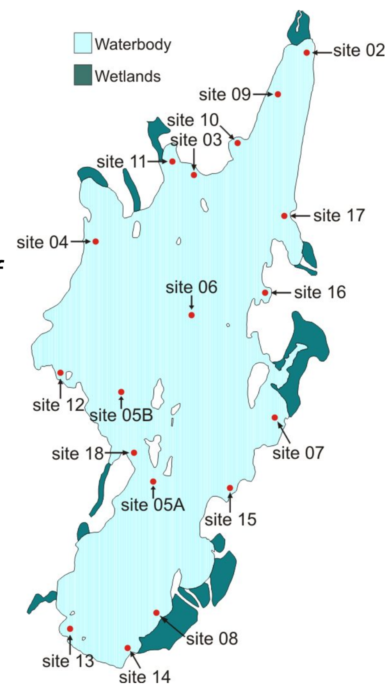
LAKE STEWARD’S REPORT - 2012

Water quality is affected by many things: natural processes of erosion and runoff accelerated by clearing of shorelines, the use of artificial fertilizers and leachate from sewage disposal systems. All result in too many nutrients reaching the lake. Too many nutrients cause profuse weed and algae growth which affect the aquatic animal species makeup by altering habitat and food sources and by reducing oxygen and light penetration.

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 once again 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. RVCA and OLLA both test at least 3 times per year but at different sites. The combined results give us a good indication of the overall state of health of the lake. The map on the right indicates the location of all the OLLA 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 sites 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. OLLA does not test at all of the sites each year, more often we test at select representative sites usually between May and October. Some of RVCA’s test sites duplicate OLLA’s but they also have sites that are distinct from ours.



NUTRIENTS & TROPHIC STATUS

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 that is lowered into the lake until it is no longer visible. Analysis of water samples for chlorophyll a, which provides the green pigment in phytoplankton, gives a more specific measure of the abundance of small creatures in the water. Another perspective is gained through analysis of samples for nutrients, particularly phosphorus but also nitrogen, which tells how much food is available for the algae and aquatic plants. In the late summer when the algae drops to the bottom of the lake, its decomposition uses oxygen, so to find out how much oxygen is available for fish and other aquatic animals, dissolved oxygen and temperature profiles are done. These tests combine to give an indication of the age of a lake and what can be expected. An old or eutrophic lake will have profuse plant growth and relatively few fish species.

The two key indicators of nutrient load in a lake are phosphorus and nitrogen. These are both principal ingredients of fertilizers. When these two are present in excessive quantities in surface water, they stimulate algae and aquatic plant growth, just as they would stimulate the growth of grass or flowers in a garden. Dissolved oxygen levels can also be used to determine the trophic status as they provide a measure of the impact of eutrophication (due to biological growth and decay). Bacterial pathogens (originating from stormwater runoff and leaking septic systems) can also be introduced into a lake, limiting recreational potential and threatening human health. *Escherichia coli* (bacteria found in the intestines of mammals) is commonly used as an indicator of faecal contamination.

<u>Phosphorous</u> 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 limiting factor in the growth of algae, meaning that algae growth will occur in greater amounts as more phosphorus is added to 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 stimulate algae and plant growth. **Mesotrophic** lakes are in between these two extremes and are typical of the lakes found in our region of Ontario.

<u>Nitrogen</u> is also an important nutrient in aquatic ecosystems. In addition to fertilizers, agricultural waste and wastewater contribute nitrogen in to lakes. In large amounts, ammonia and nitrates can be toxic to aquatic organisms. Total Kjeldahl Nitrogen (TKN) is a measure of ammonia + organic nitrogen. While there currently are no guidelines for TKN, according to RVCA, TKN in water bodies not influenced by excessive organic inputs typically range from 100 to 500 µg/L.

