Rideau Lakes Subwatershed Report 2014

BIG RIDEAU LAKE – RIDEAU FERRY CATCHMENT

RIDEAU VALLEY CONSERVATION AUTHORITY

The RVCA produces individual reports for eight catchments in the Rideau Lakes subwatershed. Using data collected and analysed by the RVCA through its watershed monitoring and land cover classification programs, surface water quality conditions are reported for Big Rideau Lake along with a summary of environmental conditions for the surrounding countryside every six years.

This information is used to better understand the effects of human activity on our water resources, allows us to better track environmental change over time and helps focus watershed management actions where they are needed the most.

The following pages of this report are a compilation of that work. For other Rideau Lakes catchments and the *Rideau Lakes Subwatershed Report,* please visit the RVCA website at www.rvca.ca

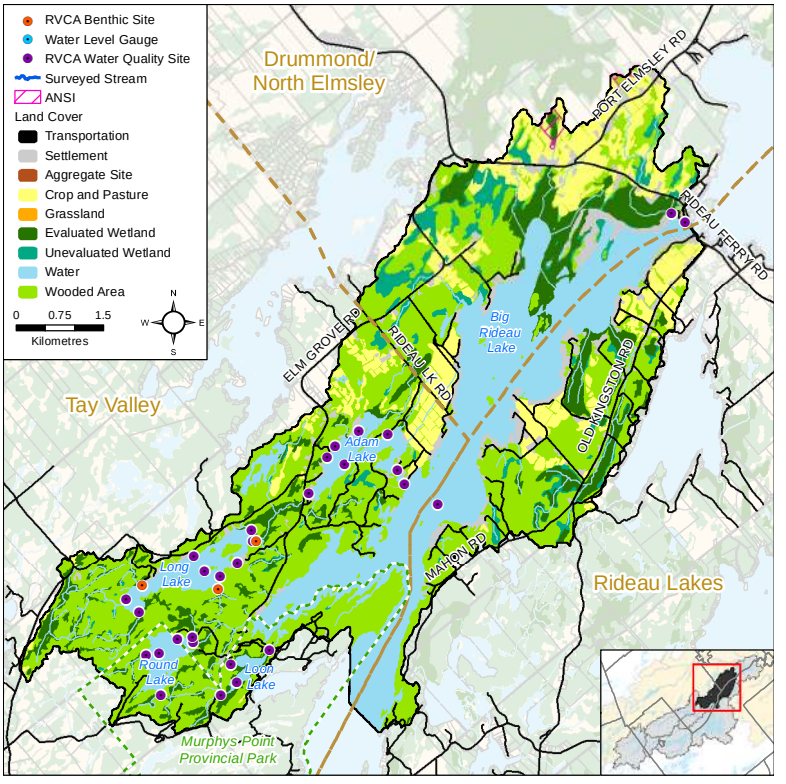
What's Inside

1. Surface Water Quality Conditions 5
   - Big Rideau Lake 5
   - Round Lake 9
   - Loon Lake 12
   - Long Lake 16
   - Adam Lake 19
2. Riparian Conditions 23
3. Land Cover 25
4. Stewardship & Protection 26
5. Issues 28
6. Opportunities for Action 29

Catchment Facts

General Geography

- The Rideau Lakes are a very popular seasonal tourist and residential destination because of its diverse natural amenity, cultural history associated with the UNESCO World Heritage Site designated Rideau Canal, close proximity to a number of large cities and towns and ease of access via the Rideau Canal. Residents and vacationers flock to Rideau Lakes in the summer to take advantage of its natural heritage and recreational opportunities such as boating, fishing and swimming. Cottages, houses, campgrounds, B&Bs and marinas stretch extensively along the shoreline that was once largely untouched, putting pressure on the natural resources that support the Rideau Lakes many uses and users
- Newboro, Portland, Rideau Ferry and Westport are the main settlement areas in the Rideau Lakes subwatershed. Of these, only Rideau Ferry is located in the Big Rideau (Rideau Ferry) catchment, which supports a substantial tourist trade and is a service centre for local residents. It is also a major boating centre in the Rideau Lakes offering marina and other services and is one of the main gateways for visitors to access the Rideau Lakes
- Parks Canada manages water levels for recreational purposes along the Rideau Canal/Waterway (also designated a National Historic Site and a Canadian Heritage River) that runs through the catchment, ensuring 1.5 metres of draft during the navigation season. In this managed system, water levels on the Rideau Canal are manipulated by operation of numerous dams. In the Rideau Lakes subwatershed, Parks Canada staff operate dams at Wolfe Lake, the Narrows on Upper Rideau and Poonamalie at the outlet of Lower Rideau Lake. The dams on Westport Sand Lake and Westport Pond are operated by the Ministry of Natural Resources and Forests in cooperation with Parks Canada. Water levels are lowered in October throughout the Canal system to the winter operating level that is maintained until early March when snow, ice and precipitation data are used to estimate spring snow melt conditions. At the onset of the spring freshet, water levels are targeted using a rule curve (i.e. a pre-determined estimate of water levels to ensure a "best fit" to prevent as much as possible high and low levels). In late May, levels are at the maximum for the beginning of the navigation season. Levels decline gradually throughout the summer until the winter level is reached once again. The annual range of operational water levels on the lakes is in the order of one metre



- The Rideau Lakes form part of the Frontenac Arch Biosphere Reserve (Frontenac Axis), an important intra-regional landscape feature which supports a wide variety of species and their movements between Algonquin Park in Central Ontario and Adirondack Park in Upper New York State
- Big Rideau Lake (Rideau Ferry catchment) has many embayments including Bests Bay, Coutts Bay, Davidsons Bay, Jacklins Bay, McLeans Bay, McVeetys Bay, Nobles Bay and O'Mearas Bay

