July 25, 2015

STATE OF THE LAKE REPORT
OTTER LAKE
Township of Rideau Lakes

Image courtesy of artist Philip Craig

1.0 INTRODUCTION

The purpose of the Otter Lake Sustainable Lake Plan is to identify the significant social, natural and physical features that make the lake and its surrounding area a desirable place for people to live and visit. The State of the Lake Report is a snapshot of the existing conditions that characterize the lake environment and provides a platform from which to launch the goals of the Sustainable Lake Plan. The final plan will recommend a series of actions that will ensure the long-term sustainability and healthy existence of the lake for future generations. The actions will encompass the lake's health, beauty, wildlife habitat, recreational opportunities as well as opportunities for residential and commercial development.

This summary document was prepared to promote discussion with government agencies, commercial operators and residents about the possible actions to be included in the Sustainable Lake Plan. The following observations and recommendations are taken from various background documents including RVCA reports, scientific papers, and OLLA records.

The observations are based on the information that has been collected to date and the framework for the report is drawn from best practices of Lake Plan templates from the Rideau Valley Conservation Authority and the Federation of Ontario Cottager's Associations.

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2.0 CHARACTERISTICS OF OTTER LAKE AND THE CATCHMENT AREA

2.1 History:

Otter Lake was carved from the retreat of the last ice age about 10,000 years ago. The location of the lake is positioned where a limestone plain intersects with the pre-Cambrian Shield causing a combination of features from both geological formations. Native fish populations populated Otter Lake at that time and largely evolved separately from other lakes until stocking began about 1920.

By 1830 some commercial and agricultural activity began in the area and some clearing began of the catchment basin draining into Otter Lake. It is suggested by Smol et al (1) that some degradation of water quality could have occurred as a result of large scale clearing of land in the catchment area during this period. Michalski and Usher (2) suggested in 1992 that Chlorophyll levels in the water column increased from half to three times in the last 200 years as a result of development on and near the lakes in the Rideau Basin. Chlorophyll is a measure if biological life in the water column as a result of nutrient enrichment.

There is some evidence that indigenous people spent time in and around Otter Lake using it for fishing and hunting. Settlers began fishing the lake in earnest in the early 1900's. Winter harvesting of Lake Trout occurred and some sport fishing began as roads and trains opened up the area for visitors. By 1930 some shoreline development began and by 1940, there were several cottages and a few permanent residents and farms around the lake.

Cottage development continued through the 1960's and 1970's with the number increasing from about 200 in 1970 to about 290 in 1980. (3) (4) Most of the new lots were created as farmland was abandoned and subdivided. MNR surveys in 1975 (5) expressed concern over development pressure and the effect on fish habitat.

Commercial operations contributed to the recreational appeal of the lake. Some have been in business since 1940 and expansion has continued to the present. Commercial operations include trailer sites and rental cabins.

Wickware (6) documented the location of development as it existed in 1959, 1965, and 1970. Higher ground and proximity to roads appeared to be the driving factors for early development. As the private road network expanded, access to other building lots became possible.

2.2 Watershed Characteristics as documented by RVCA and MNR:

- Lake Surface Area 572 ha
- Catchment basin draining into the lake: 36.38 km^2
- Shoreline: 20.1 km
- Lake Volume: 60.5 x 10^6 cubic meters
- Estimated Inflow: 15.2 x 10^6 cubic meters
- Exchange Rate or Flushing Rate: 0.25 times per year
- Max Depth: 36 m
- Drainage through Otter Creek for about 30 km to the Rideau River
- No upstream lakes over 25 ha

RVCA hydrology reports characterize the lake as a high volume lake with a relatively low flushing rate, meaning that inflow and outflow measured annually is approximately a quarter of the total volume of the lake. The surface of the lake represents a relatively large percentage of the total catchment area which results in a quick response to precipitation compared to lakes with a large catchment area relative to the size of the lake.

Soils surrounding the lake are relatively shallow on the igneous granite and sedimentary

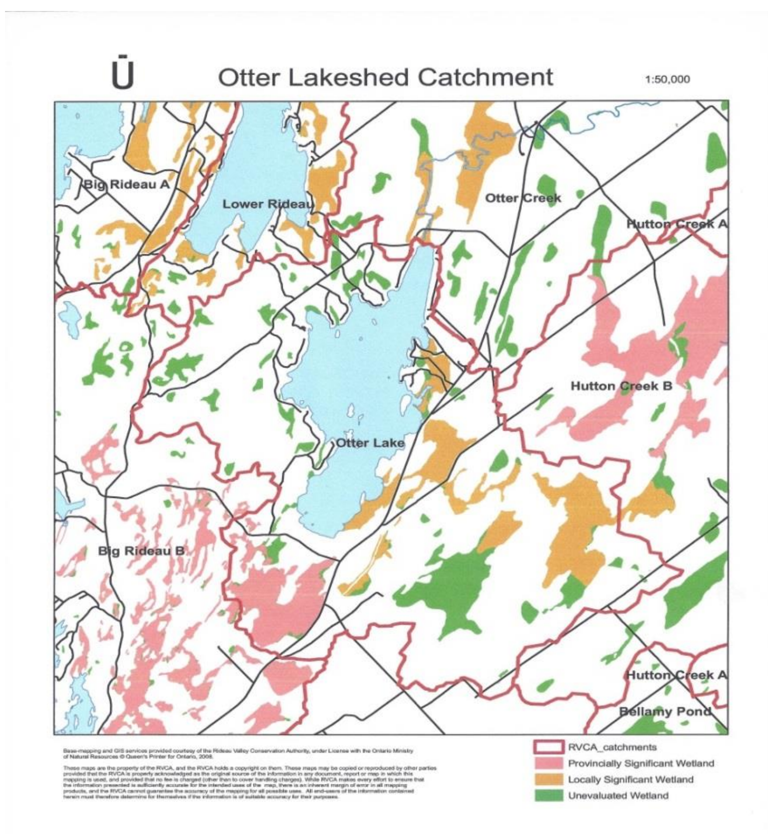


Figure 1

limestone underlays. Depths of soil range from less than 1 meter to about 3 meters. Pockets of well drained loam support mixed hardwood and coniferous forest.

Wetlands are abundant on and near Otter Lake and include provincially and locally significant areas. In figure 1, the wetlands are apparent as outlined in different colours which represent relative environmental significance.

Farming and logging operations established in the area in the early 1800's and were significant contributors to the local economies until the 1900's. Gradually farmland was abandoned with some being sold for waterfront lots and the remaining being returned to a natural state. Some local farming continues and periodic forestry operations occur in the RU (rural) areas nearby.

Statistics Canada reports that the population of the Township **declined** 1.4% between 2006 and 2011.

3.0 WATER

The RVCA 2009 document entitled: Rideau Lakes Watershed Plan – Priorities and Recommendations…..describes the preservation of water quality as its number one goal. (7) Surveys of Otter Lake residents have determined that water quality is by far the most import issue. (8)

Most of the lakes in the Rideau Watershed are described by RVCA as either "Eutrophic" or "Mesotrophic". These classifications are based on the degree of nutrient loading and plant and algae growth within the lake.