<u>Dissolved oxygen (DO) and temperature profiling</u> is important for lakes because both parameters affect all aquatic organisms and the chemistry of the lake environment. As the life cycle of many fish and other aquatic organisms are dictated by temperature, the relationship between DO and temperature is important. Also, since temperature determines the ability of water to hold DO, temperature and DO are usually measured together. Cold water can hold more DO than warm water. The primary source of oxygen in aquatic systems is the atmosphere with wind action constantly recharging the surface waters with oxygen. Lake waters also gain oxygen as a byproduct of photosynthesis by algae and macrophytes. However, as these die, they settle to the bottom of the lake where bacteria convert the organic material into carbon dioxide, consuming oxygen in the process. Because the lake becomes thermally stratified early in the summer, oxygen cannot be replenished in the water in the hypolimnion, the lower part of the lake,

so oxygen levels diminish. As a result, as oxygen levels are lowered, phosphorus in the bottom sediments becomes more readily soluble adding to the loading available for plant growth.

All the tests described above give an indication of the age of a lake and what can be expected. An old or **eutrophic** lake will have profuse plant growth and relatively few fish species because of the lack of open water and the competition for oxygen. A middle-aged or **mesotrophic** lake will support the greatest diversity of fish species with a variety of habitats and sufficient oxygen available. Young or **oligotrophic** lakes have very little or no vegetation and are usually well oxygenated but have relatively few fish species.

Bacteria will be present in all lakes, they are naturally present and 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 a few strains of coliforms produce serious toxins, most are not harmful. *Escherichia coli* (*E. Coli*) and coliforms 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 aquatic life and 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 2012

Water Quality Test Results - 2012 (OLLA + RVCA)

RVCA ID	OLLA ID	E. Coli (cfu/100 ml)					Total Kjeldahl nitrogen (µg/l)					Total Phosphorous (µg/l)					Sechi Disk (meters)			
		May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Sep
	OLLA 02																			
RVL-26C	OLLA 03				2						710					2				
RVL-26D	OLLA 04	0					340				570	3				4	7.5			5.50
RVL-26DP1	OLLA 05A							340		380	380	2	7		11	8			6.5	
	OLLA 05B																	7.0		
RVL-26DP2	OLLA 06									340	510	4	6		11	6	7.0		7.0	6.00
	OLLA 07	6	0		6		500	450		580	640	8	11		12	9				
	OLLA 08																			
RVL-26B	OLLA 09				10															
	OLLA10							520		490			7		8					
	OLLA 11	0					340					3								
RVL-26E	OLLA 12	0					460			350		8			5					
	OLLA 13				4			450		550			8		13					
	OLLA 14	0					360				510	3				3				
	OLLA 15							440					9							
RVL-26A	OLLA 16									350					6					
	OLLA 17							370					7							
RVL-26F	OLLA 18		2		2			330		360	400		10		11	2				
Average		2.67					445.19					6.90					6.64			

The table on the right indicates the results of all the water quality testing done in 2012 by OLLA and RVCA. *E. coli* was generally low or not detectable at all sites tested with the only exception being the slightly higher readings at OLLA 07 obtained in July and August. However site is 07 is where Barker's Creek flows into the lake.*E. coli* at site 09 was also a little high but for reasons unknown. This site will be retested this year. Total Kjeldahl Nitrogen levels were generally in the acceptable range of between 200 - 500 µg/L at all sites tested. Phosphorous levels were again less than 10 µg/L at most sites tested. The highest reading was 13 µg/L at site 13 which is in a very shallow bay at the south end of the lake. Secchi depth readings were all above 6 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 7 µg/L and an average Secchi depth of almost 7 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.