Physical Geography

- The northern half of the Big Rideau Lake-Rideau Ferry catchment is located within a physiographic region known as the Smith Falls Limestone Plain which, in this area, happens to consist of older Paleozoic quartzose sandstone, some dolostone and possibly conglomerate which is overlain by mixed glacial sediment often referred to as drift
- The southern half of the Big Rideau Lake-Rideau Ferry catchment and the majority of the Rideau Lakes subwatershed resides within the Algonquin Highlands, which is an ancient (Precambrian) hilly area made up of thin and variable glacial deposits overlying igneous and metamorphic rock ridges and knolls. In this catchment, these rocks are marble or granite. Rocks associated with geologic faults are also found here
- Organic deposits are also found throughout the catchment where swamps and marshes are situated. A geologic fault transects the lake in a northeasterly direction and a drumlin feature is located along Rideau Ferry Road, west of the Port Elmsley Road
- Forty-six percent of the catchment lies within Tay Valley Township, 28 percent is in Drummond/North Elmsley Township and 26 percent within the Township of Rideau Lakes
- Big Rideau-Rideau Ferry catchment drainage area is 55 square kilometres and occupies about 12 percent of the Rideau Lakes subwatershed and less than two percent of the Rideau Valley watershed
- Dominant land cover is woodland (39 percent) and water (26 percent) followed by wetland (15 percent), crop and pastureland (12 percent), settlement areas (five percent) and transportation routes (three percent)

Vulnerable Areas

- Certain lands around Big Rideau Lake are subject to flooding hazard during the regional storm flood (the 100 year flood) conditions in the area. Surveys and studies undertaken in accordance with provincial standards have determined that the 100 year flood elevation for the lake is 124.51 metres above mean sea level
- The Assessment Report developed under the Ontario *Clean Water Act* identified the catchment area as Highly Vulnerable Aquifer and a portion of the area is considered to be a Significant Groundwater Recharge Area

Development/Trends

- Given the proximity to the serviced communities of Perth, Portland, Rideau Ferry and Smiths Falls, (which have a mix of residential, commercial and institutional uses), there is added pressure for other residential development beyond existing settlement areas in the Rural zoned areas around Big Rideau Lake
- Much of this development will continue to occur along waterfronts, as it has in the past. While many lakes have been developed to the extent that the physiography of the region will allow, others still have some development potential. In some cases, new lot development can occur only on marginal lands (steep slopes, shallow soils, narrow waterfronts, low lying poorly-drained lands) as the remaining lands have been fully developed
- Most development activity is focused around redevelopment, where cottages are being replaced with large permanent residences on small lots. This can put additional stress on the lake environment because large development envelopes on smaller lots leave less space for natural processes (e.g., runoff, infiltration and retention, nutrient uptake, erosion control and shading) and natural features (e.g., trees, shrubs and plants) that support a healthy lake environment. Minor variances are frequently triggered because the lots do not have sufficient area to provide for a minimum 30 metre development setback from the lake
- In the Drummond/North Elmsley Township area of the catchment, the shoreline is densely developed and contains the longstanding residential and commercial community of Rideau Ferry. Just to the west of the village is the Coutts Bay Road neighbourhood, which has established subdivisions built on the peninsulas extending into Big Rideau Lake, many of which have year round dwellings on half acre lots. Newer subdivision development in this area features greater lake setbacks and some additional protection for wetland areas. Closer to Tay Valley Township, development consists of traditional cottage development occupying most of the shoreline, accessed from private roads (namely McVeetys, Maple Crest and Wild Grape Lane), while other areas are experiencing cottage conversion and redevelopment. Current land-use zoning in the catchment consists mainly of Limited Service Residential along the waterfront of Big Rideau Lake and Rural elsewhere with some smaller Rural and Residential zones in Rideau Ferry and in adjacent subdivisions. There is also commercial and recreational development in the catchment oriented towards the Rideau Ferry Road in the vicinity of the village
- Development in the Tay Valley Township area of the catchment consists largely of new cottages or conversions of cottages to permanent residences around Adams Lake, Big Rideau Lake and Round Lake with access being provided by a combination of municipal and private roads. Current land-use zoning is mostly Seasonal Residential or Residential Limited Services along with a large Open Space block that coincides with Murphys Point Provincial Park
- In the Township of Rideau Lakes, the catchment is zoned predominately Rural with the southern shoreline of Big Rideau Lake zoned Waterfront Residential, where intensification (i.e., conversions, expansions, upgrades) on existing lots containing smaller, older cottages accounts for much of the redevelopment activity

Conditions at a Glance

- Surface water quality rating in Big Rideau Lake (Rideau Ferry catchment) is "Fair"; "Poor" in Adams, Long and Loon Lakes and "Good" in Round Lake
- Woodland cover proportion has changed/increased by one percent (67 ha) from 2002 to 2008, due to a combination of changes in land cover/land uses and/or applied digital air photo classification methods
- In the Big Rideau Lake-Rideau Ferry catchment, the riparian buffer (30 metre wide strip along the shoreline of all lakes and streams) is comprised of woodland (46 percent), wetland (34 percent), settlement areas (12 percent), crop and pastureland (six percent), and transportation routes (two percent)
- Around Big Rideau Lake (in the Rideau Ferry catchment), the shoreline buffer is made up of woodland (46 percent), settlement areas (31 percent), wetland (21 percent), transportation routes (one percent) and crop and pastureland (one percent)
- Around Adam Lake, the shoreline buffer is made up of woodland (61 percent), settlement areas (26 percent), wetland (10 percent), transportation routes (two percent) and crop and pastureland (one percent)
- Around Long Lake, the shoreline buffer is made up of woodland (63 percent), wetland (20 percent) and settlement areas (17 percent)
- Around Round Lake, the shoreline buffer is made up of woodland

(84 percent), wetland (10 percent), settlement areas (four percent) and transportation routes (two percent)
- Along streams, the riparian buffer is comprised of wetland (46 percent), woodland (38 percent), crop and pastureland (11 percent), transportation routes (three percent) and settlement areas (two percent) throughout the whole catchment
- Development on Big Rideau Lake (in the Rideau Ferry catchment) and in Rideau Ferry occurs on private wells (of which there are about 618 water well records in the catchment) and septic systems
- Since 1987, Big Rideau Lake has been managed as a Class One, cold water lake that can support natural reproduction of important sport fish species such as lake trout. Big Rideau Lake has been stocked (with nine different fish species, but mainly with lake trout, over the last 100 years). Stocking ceased entirely in 2009 because it was determined that the practice was introducing too much intra-specific stress on the native population (to the point that more and more stocked fish were showing up on spawning shoals). The only remaining Rideau Lakes stocking takes place on Westport Sand Lake where walleye is stocked annually by the Westport Area Outdoors Association
- Commercial fishery quotas and conditions for the last several years on Upper, Big and Lower Rideau Lakes have remained the same with one exception on Upper Rideau where MNR has increased the yellow perch quota based on the 2013 assessment. MNR fisheries research specialists confirm that inland commercial fishery quotas on the Rideau Lakes system are sustainable
- 2009 MNR fish population survey of Big Rideau Lake Fisheries Management Zone 18 identified 20 large mesh net species: pumpkinseed (19%), yellow perch (17%), brown bullhead (13%), cisco (11%), alewife (7%), rock bass (6%), northern pike (6%), smallmouth bass (5%), bluegill (5%), lake trout (4%), lake whitefish (3%), largemouth bass (2%), black crappie, burbot, walleye, white sucker (2%) and four small mesh net species: gizzard shad, golden shiner, ninespine stickleback and sand shiner