Otter Lake is relatively deep compared to its area and Phosphorus levels appear to be less than neighbouring lakes such as Bass Lake and Upper Rideau Lake. Where the latter lakes are categorized as "Mesotrophic", which means they have more nutrients and plant life, Otter Lake trends toward "Oligotrophic" which is characteristic of deep, clear lakes. This may mean that nutrient contamination here will have a more profound affect compared to the same amount deposited in another lake. Some municipalities classify lakes according to their sensitivity to Phosphorus or other characteristics however no such system is in place in Rideau Lakes Township or under the RVCA jurisdiction. There is however a comprehensive system of site assessment administered by the RVCA which is discussed under the Development heading.

3.1 Water quality

Surveys conducted by OLLA in 2006 and 2015 (8) indicate water quality is a top priority with residents. A 1994 Shoreline and Resident survey (9) performed by the Township of South Elmsley indicated that 90% of us use the water recreationally, 70% use it as a source of wash water and 20% use it as a source of drinking water. Water sampling and a range of testing has been performed for about 10 years by OLLA and intermittently for many years prior. In addition samples have been drawn by technicians at the Rideau Valley Conservation Authority and the combined information from OLLA and the RVCA provides a detailed data set for nutrients, bacteria, and dissolved oxygen. There are periodic water chemistry reports conducted by MNR and MOE that are decades old and provide some historical reference points. Much of the work was performed to support fish stocking activities that were been done between 1920 and 2002. These historical tests suggest that Otter Lake had a healthy native Lake Trout population and was classified as a "Trout Lake" under provincial policy. Overfishing on the Rideau Lakes led to efforts to stock Otter Lake as an alternative fishing location. At some point in the past, water quality changed and/or environmental conditions changed and both the native Lake Trout and introduced salmonid species declined or failed to survive. (10)

Sampling points are identified on the map in figure 2.

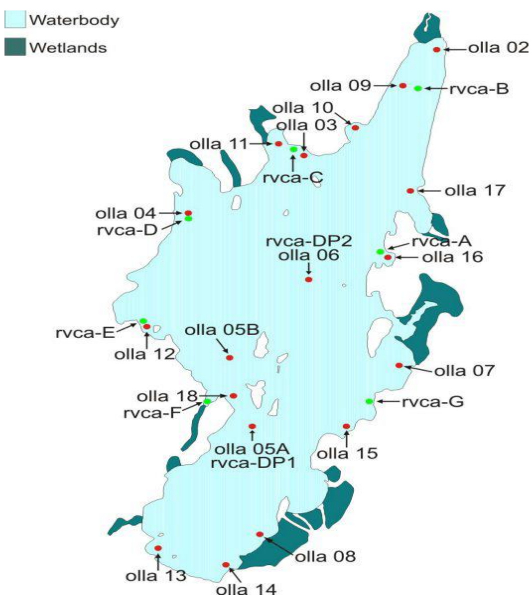


Figure 2

Oxygen and Temperature:

Temperature and depth readings taken during the summer indicate that there is a normal thermocline however oxygen levels in the deep levels (hypolimnion) are often less than the 7 ug/L required for trout species to thrive and that specified by provincial policy to qualify as a "Trout Lake". Although historical oxygen reports are not available, field notes and observations made by field technicians for MNR in the 1950's (10) through to the 1970's suggest that there was a gradual decline in cold-water fish in response to declining cold water characteristics and/or loss of habitat and spawning grounds.

Nutrients:

Nutrients, especially Phosphorus, are indicators of lake health. Sampling has been done over many years and recorded over a background of changes such as development pressures, septic technologies, changes to consumer products, invasive species and climate change.

Dr. John Smol of Queen's University, (1) suggests that water nutrient levels in Otter Lake prior to 1900 were probably higher than they are now. Total Phosphorus may have been as high as 30 ug/L compared to an average of about 12.8 in 2013. This probably would have resulted in a more turbid water profile with much more algae than what we see today. It is suggested that as fields were cleared for agriculture and lumber, massive amounts of nutrients were released into the water from decomposing root and vegetative matter in a relatively short period of time. Today it is possible that open fields being reclaimed by nature are acting as a nutrient sink thereby keeping them from the lake.

Phosphorus is the "limiting factor" in algae and aquatic plant growth in a sensitive lake meaning that there is a direct response in growth when additional Phosphorus is available. Other nutrients and trace elements are important as well however Phosphorus is the chief indicator for water quality. Phosphorus contributions arise in large part from human activities so long term monitoring is desirable. The table below illustrates the most recent data as collected by OLLA and the RVCA.

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			

Figure 3

Water Clarity:

Water clarity is a measure of the population of plankton in the water column and this is usually accepted as an indicator of eutrophication resulting from nutrient loads. This measurement has been confused by the introduction of Zebra Mussels about 15 years ago which are aggressive feeders of plankton. The Sechi Disk readings, as tabulated above, indicates an improvement in water clarity since early readings taken from 1950 to 1995. (10) The average for the Rideau watershed is 5 m. The average for Otter Lake at 7.18 m in 2013 is 43% better than the watershed average. There has been an approximate 40% increase in water clarity in Otter Lake over recent years but this does not necessarily indicate an improvement in water quality since Phosphorus levels have remained fairly consistent. In the absence of Zebra Mussels, nutrients are utilized by plankton and would grow in response to increased Phosphorus in the water. These small species of algae would increase quickly in the water column and this would lead to a decrease in water clarity. Although this relationship still exists, the introduction of Zebra Mussels has increased clarity so measurements of chlorophyll and water clarity are not reliable indicators of Phosphorus loading as they once were.

While water clarity is usually considered desirable, this change has created a different lake environment. As the sun penetrates to greater depths, the available habitat increases and the nutrients formerly utilized by plankton become available to others. Anecdotal evidence from surveys in 2006 and 2015 indicates that there has been an increase in aquatic plants and larger species of algae since water clarity has increased. Other factors such as a warming climate and changing oxygen levels may be influencing the increase in certain aqueous plants and filamentous algae or "slime". There is a possible link between water clarity, nutrient loading, and oxygen however scientists haven't yet documented which of these factors has the greatest influence. A survey in 1994 reported that 80% of lake residents felt that algae and plant growth had increased in previous years. (9) Records for adjacent lakes at that time show a gradual increase in Phosphorus so it is possible that Otter Lake was subject to that trend as well. The 1994 survey was prior to the introduction of Zebra Mussels so concerns about algae have been with us for some time.

Coliform Bacteria:

Routine sampling indicates bacteria levels fall within recommended provincial guidelines. Coliform bacteria originates in the gut of mammals, and although high levels can be caused by non-human sources, it is generally accepted that high levels are a result of human activity and could be due to inadequate septic treatment before waste water reaches the lake. Over 10 years there have been a few high readings but none on a regular basis.