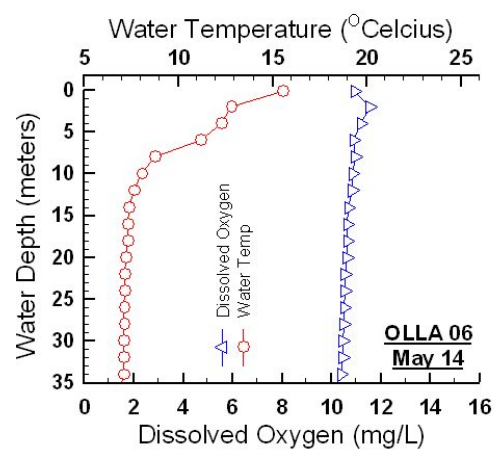
Water Quality Test Results - 2011 (OLLA+RVCA

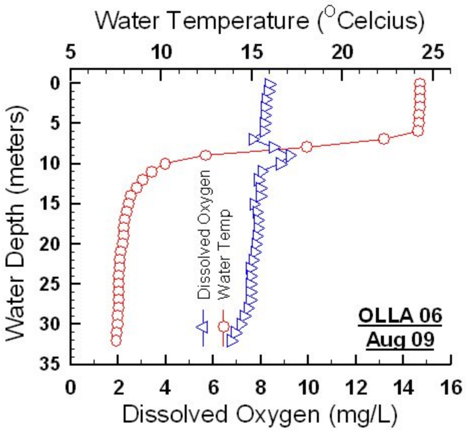
RVCA ID	OLLA ID	E Coli (cfu/100 ml)						Total Kjeldahl nitrogen (µg/l)						Total Phosphorous (µg/l)						Secchi Disk (meters)				
		May	Jun	Jul	Aug	Sep	Oct	May	Jun	Jul	Aug	Sep	Oct	May	Jun	Jul	Aug	Sep	Oct	May	Jun	Jul	Aug	Sep
	OLLA 02																							
RVL-26C	OLLA 03		0	<2					340	330					9	6								
RVL-26D	OLLA 04		0		2				370		380				5		7							
RVL-26DP1	OLLA 05A								520	320		290			21	3		14		8.5		6.5		6.25
	OLLA 05B																							
RVL-26DP2	OLLA 06								340	290		430			9	2		18			6.5	6.0		6.50
	OLLA 07			10	12					730	400					<2	4							
	OLLA 08				2						350						5							
RVL-26B	OLLA 09		0	<2					320	310					11	6								
	OLLA 10																							
	OLLA 11				2						410						8							
RVL-26E	OLLA 12																							
	OLLA 13				4						400						5							
	OLLA 14			2						550						<2								
	OLLA 15																							
RVL-26A	OLLA 16																							
	OLLA 17			<2						490						10								
RVL-26F	OLLA 18		0	4					340	300					7	4								
Average		3.17						389.06						8.11						6.71				

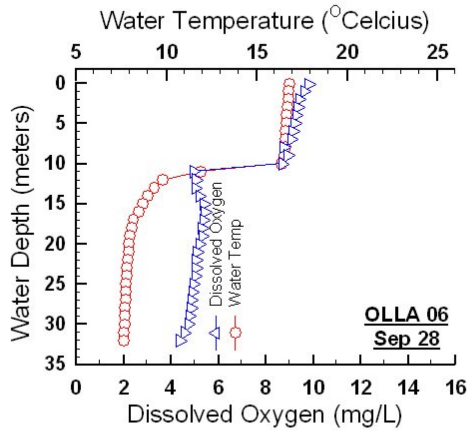
For comparison, the table on the left shows the water quality data for 2011 which is not very different from 2012 indicating that nothing drastic is changing.

As mentioned earlier sufficient DO in a lake is necessary for all aquatic organisms to survive. Dissolved oxygen concentrations are linked to water temperature and depth and will therefore fluctuate with the seasons. Over the winter, water temperature decreases and becomes relatively constant (below 10°C). As a result, DO is also relatively constant. As the lake warms up during the months of June through August DO at the surface remains plentiful since it is constantly being recharged from the atmosphere. However, since warm water is less dense than cold water, the DO in the warmer surface water is not able to penetrate the hyperlimnion. As a result, the DO below the hyperlimnion cannot be replenished and DO concentrations at depths greater than 10 - 15 metres will begin to decrease. This stratification of DO usually reaches a peak in early fall. Cold water fish such as lake trout, rainbow trout and splake require a minimum of 5-6 mg/L of DO below the hyperlimnion but will not survive if concentrations fall below 4 mg/L.