Catchment Care
- Since 2000, RVCA monitors Big Rideau Lake surface water quality through its Watershed Watch Program. In 2006, the program was altered to gain consistent, year to year data for the set of lakes being monitored. In response to the 2009 *Rideau Lakes Watershed Plan* action to "Develop a more intensive and coordinated water quality monitoring program for the Rideau Lakes," RVCA monitors surface water quality: on Big Rideau Lake (in the catchment) four times of the year at one deep point site (four samples annually) and twice a year at two shoreline sites (four samples annually); on Loon Lake four times of the year at one deep point site (four samples annually), twice a year at one shoreline site (two samples annually) and twice at an additional two shoreline sites every fifth year (four samples in total); on Round Lake four times of the year at one deep point site (four samples annually), twice a year at two shoreline site (four samples annually) and twice at an additional three shoreline sites every fifth year (six samples in total); on Long Lake four times of the year at one deep point site (four samples annually), twice a year at three shoreline site (six samples annually) and twice at an additional four shoreline sites every fifth year (eight samples in total); on Adam Lake four times of the year at one deep point site (four samples annually), twice a year at three shoreline site (six samples annually) and twice at an additional five shoreline sites every fifth year (ten samples in total)
- RVCA provides septic system re-inspection at the request of the Township of Rideau Lakes (since 2007) and Tay Valley Township (since 2004); currently, there is no re-inspection program offered in the catchment within Drummond/North Elmsley Township
- Tay Valley Township septic system voluntary re-inspections were undertaken on 47 Big Rideau Lake properties in the catchment by the Mississippi Rideau Septic System Office. Remedial/maintenance work was advocated for 26 of those properties, a septic system replacement at one other property with more information supplied to a further three landowners with septic system concerns; 17 properties were identified as having no concerns
- Township of Rideau Lakes septic system voluntary re-inspections were undertaken on 20 Big Rideau Lake properties in the catchment by the Mississippi Rideau Septic System Office. Remedial/maintenance work was advocated for 10 of those properties and one septic system replacement at another property; nine properties were identified as having no concerns
- Twenty-four stewardship projects have been completed through RVCA's Private Land Forestry, Rural Clean Water and Shoreline Naturalization Programs (see Section 4 of this report for details)
- RVCA completed littoral zone mapping around Adam Lake, Big Rideau Lake, Loon Lake and Round Lake in 2013, identifying substrate type, vegetation and habitat features along with opportunities for shoreline enhancements
- Big Rideau Lake Association has worked for many decades to enhance the social community and natural environment of the Rideau Lake system by providing ongoing activities and programs for residents living along its shores from the Narrows Lock to Poonamalie (visit Big Rideau Lake Association for more information)
- Adam Lake Property Owners Association has prepared the *Adam Lake Stewardship Plan*(2009) in which its residents have identified their community as a tranquil and unspoiled place consisting of single family dwellings in a natural setting and where the lake should provide an opportunity for recreation and relaxation in an atmosphere of mutual respect and consideration. To achieve this vision, residents have set quality of life related objectives to maintain and improve water quality, to make sure that development enhances and does not harm the lake, to promote responsible lake use and safe swimming and to build a sense of community
- One Permit to Take Water (PTTW) has been issued for campground recreational activities
- A watershed model developed by the RVCA in 2009 was used to study the hydrologic function of wetlands in the Rideau Valley Watershed, including those found in the Big Rideau Lake-Rideau Ferry catchment
- RVCA provides flood forecasting and warning services throughout the Rideau Valley watershed. In the Upper Rideau watershed, only general flooding information has been made available historically for the lakes. In 2014, lake levels were higher than most years and more attention was required from RVCA and municipal staff, resulting in the decision to review what the flood forecasting and warning program provides to the Upper Rideau Valley
- The Townships of Drummond/North Elmsley, Rideau Lakes and Tay Valley have land use planning policies and zoning provisions (on lake capacity, water setbacks, frontage, naturalized shorelines and wetland protection) and use site plan control to implement these policies and provisions. Together with RVCA and Parks Canada, they work with landowners on a case by case basis to achieve net environmental gains (particularly with respect to shoreline vegetation protection and rehabilitation) through the use of shoreline best management practices. Collectively, the Townships and the agencies request conditions on planning approvals to ensure that development and redevelopment is appropriate for the property, impacts on neighbours are minimized (particularly on very small lots) and development setbacks for the shoreline are maximized
- Development in and adjacent to Provincially Significant Wetlands and some locally significant wetlands is subject to Ontario Regulation 174-06 (entitled "Development, Interference with Wetlands and

Alterations to Shorelines and Watercourses") that protects the hydrologic function of the wetland and also protects landowners and their property from natural hazards (flooding, fluctuating water table, unstable soils) associated with them