Heavy Metals:

Water samples were tested by OLLA for lead and mercury in 2007 and found to be at very low levels.

3.2 Septic Systems and Impact on Water Quality

Phosphorus and other nutrients arise from several sources, one of them being the nutrient loading from septic systems. At this time scientists assume some of the Phosphorus produced in septic systems with leaching beds eventually makes its way to the water body. (12) How much reaches the lake is dependent on soil types, drainage, and vegetation buffering the leaching bed. For seasonal residents studies have shown that on average .66 kg of Phosphorus is produced per person per year. For permanent residents it is approximately 2.39 kg. Anecdotal evidence suggests that buffer strips of vegetation between the septic leaching bed and the lake prevents or delays the introduction of nutrients to the lake. There are no studies that document an exact relationship between vegetation and nutrient leaching into a water body but there is a general acceptance that the greater the buffer strip, the less contamination will reach the lake. Peterjohn and Correll 1984 (13) suggests that a 30 m buffer strip will capture a very high percentage of the nutrients.

In a 1992 report by Michalski and Usher, (2) development was attributed to 59.1% of the Phosphorus on Bass Lake but only 41% on Otty Lake. It was noted that at that time Bass Lake had on average, more residents per km of shoreline and less shoreline vegetation. Otter Lake was not part of the study.

Properly maintained advanced secondary treatment systems such as "EcoFlow" and "Clearwater" do a good job of reducing nutrients discharged to ground water. In 1994 approximately 90% of septic systems around the lake were traditional tank and leaching bed systems.(9) Since then an undetermined number of residents have adopted the use of advanced systems which would have a beneficial effect on nutrient loading and thus water quality. The nutrient levels recorded in figure 3 indicate levels well within the range of the Ontario Water Quality Standards. Nothing is known about the pre-development levels (notwithstanding the Smol estimate) but Michalski and Penner suggested that the nutrient load has doubled or tripled in the last 200 years in the Rideau Lakes Basin. It is unknown what the background levels were prior to development activity around the lake.

Septic systems can be a source of pathogens such as E.coli and other fecal coliform bacteria. OLLA testing has indicated Otter Lake has low levels of bacterial contamination on average which suggest that in general there is minimal contamination from septic systems. However the 2007 voluntary septic re-inspection program conducted by Rideau Lakes Township revealed that there was a 56% deficiency level meaning that at least one defect was found in over half of those inspected.

3.3 Otter Creek Water Quality

Field studies on Otter Creek by RVCA (14) rate the condition as "fair" based on high nutrient and bacteria levels. Based on samples of benthic organisms (bugs in the mud) it is rated as "poor". Over a period of 6 years 76% of E.coli counts and 67% of Phosphorus levels exceeded provincial guidelines. It is unclear what has contributed to the less-than-ideal rating for Otter Creek. RVCA recommends further study and actions to improve the quality characteristics.

Creek netting studies by RVCA indicate that Otter Creek is a primary spawning area for certain species of fish and contains a diverse population of wetland flora and fauna species. Preserving spawning habitat and water quality is important to the fish populations in the lake. (15) (16)

3.4 Water Levels

Water levels have fluctuated within a range of 0.8 m or 2 feet 7 inches since water level records have been routinely recorded starting in 2003. Usually fluctuations are limited to about a half meter in a given season. The graph charting these fluctuations is in figure 4:

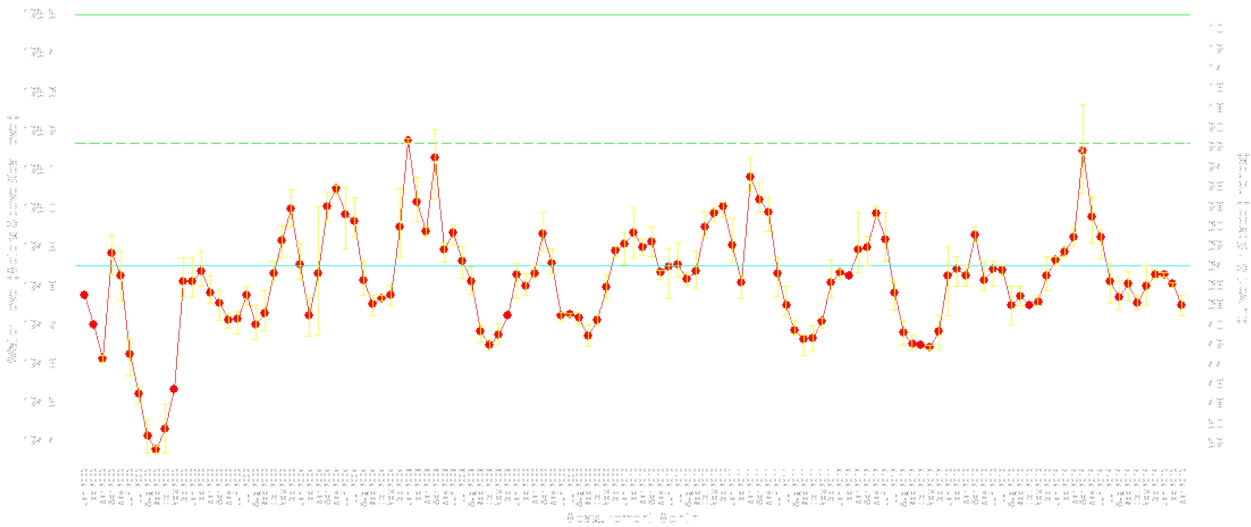


Figure 4

Water levels are dictated by several factors including precipitation, ambient temperature, and the presence or absence of beaver dams in key locations of inflow and outflow creeks. The RVCA has determined that the 1:100 year flood level is 125.5 Meters Above Sea Level (MASL) which in familiar terms is about 9 cm below the top of the culvert under Otter Lake Road and is about 30 cm higher than the highest levels experienced in the last 10 years on Otter Lake. A 2011 hydrology report concludes that the culvert under Otter Lake Road would function adequately in a 1:100 year flood or at least within expected parameters. (17) This is based on the assumption that there is no beaver activity in the culvert or at the ridge 200 m downstream which has an elevation of 124.4 MASL. The ridge elevation is about 50 cm above the bottom of the culvert and even without beaver activity there, water flow stops when the water level drops to that elevation.

The significance of the 1:100 year level of 125.5 MASL is that this figure can be used to restrict development on property on the flood pain or on properties served by roads that are under this elevation.

OLLA adopted a water level policy in 2007: "***The natural flow of water into and out of Otter Lake should be left to the forces of nature. In the event that water level extremes (high or low) occur, OLLA will use its best efforts to communicate with authorities that can undertake remedial action on water flow, either inflow or outflow, to reduce damage, pollution, and other environmental effects. This policy will be construed and***

applied in accordance with the laws of the Province of Ontario and of Canada".
The policy is intended to recognize that water levels will not be managed to a specific level but it does recognize that it is desirable to mitigate extreme flooding where possible to minimize environmental impacts to shorelines and damage to property. In the presence of extreme drought and low water levels, there are few options available but to the extent possible OLLA will seek remedies with the appropriate agencies.