Otter Lake was stocked with splake by MNR in 1999, however by 2002 DO levels below the hyperlimnion were almost zero by the end of the summer. Hence Otter Lake would not have been able to support these cold water fish. The reason for this rapid drop in oxygen levels over the summer is unknown. However, beginning in 2007 DO levels began to improve. The following graphs show the water temperature and DO data obtained by RVCA for the months of May to September, 2012. The data shown are for the deepest location in Otter Lake (OLLA 06) which is about 35 metres (120 ft). As can be seen by the graph on the right, by mid May, before any significant temperature stratification has occurred DO levels were quite high at 10 mg/L at all depths. By August, when the hyperlimnion had



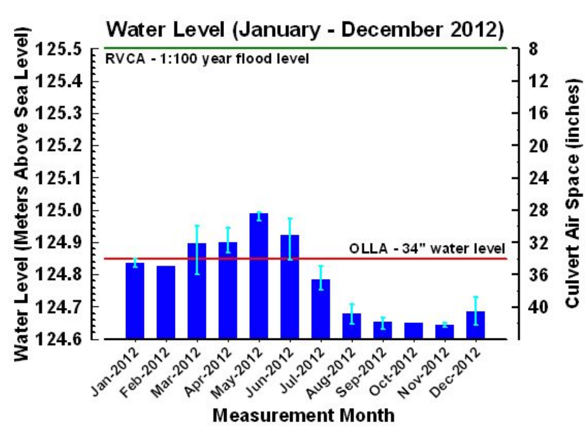




formed between 5 and 10 metres depth the level of DO had dropped slightly, but remained relatively constant. By late September DO concentrations were still at 8 mg/L above the hyperlimnion but had dropped to 4mg/L below it. Depending on how long this level of DO persists it might be stressful for cold water fish since it is below the 5-6 mg/L that these species require. These results are very similar to what was obtained in 2011 aand despite the low levels of DO reached by early fall, the DO levels do seem to recover well over the winter when the lake de-stratifies. Hopefully the May 2013 DO levels will indicate that this trend continues, since it will help us to convince MNR that Otter Lake can once again be restocked with cold water fish.

WATER LEVELS

As most of you will remember last Summer was very hot and dry. In fact RVCA announced as early as April that the entire Rideau watershed was in a Level 1 low water condition, and this was increased to a level 2 low water condition in July that remained in effect until October. Many lakes in the area had extremely low water levels as a result of these near drought conditions. Nonetheless, Otter Lake survived the summer quite well mostly as a result of beaver activity. As reported in an earlier Newsletter, beavers built a dam in the culvert where Otter Creek flows beneath Otter Lake Road. This dam remained in place for most of the summer even though the Township removed it every couple of weeks. The end result was that the lake had reduced outflow and the lake survived the water loss due to evaporation considerable better than other lakes in the region. The graph on the right shows the Otter Lake water levels for 2012. The reference line in red shows the empirical “optimal” water level of 34" put forward by OLLA at the AGM in 2007. RVCA performed a detailed study of water volume, inflow and outflow rates on Otter Lake in the spring of 2011 and came up with a new 1:100 year flood level for Otter Lake of 125.5 meters above sea level (masl). This level is shown on the graph by the upper reference line in green.



In 2012 most of our winter snow melted

in late March when we had an incredibly long spell of extremely mild weather. Interestingly, the ice was completely off the lake by March 23, probably the earliest on record. There was a fair amount of rain in April, hence the rise in water level in May. Even though we had some very warm weather in May we also had significant rainfall. The rainfall, coupled with the fact that some beaver dams breached on at least two streams that feed Otter Lake resulted in a significant increase in water levels, so our spring "high" was actually reached in May and June. However, since there was little rain in June and July the water level dropped quite rapidly, mostly as a result of evaporation. The 34 mm of rain we received in August was not sufficient to counteract the evaporation loss. However, the 106 mm of rain we received in September allowed the lake level to remain about the same as it was in August and throughout the remainder of the fall.

Doug Franks
Lake Steward