- *Rideau Lakes Basin Carrying Capacity Study* (1992) evaluated the capacity of the Rideau Lakes to support development with respect to lake trophic state (level of phosphorus and chlorophyll a) and shoreline development. Results have been used to provide land-use planning policy direction and guidance (in the form of a site evaluation guideline) to the municipalities of Drummond/North Elmsley, Rideau Lakes and Tay Valley and the Conservation Authority. Using phosphorus as the determinant for lake capacity, the study attempted to identify how much development was permissible to retain the "no net loss" in water quality principle (i.e., no net increase in phosphorus loading). Recommendations from it included the need to set water quality targets for each lake of concern, requiring buildings to be set no closer than 30 metres from water (with greater widths being recommended in areas with poor phosphorus retention based on soil type, slope and geological conditions), minimizing disturbance to shoreline vegetation and no alteration to the soil mantle within the protective setback area. An update to the abovementioned site evaluation guide is currently underway and is to be made available in 2015
- MNR conducts Broad-scale Monitoring of the Big Rideau Lake fishery on a five year rotation within Fisheries Management Zone 18 to provide information for effective fisheries management
- Parks Canada attempts to incorporate the breeding and habitat needs of fish and wildlife when determining water levels, flows and timing of drawdowns in the Rideau Lakes. For more information, please refer to the "Operating Rule Curve" for Big Rideau Lake available (at www.rvca.ca) in the 2014 R*ideau Lakes Subwatershed Report* section on "Water Levels"
- *Rideau Canal National Historic Site of Canada Management Plan* (2005) update establishes the long term strategic direction for the management of the Rideau Canal
- *Rideau Canal World Heritage Site Management Plan* (2005) specifies how its world heritage values will be protected for present and future generations
- 2002 *Rideau Lake State of the Lake Report (*Centre for Sustainable Watersheds) seeks to give a backdrop of understanding of the lake and the natural forces and past human activities that have shaped it
- Most of the shoreline of Big Rideau Lake is held in private ownership, so that the best opportunity for shoreline restoration/enhancement rests with private landowners. RVCA offers its Shoreline Naturalization Program to Rideau Lakes landowners to assist with shoreline re-vegetation (an enhanced delivery program has been put into place in response to the 2009 *Rideau Lakes Watershed Plan* action to "Increase funding for the RVCA Shoreline Naturalization Program")

1. Surface Water Quality Conditions

Surface water quality conditions in the Big Rideau Lake-Rideau Ferry catchment are monitored by the Rideau Valley Conservation Authority's (RVCA) Watershed Watch Program and Baseline Water Quality Monitoring Program. Watershed Watch monitors watershed lakes to assess nutrient concentrations, water clarity, dissolved oxygen availability and pH. The baseline water quality program focuses on streams; data is collected for 22 parameters including nutrients (total phosphorus, total Kjeldahl nitrogen and ammonia), *E. coli*, metals (like aluminum and copper) and additional chemical/physical parameters (such as alkalinity, chlorides, pH and total suspended solids). The locations of monitoring sites are shown in Figure 1 and Table 1.

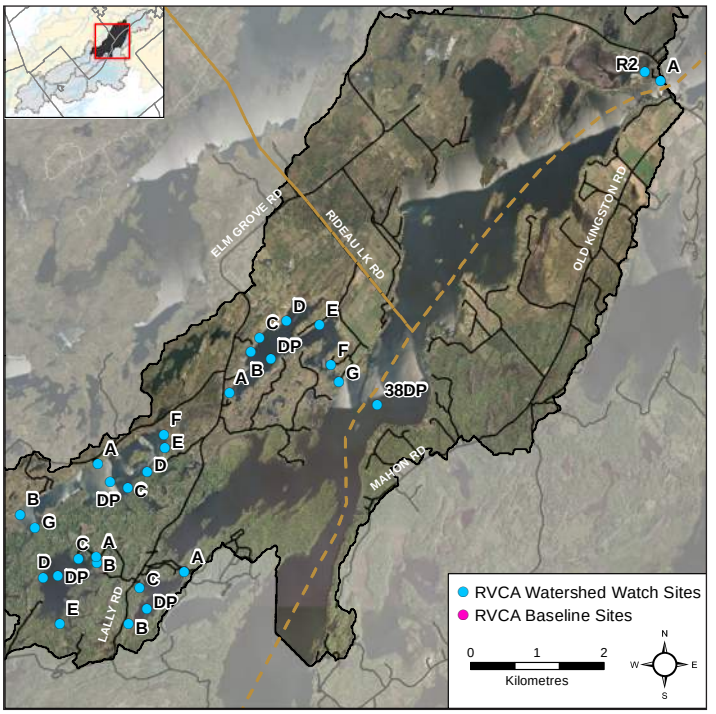


Figure 1 Water quality monitoring sites in the Big Rideau Lake-Rideau Ferry catchment.

The water quality ratings for this catchment range from "Poor" to "Good" (Table 1) as determined by the CCME Water Quality Index. Each parameter is evaluated against established guidelines to determine water quality conditions. Those parameters that frequently exceed guidelines are presented below. There is limited data available for the majority of lakes prior to 2006 thus only 2008-2013 data is considered in this report. Table 1 shows the overall rating for the monitored surface water quality sites within the Big Rideau-Rideau Ferry catchment and Table 2 outlines the Water Quality Index (WQI) scores and their corresponding ratings.

Table 1 WQI Ratings for Big Rideau Lake (Rideau Ferry catchment), 2008-2013

Sampling Site	Location	2008-2013	Rating
RVL-34	Loon Lake	52	Poor
RVL-33	Round Lake	88	Good
RVL-13	Long Lake	53	Poor
RVL-32	Adam Lake	53	Poor
RVL-38	Big Rideau Lake (Rocky Narrows to Rideau Ferry)	77	Fair

Table 2 WQI Ratings (RVCA terminology, original WQI category names in brackets) and corresponding index scores

Rating	Index Score
Very good (Excellent)	95-100
Good	80-94
Fair	65-79
Poor (Marginal)	45-64
Very poor (Poor)	0-44

1) a. Big Rideau Lake Water Quality

Surface water quality conditions in Big Rideau Lake have been monitored by RVCA's Watershed Watch Program since 2005. Data from one deep point site (RVL-38) has been used to calculate the WQI rating for Big Rideau Lake within this catchment, which was determined to be "Fair" (Table 1). Relatively few nutrient exceedances, good oxygen conditions for fish habitat, clear water and occasionally elevated pH levels contributed to the rating. The following discussion explains how each of the monitored water quality parameters contributes to the lake's water quality.

This report also considers data from two additional sites that are monitored near the shoreline. These sites have not been included in the calculation of the CCME WQI rating as they are not monitored with the same frequency as deep point sites. However, they do provide important information on water quality conditions in the near shore areas. For locations of shoreline sites please see Figure 1.