The 2006 survey of residents indicates that 64% find water levels acceptable, 20% had no opinion, 16% thought they were too high, and 14% too low. 50% thought that water levels should not be controlled by artificial means, 21% had no opinion, and 28% thought water levels should be controlled.

2006 RESIDENT SURVEY

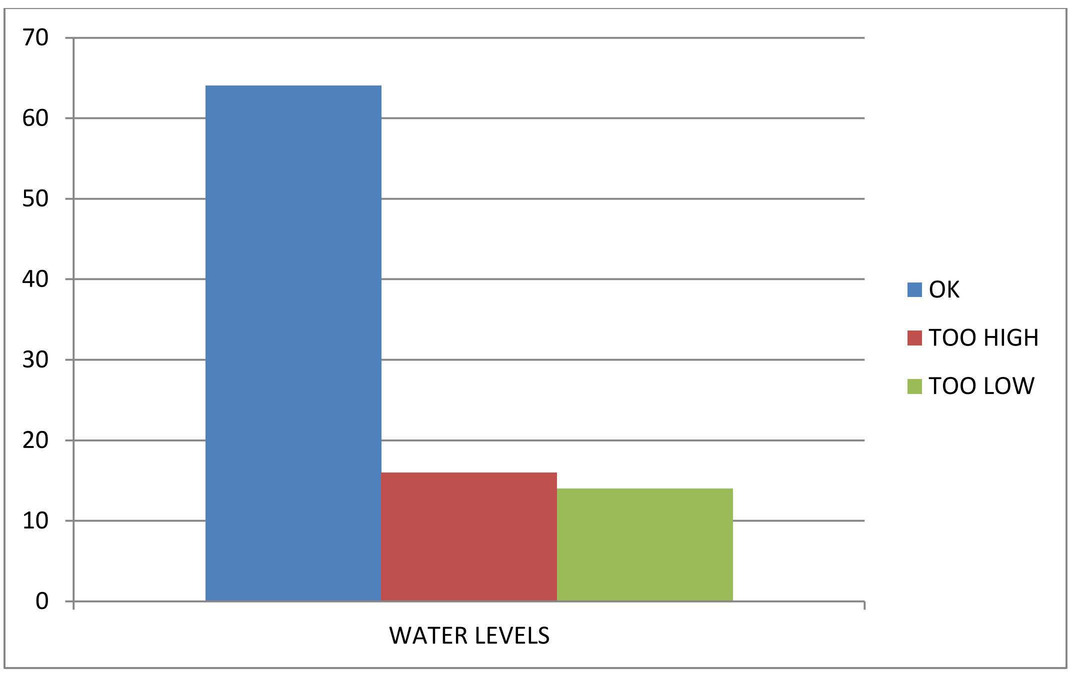


Figure 5

In the 2015 survey there were no specific questions related to water levels but there was an opportunity to express opinions. 12% of responders raised water levels as an issue. Of all responders, 8% favour a "hands-off" approach to water level control, 2% favour managing to lower water levels and 2% favour higher water levels. Of the total, 88% did not raise any water level issues.

The RVCA has a mandate to monitor and alleviate flooding from beaver dams as outlined in its 2015 Work Plan. They perform this task in several areas including Kemptville Creek and Otter Creek.

In 2007, RVCA began a program of removing dams in the upper reaches of Otter Creek in an environmentally responsible manner. This was in response to general concerns about spring flooding from residents and maintaining culvert drainage by the Township.

In 2011, OLLA approved a motion at the AGM to support the continued action by RVCA regarding beaver management as they have since 2007.

A resident group, the Otter Creek Beaver Management Group, works with the Rideau Valley Conservation Authority to monitor beaver activity in the upper reaches of the creek. When action is required to prevent flooding, the RVCA facilitates the removal of dams in a way that minimizes impact to fish and wildlife. This means that it is done in a way that fish spawning areas are protected and the downstream natural areas are not damaged. RVCA and the Otter Creek Beaver Management Group is committed to acting within the scope of the OLLA water level policy.

4.0 NATURAL ENVIRONMENT

4.1 Aquatic Plants and Algae

Aquatic indigenous vegetation is an important aspect of a healthy lake ecosystem and therefore must be understood and respected. Aquatic plants are categorized as either submersed or floating, but some can be both. Residents on Otter Lake have reported an increase in aquatic plants which is likely, in part, due to the introduction of zebra mussels but may also be influenced by climate and changing water chemistry. An overgrowth of indigenous aquatic plants can have a negative effect both on the health of a lake and from a recreational perspective. Aquatic plants and algae contribute to fish habitat therefore indiscriminate destruction is unlawful. Removal of any aquatic plants is allowed under certain conditions and guidelines and with the appropriate permissions received from MNR.

Field surveys of flora and fauna of the natural environment, conducted by RVCA, MOE, and MNR since 1930 have revealed a lengthy list of species. These can be found in Appendices 1, 2 and 3.

4.1.1 Aquatic Plant Survey

In 2005, the OLLA Lake Steward surveyed Otter Lake to determine how many species of aquatic plants existed. The following were found:

Water Milfoil, *Myriophyllum sp.*
Coontail, *Ceratophyllum sp.*
Canada Waterweed, *Elodea sp.*
Pondweed, *Potomogeton sp.*
Water Lily, *Nymphaea sp.*
Duckweed, *Spirodela sp.*
Pickerelweed, *Pontedaria sp.*
Bladderwort, *Utricularia sp.*
Cabomba sp. (no common name)

Three of these species were found in a 1930 MNR survey: Milfoil, Canada Waterweed, and Pondweed.

4.1.2 Invasive Aquatic Plants

There has been no comprehensive study of aquatic invasive plants in and around Otter Lake. Plants considered to be "invasive" are introduced from other geographical areas or other parts of the world and threaten the natural environment of existing aquatic vegetation. Invasive species do not typically have natural predators, are easily adaptable and thrive in disturbed systems thus reproduce quickly and out-compete common vegetation. Indigenous species can also be considered a problem if moved from one lake to another. The most common pathway for spreading aquatic invasive plants is recreational boating but they can also be introduced by ATVs, bikes, wind, water currents, gardening and aquariums. Many invasive plants are readily available for purchase at gardening centres and pet stores. Education is paramount to prevent the introduction and spread of invasive species. Early detection and rapid response is the only way to manage, and possibly eradicate, an invasive plant. Participation in the new Aquatic Invasive Species (AIS) Program is strongly recommended. The program is offered through an MNR and OFAH partnership and facilitates early detection, mapping and trending.

The following list of aquatic invasive plants is on the Watch List:

- European Frog-bit
- European Water Chestnut
- Fanwort
- Flowering Rush
- Hydrilla
- Parrotfeather
- Yellow Floating Heart
- Yellow Iris
- Water Soldier

Note: European Milfoil and Purple Loosestrife are considered to be too firmly entrenched to be on the Watch List.

