a result, oxygen levels below the hyperlimnion diminish as the summer progresses. Unfortunately this is where deep cold water fish, such as lake trout live and breed.



The graphs on the right show temperature and DO measurements for the months of May to October, 2014 at OLLA 06, the deepest location in Otter Lake (35 metres or 120 ft). The graph shows how the water temperature changes during the course of the Summer months which leads to the development by July and August of an established hyperlimnion at between 10 and 15 meters. DO concentrations in mid May before any significant temperature stratification had occurred DO levels were quite high at 12 mg/L at all depths. DO levels dropped to 9 mg/L in July but were still relatively constant irrespective of water depth. However by August, we began to see a loss of DO occurring below the hyperlimnion but DO levels were still around 7 mg/L which is acceptable for cold water fish. By October DO concentrations were still at 9 mg/L above the hyperlimnion but had dropped to 4 mg/L below it. Depending on how long this level of DO persists it would be stressful for cold water fish since it is below the 5-6 mg/L that these species require. These results are very similar to what has been seen in Otter Lake since 2011, and it therefore remains unlikely that MNR will agree to restock the lake with cold water fish. However, Otter Lake remains a suitable habitat for all warm water fish species (water temperature <25°C and dissolved oxygen >4 mg/l).

WATER LEVELS

As many of you will remember, the Winter of 2013-2014 produced a lot of snow, not quite as much as the winter of 2008, but close to it. We also had some lengthy periods of very cold weather. As a result the lake was completely frozen over by December 15 and our ice sheet was very thick, up to 3 feet in some places by mid February. The water level rose somewhat in December, perhaps because the significant snowfall in late November and early December was followed by milder temperatures that melted a lot of that snow. The water level continued to rise slowly throughout the winter. If all the snow that was currently on the ground in March had melted slowly there would have been no serious flooding problems in the Spring of 2014. Unfortunately, that did not happen. With mild temperatures and 40 mm of rain in the first 2 weeks of April all the snow melted rapidly and with the ground still frozen there was nowhere for the meltwater to go except the lake. Water levels in Otter Lake in mid April were the highest they have been since OLLA started keeping records. The mid April water level even exceeded RVCA,s estimated 1:2 year flood level. Our situation was not unique since RVCA issued numerous flood warnings for the entire Rideau and Tay River Watersheds in April and May. The graph on the right represents the water levels for all of 2014. The vertical bars represent maximum and minimum water levels recorded for each month. There was significant flooding of low lying areas and cottage access roads, especially Roads O9, O10 and O3 in April which caused concern to some property owners.



Nonetheless, Otter Creek did remain open all winter and was flowing at maximum capacity throughout April and May. The "ice off" for Otter Lake occurred on April 24. The water level in Otter Lake slowly dropped 20 inches since the Spring high and has been fairly stable since July, at about the same level it was last year.

Doug Franks
Lake Steward