The 2009 *Rideau Lakes Watershed Plan* stated that Big Rideau Lake was in good ecological health but showed signs of stress resulting from recreational use, climate change and development pressure (Rideau Valley Conservation Authority, 2009). The data presented in this report indicates that this continues to be the case and that a proactive cautionary program of best management practices is important to ensure the protection of the lake environment.

Nutrients

Total phosphorus (TP) is used as a primary indicator of excessive nutrient loading and may contribute to abundant aquatic vegetation growth and depleted dissolved oxygen levels. The Provincial Water Quality Objective (PWQO) is used as the TP Guideline and states that in lakes, concentrations greater than 0.020 mg/l indicate an excessive amount of TP within the water column.

Total Kjeldahl nitrogen (TKN) is used as a secondary indicator of nutrient loading. RVCA uses a guideline of 0.500 mg/l to assess TKN[1] within surface waters.

At the Deep Point

One deep point site is monitored within this catchment. Average nutrient concentrations at this site is summarized in Table 3 as well as the proportion of results that meet the guideline.

[1] No Ontario guideline for TKN is presently available; however, waters not influenced by excessive organic inputs typically range from 0.100 to 0.500 mg/l, Environment Canada (1979) *Water Quality Sourcebook, A Guide to Water Quality Parameters,* Inland Waters Directorate, Water Quality Branch, Ottawa, Canada

Table 3 Summary of nutrient results for Big Rideau Lake (Rideau Ferry catchment), 2008-2013

Total Phosphorus 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-38	0.013	95%	21
Total Kjeldahl Nitrogen 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-38	0.299	100%	21

TP and TKN sampling results are presented in Figures 2 and 3. The majority (95 percent) of samples analyzed for TP were less than the TP guideline and the average concentration was 0.013 mg/l (Table 3). TKN concentrations were also minimal; all reported results were below the TKN guideline as was the average concentration at 0.299 mg/l (Table 3). Average year to year concentrations have varied for both TP and TKN (Figures 4 and 5) but do not indicate a general trend; all average results are below guidelines. Overall the data presented indicates that nutrient enrichment is not a significant concern at this mid-lake, deep water site on Big Rideau Lake.

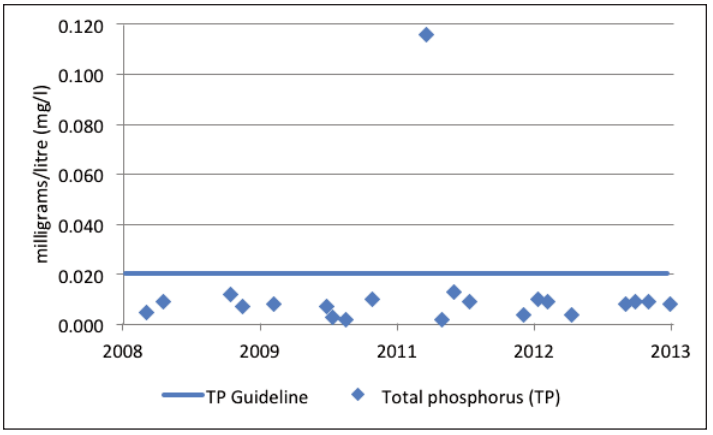


Figure 2 Total phosphorus sampling results at deep point sites in Big Rideau Lake (Rideau Ferry catchment), 2008-2013

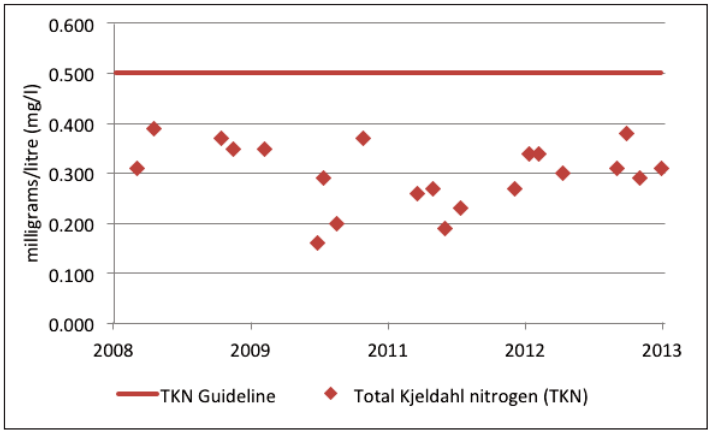


Figure 3 Total Kjeldahl nitrogen sampling results at deep point sites in Big Rideau Lake (Rideau Ferry catchment), 2008-2013

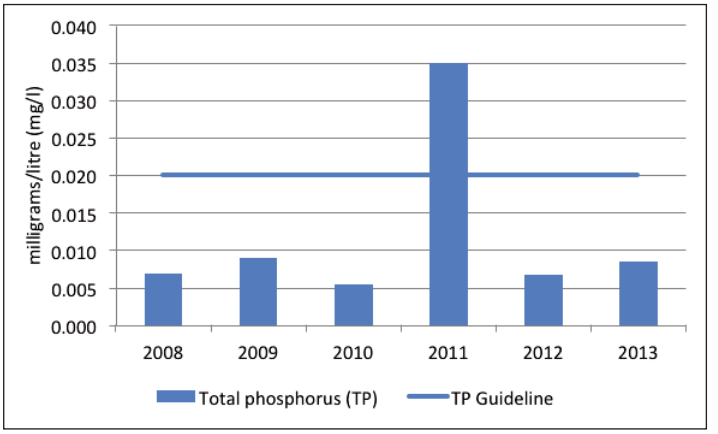


Figure 4 Average total phosphorus at deep point sites in Big Rideau Lake (Rideau Ferry catchment), 2008-2013

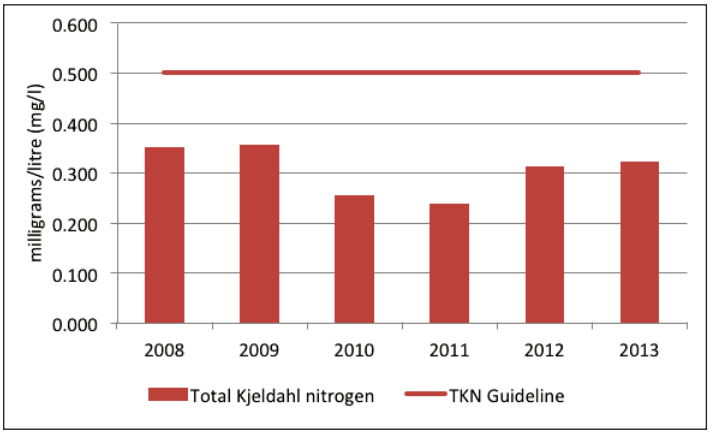


Figure 5 Average total Kjeldahl nitrogen at deep point sites in Big Rideau Lake (Rideau Ferry catchment), 2008-2013

Around the Lake

Limited data exists for shoreline sites on Big Rideau within this catchment, as sites A and R2 are only monitored every fifth year. Site A is located just upstream of the Rideau Ferry bridge while R2 is at the entrance to Coutts Bay.