4.1.3 Algae Blooms

Algae blooms can be attributed to a favourable set of conditions such as ideal water temperature, excessive nutrient levels, and adequate sunlight penetration of the water column. In some cases, lack of wind is favourable especially for certain species of blue-green algae. Usually there are many species of algae found in Otter Lake at any given time but their appearance isn't noticed until growth is more visible or excessive.

Of particular concern are blue-green algae blooms. Some species are harmless, such as *Anabaena sp.* which is noticeable in Otter Lake as a black scum on dock and boat lift legs at the water surface. Some species can produce toxins that cannot be removed by filtration or boiling. There are no reports of blue-green algae on Otter Lake in recent years. There was a blue-green bloom on the Upper Rideau Lake in 2014.

4.1.4 Algae Survey

In 2005 the OLLA Lake Steward found the following larger species of algae in Otter Lake:

Stonewort, *Chara sp.* Found in higher calcium lakes, in shallow water.
Muskgrass, *Nitella sp.*
Spyrogyra sp. This is the filamentous algae that can form slime, sometimes called "Elephant Snot".

There are numerous species of microscopic species of algae, including the class called Diatoms that inhabit the lake. Most are beneficial and can be good indicators of lake health. Diatomaceous algae are very sensitive to their environment and live in very narrow environmental conditions. When they die, Diatom's crystalline shells are deposited in lake sediments where they can be identified according to deposition rates. Smol's study (1) of the environmental effects of the construction of the Rideau Canal used Otter Lake as a control. One of the interesting parallels is demonstrated in the relationship between Phosphorus levels and the Diatom Aurlcoseira sp. This species population is closely tied to Phosphorus levels and therefore Smol estimated Phosphorus levels in Otter Lake from the levels of Aurlcoseira in the sediments.

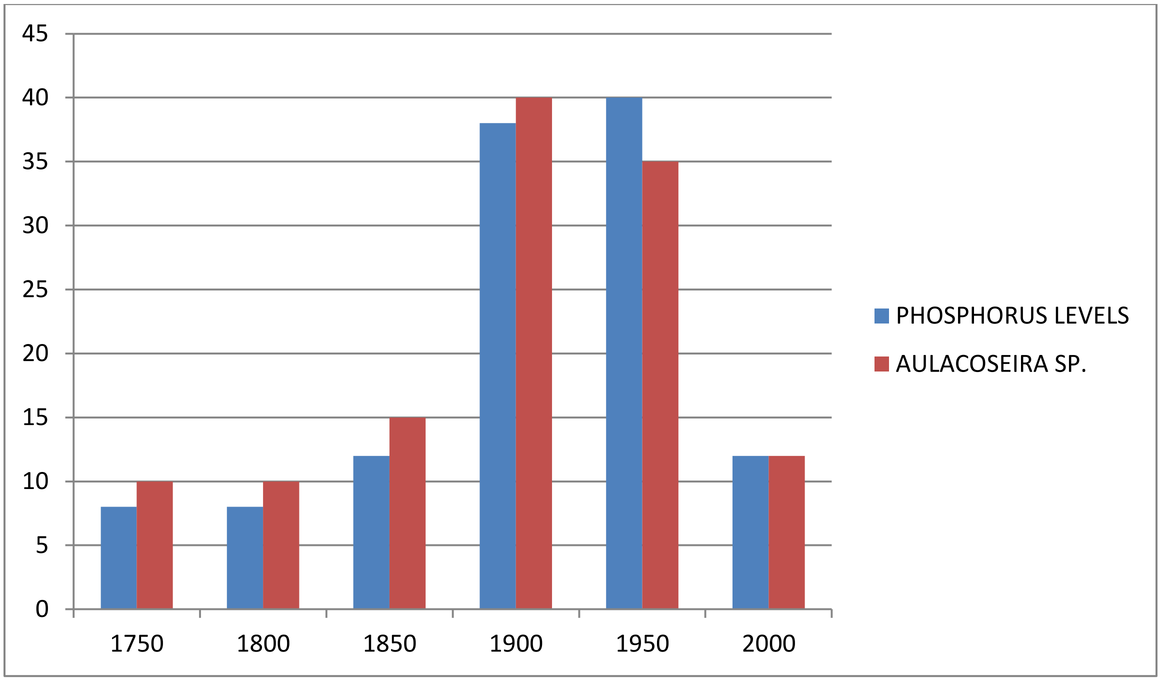
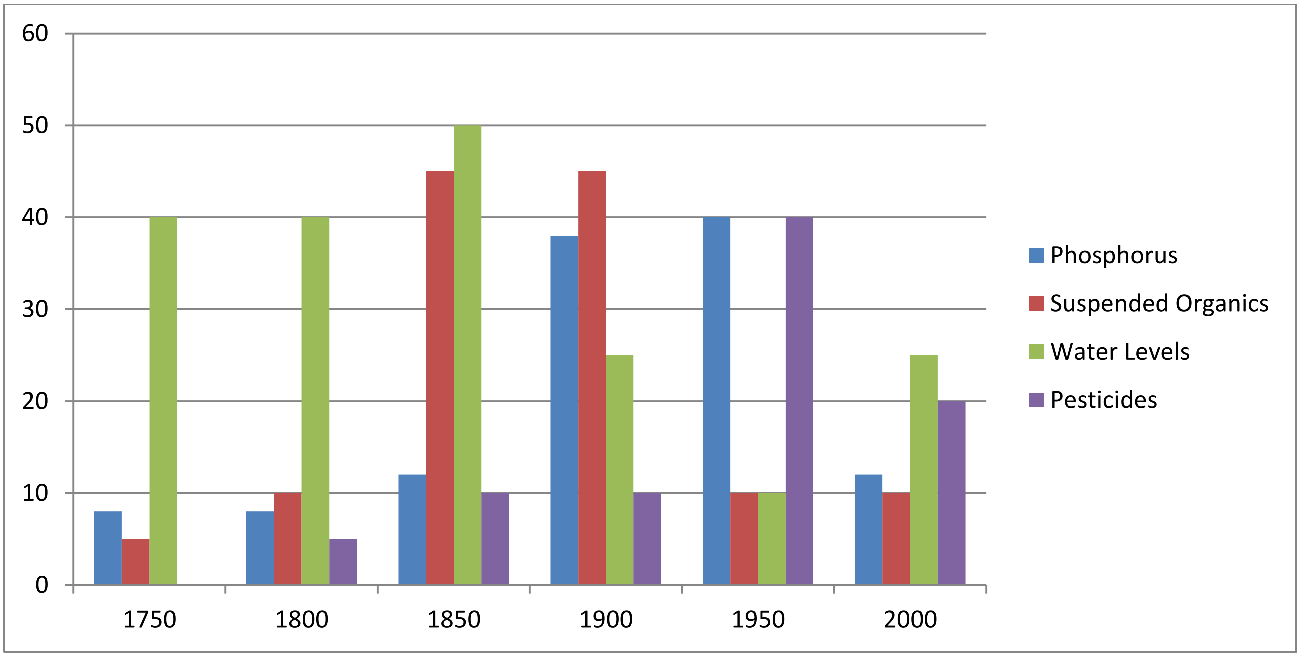


Figure 6

With the close relationship between water conditions and certain algae species, the water conditions of the time can be predicted.