Total phosphorous concentrations are below the TP guideline at both sites (Figure 6), indicating nutrient enrichment does not appear to be a problem at either location.

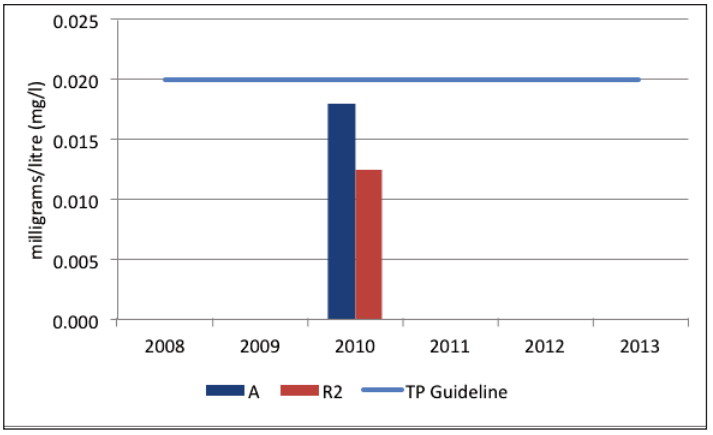


Figure 6 Average total phosphorus concentration at additional monitoring sites on Big Rideau Lake (Rideau Ferry catchment), 2008-2013

TKN concentrations were also below the guideline at both sites (Figure 7). These results provide further support that nutrient enrichment is limited. Given the high level of development at both the sites it is important that property owners and recreational users continue to employ methods to protect water quality and make improvements wherever possible.

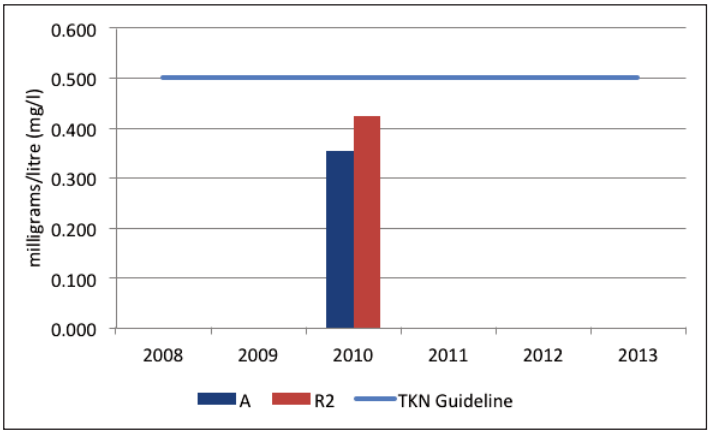


Figure 7 Average total Kjeldahl nitrogen concentration at additional monitoring sites on Big Rideau Lake (Rideau Ferry catchment), 2008-2013

Summary

Within Big Rideau Lake (Rideau Ferry catchment) nutrient concentrations generally meet guidelines. TP concentrations are comparable to the *2002 State of Rideau Lake Report* (Centre for Sustainable Watersheds, 2003) which noted TP typically fell between 0.01 mg/l-0.02 mg/l and TKN was below 0.500 mg/l.

Efforts such as the diversion of runoff and enhanced shoreline buffers are important to continue to protect and enhance water quality. Given the high boat traffic just upstream of Rideau Ferry continued responsible boating practices are encouraged particularly in the “no wake” zone which helps to prevent erosion, and thus additional nutrient loading. All residents can help reduce their impact on the lake by reducing nutrient inputs through practices such as proper maintenance of septic systems, keeping shorelines natural and using phosphate free soaps and detergents.

Water Clarity

Water clarity is measured using a Secchi disk during each deep point sample. Table 4 summarizes the recorded depths and shows that all readings have exceeded the minimum PWQO of 2 metres indicating good water clarity, the average Secchi depth is 7.6 metres Figure 8 shows that no individual reading has been below the guideline and measured depths range from 4.5 metres to 11 metres It should be noted that Secchi depths in many waterbodies have been influenced by the colonization of zebra mussels resulting in clearer waters than may have been seen prior to the introduction of this species. Zebra mussels are present in Big Rideau Lake.

Table 4 Summary of Secchi depths recorded at deep point sites in Big Rideau Lake (Rideau Ferry catchment), 2008-2013

Secchi depth 2008-2013			
Site	**Average (m)**	**Above Guideline**	**No. Samples**
RVL-38	7.6	100%	21

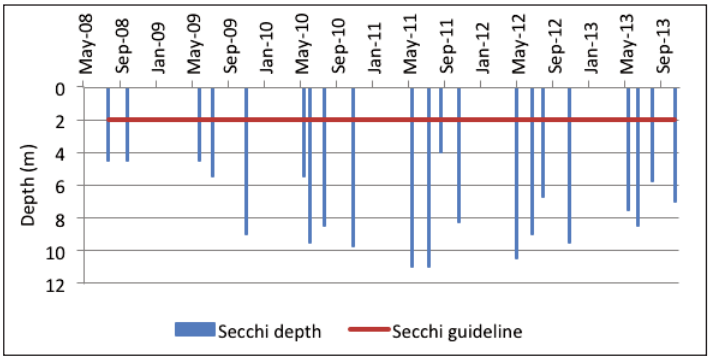


Figure 8 Recorded Secchi depths at deep point sites in Big Rideau Lake (Rideau Ferry catchment), 2008-2013

Summary

This data indicates that waters are very clear and sufficient sunlight is able to penetrate the water column to support aquatic life and provide sufficient visibility for safe recreational use (i.e., boating, swimming, etc.).

Fish Habitat

Two other factors, dissolved oxygen/temperature and pH were also assessed to provide an overall sense of the health of Big Rideau Lake from a fish habitat perspective.

Dissolved Oxygen and Temperature

The red bars in Figure 9 show the depths where suitable conditions exist for warm water fish species (temperature less than 25°C and dissolved oxygen greater than 4 mg/l) at the monitored deep point. The vertical axis represents the total lake depth at each site where the profile is taken. Suitable oxygen temperatures exist to an average depth of 37 metres.

Optimal conditions for lake trout habitat (temperature less than 10°C and dissolved oxygen greater than 7 mg/l) are also shown by the blue points. There are typically good conditions for lake trout habitat but as temperatures warm throughout the summer available habitat becomes more limited in the upper portions of the water column.

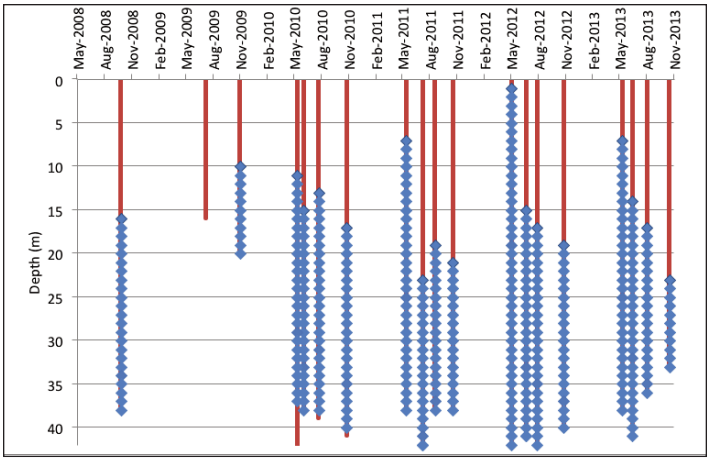


Figure 9 Depths suitable for warm water fish (red bars) and lake trout (blue points) at site RVL-38 in Big Rideau Lake (Rideau Ferry catchment)

pH

pH is a basic water quality parameter used to assess the acidity of water, an important factor for aquatic life. Figure 10 shows pH concentrations in Big Rideau Lake (Rideau Ferry catchment) and Figure 11 summarizes average concentrations by year.

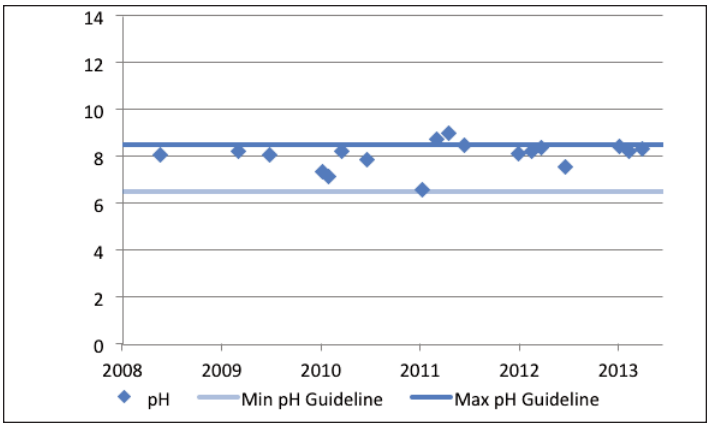


Figure 10 pH concentration at the deep point sites in Big Rideau Lake (Rideau Ferry catchment), 2008-2013.

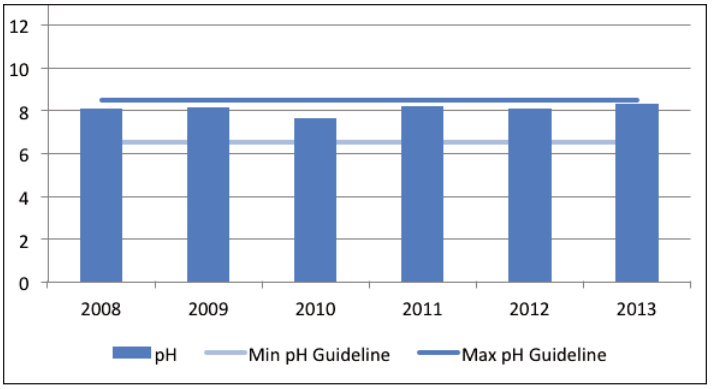


Figure 11 Average pH concentrations at the deep point sites in Big Rideau Lake (Rideau Ferry catchment), 2008-2013

Eighty-nine percent of samples (Table 5) were within guidelines established by the PWQO which state that pH should be between 6.5 and 8.5 to protect aquatic life and prevent irritation for anyone using the waters for recreational purposes.

Table 5 Summary of pH results for deep point sites in Big Rideau Lake (Rideau Ferry catchment)

pH 2008–2013			
Site	**Average**	**% that meet guideline**	**No. Samples**
RVL-38	8.1	89%	18

In some areas of the Rideau Lakes subwatershed, surface waters tend to be a bit more alkaline (higher pH) which can generally be attributed to geology rather than anthropogenic activities; biological activities such as photosynthesis may also affect pH.

Summary

Overall the water chemistry data at the deep point describes good habitat conditions for warm and cold water fish species. pH conditions are typically within the range recommended for the protection of aquatic life, indicating a healthy environment for aquatic species.

E. coli

E. coli is sampled at monitored shoreline sites twice each sampling season data. *E. coli* was not used in the calculations of the WQI rating for the lake due to differences in sampling frequency and site locations. All samples were below the *E. coli* guideline of 100 colony forming units (CFU) per 100 ml set by the PWQO; across the lake the count at the geometric mean[2] was only 4 CFU/100ml (Table 6). Figure 12 shows that samples across all sites were well below the guideline.