By tracking the Diatom class of algae population of various species in Otter Lake sediments from 1750 to 2000 the following lake characteristics were estimated by Smol:

Figure 7



The results suggest that water levels were higher in 1750 but conditions were stable as no outside forces such as deforestation, beaver trapping and development had influenced the lake environment. As development occurred, organic levels and phosphorus rose. Beaver trapping probably had a lowering effect on water levels from 1850 through to 1950 until this practice declined.

4.2 Shoreline Conditions

Various field surveys by MNR from 1930 to 1999 have recorded some details about shoreline conditions. A 1986 survey which included scuba inspections, revealed conditions of sub-surface materials (i.e. gravel, silt, muck) in an effort to determine fish spawning habitat. (18)

In 1994 a summer survey of 100 properties on Otter Lake was completed by the Township of South Elmsley. (9) It was determined that approximately 42% of the shoreline was "natural" and approximately 45% was "manicured lawn". It was further estimated that the lake had 34% of all lots in an "untouched" state.

There is a close, but not well documented, relationship between water quality and shoreline conditions. Knutson and Naaf (1997) (19) reported that 90% of surface drainage sediment is removed in a 30 m buffer strip over a 2% grade. Most environmental scientists suggest that 75% of the shoreline around a lake should be left in a natural state. Best Management Practices (BMP) for shoreline preservation include maximizing buffer strips to 30 m from the high-water mark, increasing building and septic setbacks, and encouraging tertiary septic treatment systems. Based on the 1994 survey mentioned above, Otter Lake is deficient in natural shorelines.

As water quality is closely tied to diverse and natural shorelines, further studies would be beneficial.

4.3 Fish

Numerous hoop, angling and net surveys have been performed by MNR and RVCA to determine the natural and stocked populations in Otter Lake. (20) Most of this has been to assess the success of fish stocking which has been done since 1930 and include many salmonid species and Smallmouth Bass.

The species recorded in fish surveys over the years include:

SPECIES	1930	1959	1970	1975	1990	1994	1997	2000	2003
S.M Bass	x	x	x	x				x	x
L.M Bass			x	x				x	
Ling Cod	x	x							
Northern Pike		x	x	x			x	x	x
Bullhead		x	x			x		x	
Golden Shiner	x		x			x			
Lake Trout			x	x					
Sunfish		x	x			x	x	x	
Splake					x	x			x
Whitefish	x								
Lake Herring	x		x						x
Sucker	x	x	x					x	x
Perch	x	x	x		x	x		x	x
Rock Bass	x	x	x			x		x	x
Common Carp								x	

Figure 8

Fish surveys are not an exact science so the presence or absence of a species does not necessarily mean it is gone from the lake. In early years there was a specific effort to rid the lake of Ling Cod as it was perceived that they were threatening Trout populations.

In the case of stocked fish, there were follow-up studies done to determine the success of stocking and there is little evidence of success for any of the stocked Trout species.

Between 1957 and 2003, the following fish numbers were stocked by MNR:

Small Mouth Bass	Lake Trout	Splake	Brook Trout	Rainbow Trout
33,250	66,500	27,000	2,000	50,500

Figure 9

Stocking apparently took place as early as 1920 but there are no details available.

In 1996, Lake Steward Jim Reeves worked with MNR to determine the extent of the Trout habitat in Otter Lake. Through an extensive testing of oxygen and temperature across the entire depth of the lake it was determined that only 4% of the lake volume would support Lake Trout. (21) Further field notes labelled the lake as "poor" for Lake Trout from 1983 to 2003. These studies indicated that the warmer epilimnion layer was increasing in depth thus reducing the available habitat for cold-water fish such as Trout which reside in the hypolimnion. Rainbow Trout were stocked aggressively from 1999 to 2002 in an effort to support some form of Trout fishery but as no evidence of Rainbow Trout was found in the 2003 survey, all stocking was stopped.

Current provincial policy dictates that 7 ug of oxygen is required in the hypolimnion in September in order to classify the lake as a "Trout Lake" and therefore Otter Lake does not qualify. There has been an improvement noted by OLLA testing but not to the extent required.

4.4 Wetlands

Wetlands are key areas for lake health. They support fish spawning, food for waterfowl and other birds and act as a filter for contaminants. Much of the loon population will nest or seek refuge in wetlands.

When wetlands are linked, they support a greater and more diverse population of wildlife therefore carving wetlands into smaller parcels through drainage and development is not recommended.

Wetlands are categorized by level of significance. "Provincially Significant" (shown as pink in the map in figure 1) is the highest category. "Locally Significant" is in yellow and wetlands not yet assessed are in green.

RVCA and Township policies are in place to protect wetlands.

5.0 DEVELOPMENT

In early years, development progressed without significant environmental considerations. Guidelines for sewage systems, setbacks, and building size were lax or non-existent. This led to a rather uncoordinated system of approvals with little consideration of long-term sustainability. Municipalities considered cottage development as a seasonal activity with little drain on municipal resources, so they were taxed at a "seasonal" rate which was much less than permanent residential units.

In 1965, the Ontario Government acted to form conservation authorities which would manage water resources on a watershed basis. This allowed for consistent guidelines across municipal boundaries.

Gradually, regulations were created and enhanced and development around Otter Lake moved from a largely unregulated activity to one that is controlled to a greater extent.

Development on or near the waterfront is governed by several provincial and federal policies acts and regulations. Guidelines are enforced by the Township of Rideau Lakes.

The Ontario Provincial Policy Statement sets broad policy that municipalities must meet. Water quality, shoreline protection and protection of the natural environment are all mentioned in the PPS. Usually a municipality determines priorities in the Official Plan and uses the Zoning Bylaw as the enforcement arm of these priorities. In the Township of Rideau Lakes, the Rideau Valley Conservation Authority is delegated certain responsibilities to render opinions and decisions on development matters.

In Ontario, shoreline development is handled in two general ways:
1) Management by Capacity…..in other words setting limits on development, or
2) Management by Mitigation….using best management practices to minimize the effect of development.

The RVCA has a well- developed site assessment program which is used by the Township to consider development proposals within 300 m of a waterfront. This falls into the second of the above two management options. It includes a detailed site-scoring system which is used to identify the suitability of the development for the site and recommendation for mitigation methods depending on the classification of the lot. The Township however, has not entrenched the RVCA site-assessment program into planning policies or the Official Plan. Therefore they are free to deviate from the RVCA recommendations. The RVCA site assessment goal is "*NO NET DECLINE IN WATER QUALITY ASSOCIATED WITH DEVELOPMENT*". Among the RVCA site criteria:

- Determination of the 1:100 year flood level on a building lot or serviced by a private road
- Set-back, frontage, and lot area

- Slope, depth of soil and type
- Degree of existing vegetation in the 30 m buffer zone
- Proximity to wetlands

For large scale development, a "Lake Impact Study" would be required to be produced by the developer in conjunction with the RVCA.

Locally there is no system in place that recognizes lake sensitivity as a factor in the planning and approval process. Furthermore there is no entrenched method of assessing lake or recreational capacity which could be used to determine maximum development loads.

In Ontario the Planning Act requires that Official Plans for municipalities must take into account the cumulative impacts of planning decisions. In other words, the site by site approval process is important but the cumulative effects of these approvals must be considered as well.

5.1 Residential Development

Wickware (6) documented development on Otter Lake from 1950 to 1970. Prior to that, records are incomplete but it is generally assumed that shoreline cottages and residences were constructed beginning in the 1930's and reached a peak rate in the 1960's. As the supply of subdivided lots decreased, the rate of construction slowed and is now close to zero with about 295 cottages and homes. Conversion of existing cottages to homes continues. The density on the lake is 15 residential units per km of shoreline which is one the highest in the Rideau Basin and 3 times higher than Big Rideau Lake.

Seasonal cottages make up 72% of the total based on a 2007 RVCA survey.

There are no large-scale backlot developments on or near the lake.

Development on and near the shoreline contributes to eutrophication which essentially is a conversion of a clear cold-water lake with few nutrients to a warm turbid lake with high levels of nutrients. This happens to all lakes over time however the effects can be mitigated with good stewardship techniques and development controls. Models exist which may be useful to determine if Otter Lake is approaching the point where further development will result in a degradation of water quality. These models are not extremely accurate but may prove to be one factor in the decision-making process.

A 2014 report by Hutchinson Environment Services to the MOEE (22) recommends that municipalities use three tools to mitigate degradation to water quality:
1) Classify lakes according to sensitivity to Phosphorus or other factors,
2) Use lake capacity and recreational models to add to the available data
3) Encourage BMP's to increase shoreline health and stability

There has been no development or lake capacity modeling performed on Otter Lake however Michalski and Usher (2) modeled Bass Lake in 1992 and predicted a 30% rise in Chlorophyll content (due to nutrient loading) with a 5% increase in development and a 56% increase with 25% more development.

5.2 Commercial Development

There are 4 resort operations on the lake. Four trailer parks contain approximately 195 permanently fixed trailer units with accompanying stores, pools etc. (Google Earth Survey 2015) There were 25 motel rental units in the 1970's but these have been discontinued. There are 28 rental cabins currently in use. Camp Otterdale has a complement of an estimated 100 campers from July 1-August 15.

5.3 Recreational Use

There is public use of the lake through the public launch area with unlimited and undocumented access. The launch property is owned by MNR and leased to Rideau Lakes Township.

There is a large land area owned by the RVCA on the southwest side of the lake however no immediate plans exist for development of the site into a recreational or natural area.

It is unknown how many boaters use the lake on a day-use basis. Residents indicated in the 2006 survey that 70% had power boats. Based on the estimate of property owners, this equals 206 power boats. Of those, 66% are greater than 25 HP.

There are few studies which identify the effect on water quality by boat traffic but Michalski and Usher (2) concluded that the pollution from boat traffic was minimal compared to other sources.

Robina Duermeyer, in a 1998 Carleton University thesis on Otter Lake recreational power boat use, (23) reported that Volatile Organic Compounds (arising from boat fuel use) did not persist for long in the water and that they were dissipating faster than they accumulate over time. She noted that there were approximately 30 power boats operating on the lake during a typical long weekend.

In some municipalities in Ontario a calculation of "Recreational Capacity" is used to assess development capacity for a lake. Similar to the calculation planners use to determine how much park space is required for cities, municipalities can estimate how much lake area is suitable for the number of lake users. This serves as a "social density filter" which accounts for environmental as well as social pressures. Seguin Township has used such a system for several years and applies a factor of 1.62 ha per residential user. Using such a formula would allow for 359 residence units on Otter Lake. Including cottages, permanent homes and trailer park residents there are 490 residential units, exceeding the maximum by 36% using this form of calculation. While this type of assessment is quite subjective, it is easy to calculate and accounts for a range of factors including social pressures. Hutchinson (22) suggests it is one tool that planners can use in a holistic approach to lake planning.

5.4 Septic Systems

Private on-site sewage systems are considered "buildings" under provincial regulations and therefore are regulated under part 8 of the Ontario Building Code which is administered by the Ministry of Municipal Affairs and Housing. These regulations cover systems up to 10,000 L per day. Larger systems, such as those found in trailer parks, are regulated by the MOE but usually operate on the same principles as small private systems.

Section 8.9.2.3(2) of the Ontario Building Code dictates that the homeowner is responsible for the effective operation of a septic system.

Septic systems are important considerations in the lake environment since nutrients released from them can and do reach the water and can contribute to poor water quality.

Systems are composed of two or three units depending on the design:

Tanks: The septic tank is the primary treatment unit and its purpose is to liquefy solids and allow wastewater to pass on to the secondary treatment system. The discharge from the tank includes water, organic material usually measured as BOD (Biological Oxygen Demand), bacteria, and nutrients. Inorganic sludge remains at the bottom of the tank and must be pumped out periodically to maintain the effectiveness of the tank. Tanks are designed to receive twice the estimated daily capacity of the house.

This allows more time for biological action before effluent is discharged from the tank to the secondary treatment system.

Secondary Treatment System: A traditional system uses a leaching bed to distribute wastewater to the soil where it is processed by organisms in the presence of oxygen. Essentially the soil bacteria fulfill the role of processing the effluent and discharging it to the groundwater. In a properly functioning leaching bed, there should be minimal contamination of groundwater and the lake however the design and construction of the system must be adequate for the volume it receives. Seasonally used systems can be less efficient since it takes time for the biological action to initiate the degradation process in the tank. A leaching bed is also limited by the thickness and consistency of the soil in which the effluent is treated. Thin sandy soil is less able to process effluent and has a greater risk of passing nutrients and bacteria to the lake.

There are units available that intensively treat effluent and discharge it to the soil with reduced levels of bacteria, nutrients and BOD. Eco-Flow and Waterloo Biofilter are examples of advanced secondary treatment units that offer better effluent discharge characteristics compared to a leaching bed.

Tertiary Treatment: In highly sensitive areas, technology exists to remove virtually all the harmful bacteria and nutrients prior to discharge to the environment. These would be located in or after the secondary unit but before effluent is discharged to the soil.

Inspection:

Exact numbers are not known but systems around Otter Lake include traditional leaching beds, some holding tanks, and some advanced secondary treatment units. Holding tanks are not allowed for new construction but existing systems are grandfathered. All systems need to be inspected and maintained periodically. No mandatory inspection is currently in place in Rideau Lakes Township but if complaints are received, inspectors are obligated to respond.

A voluntary inspection program was undertaken in 2007 of 100 systems in Rideau Lakes with some on Otter Lake. There was a 56% failure rate on this program although most were minor. 5% of units were found to be completely inoperable and taken out of use until repaired. Otter Lake was among 4 lakes surveyed in 2007 and the type of systems found were overwhelmingly the traditional tank and leaching bed systems. Holding tanks were found in 5% of those surveyed.

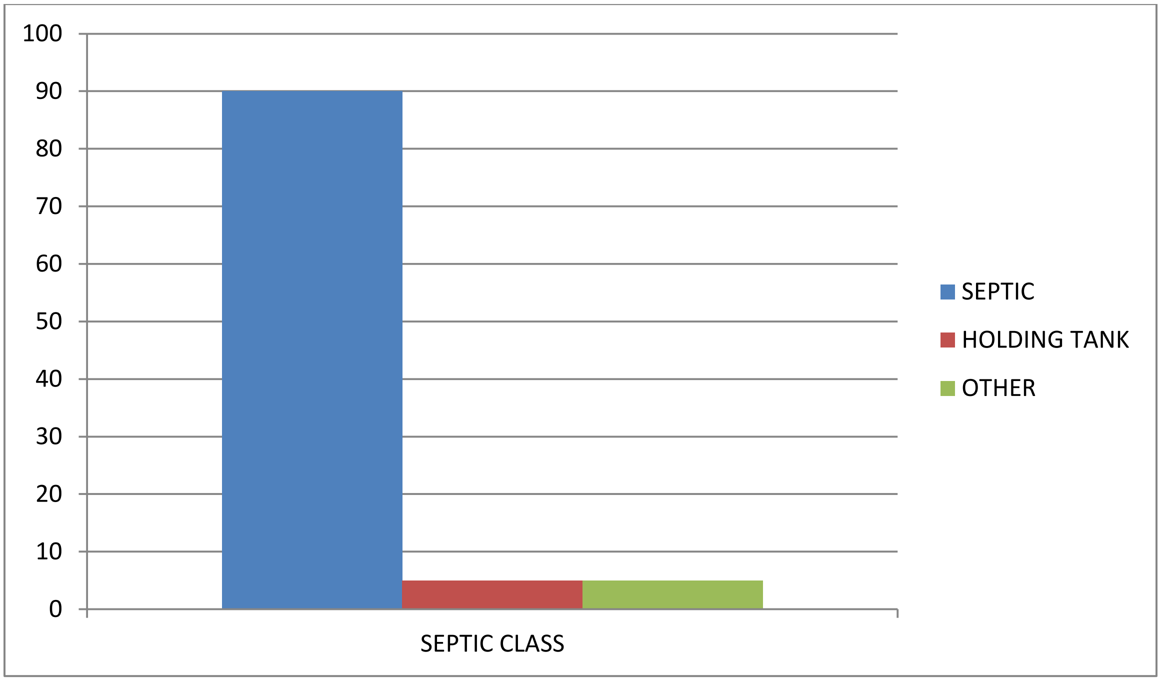


Figure 10

The 2007 septic inspections found the following deficiency levels:

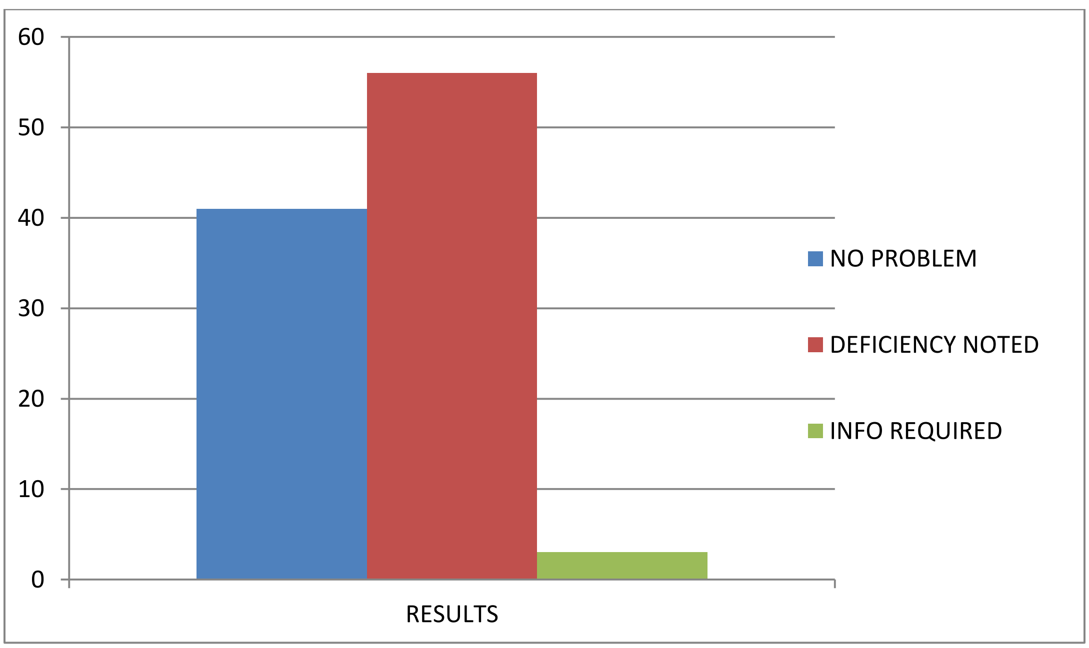


Figure 11

The deficiencies required solutions that ranged from total replacement (5%) to needing a tank pump-out (37%).

It was observed during the inspections that some residents had pumped out their tank just prior to the inspector arriving which means that the number of pump-outs required is likely under-reported.

Some municipalities are adopting mandatory inspections usually on a 5 or10 year cycle and/or upon sale of the property.

Mandatory Re-Inspection:

In the 2006 survey 89% of Otter Lake residents agreed that septic inspection was important. In the 2015 survey 77% are in favour of mandatory re-inspection.

Ontario Regulation 315/10 was established in 2011 to govern mandatory and discretionary sewage system re-inspection programs. It forms part of the Ontario Building Code and serves to further the goals of the Clean Water Act.

The Township of Rideau Lakes has followed a discretionary program since 2007 which invites approximately 100 volunteers annually to have their systems inspected by an accredited person. The reports are available at: http://www.twprideaulakes.on.ca/development/septic-reinspection.html.

A voluntary program may not capture a true cross-section of systems and their operational condition.

6.0 SUMMARY

Otter Lake has been well-studied over several decades and residents are fortunate to have a significant amount of data available for use in a Sustainable Plan. Significant gaps do exist for some issues namely extensive hydrology reports, mapping of fish habitat and spawning beds, cumulative development impacts, and shoreline assessments.

It is recommended that the Sustainable Lake Plan for Otter Lake, make efforts to document some of this incomplete data and work with local and regional agencies, scientists, and local residents, to further the aims of the proposed Sustainable Lake Plan.

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Photo Credit: Philip Craig, Artist, Otter Lake Resident