Table 6 Summary of *E. coli* results for Big Rideau Lake (Rideau Ferry catchment), 2008-2013

E. coli 2008–2013			
Site	**Geometric mean (CFU/100ml)**	**Below Guideline**	**No. Samples**
RVL-38	4	100%	4

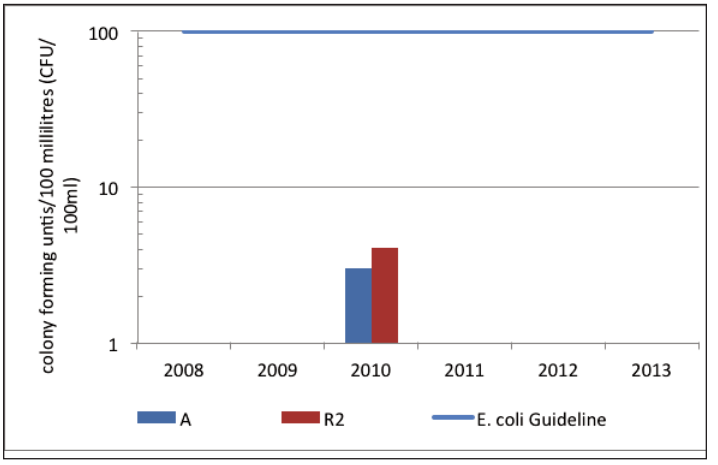


Figure 12 Geometric mean of shoreline sites monitored on Big Rideau Lake (Rideau Ferry catchment), 2008-2013

Summary

The results indicate that bacterial contamination is not a significant concern in Big Rideau Lake and the water should be safe for recreational use such as swimming and boating.

1) b. Round Lake Water Quality

Surface water quality conditions for Round Lake (RVL-33) have been monitored by RVCA's Watershed Watch Program since 2005. Data from the deep point site has been used to calculate the WQI rating for Round Lake, which was determined to be "Good" (Table 1). Low nutrient concentrations, good conditions for fish habitat, clear water and occasionally elevated pH levels contributed to the rating. The following discussion explains how each of the monitored water quality parameters contributes to the lake's water quality.

This report also considers data from five additional shoreline sites that are regularly monitored around the lake. These sites have not been included in the calculation of the CCME WQI rating as they are not monitored with the same frequency as deep point sites. However, they do provide important information on water quality conditions in the near shore areas. For locations of shoreline sites please see Figure 1.

Nutrients

Total phosphorus (TP) is used as a primary indicator of excessive nutrient loading and may contribute to abundant aquatic vegetation growth and depleted dissolved oxygen levels. The Provincial Water Quality Objective (PWQO) is used as the TP Guideline and states that in lakes, concentrations greater than 0.020 mg/l indicate an excessive amount of TP within the water column.

Total Kjeldahl nitrogen (TKN) is used as a secondary indicator of nutrient loading. RVCA uses a guideline of 0.500 mg/l to assess TKN[3] within surface waters.

At the Deep Points

One deep point site is monitored within this lake. Average nutrient concentrations are summarized in Table 7 as well as the proportion of results that meet the guideline.

Table 7 Summary of nutrient results for Round Lake, 2008-2013

Total Phosphorus 2008–2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-33	0.009	100%	24
Total Kjeldahl Nitrogen 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-33	0.308	100%	24

TP and TKN sampling results are presented in Figures 13 and 14. All samples analyzed for TP were less than the TP guideline and the average concentration was 0.009 mg/l (Table 7). TKN concentrations were low as well with all results below the TKN guideline, and an average concentration of 0.308 mg/l (Table 7). Average year to year concentrations have varied for both TP and TKN but are continually below their respective guidelines (Figure 15 and 16). Overall, the data presented indicates that elevated nutrients concentrations are not a problem in Round Lake.

[2] A type of mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum). It is often used to summarize a variable that varies over several orders of magnitude, such as *E. coli* counts

[3] No Ontario guideline for TKN is presently available; however, waters not influenced by excessive organic inputs typically range from 0.100 to 0.500 mg/l, Environment Canada (1979) *Water Quality Sourcebook, A Guide to Water Quality Parameters,* Inland Waters Directorate, Water Quality Branch, Ottawa, Canada

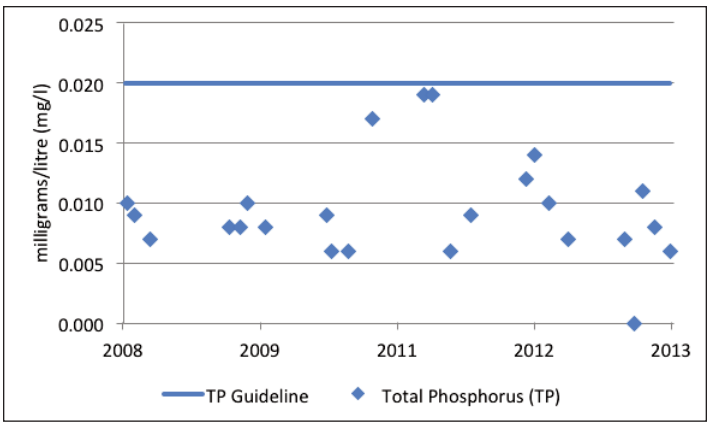


Figure 13 Total phosphorus sampling results at the deep point in Round Lake, 2008-2013

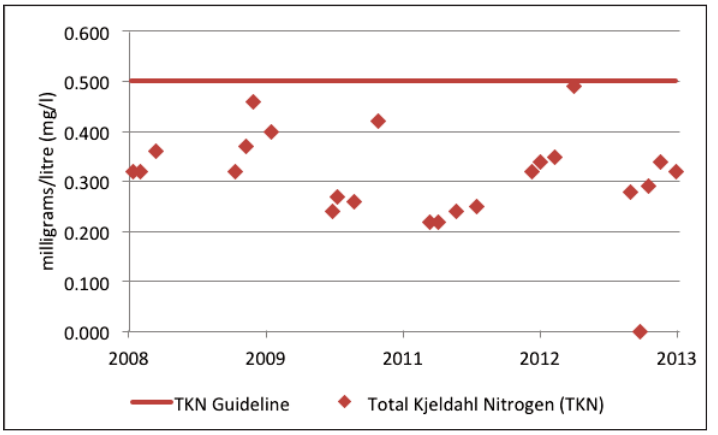


Figure 14 Total Kjeldahl nitrogen sampling results at the deep point in Round Lake, 2008-2013

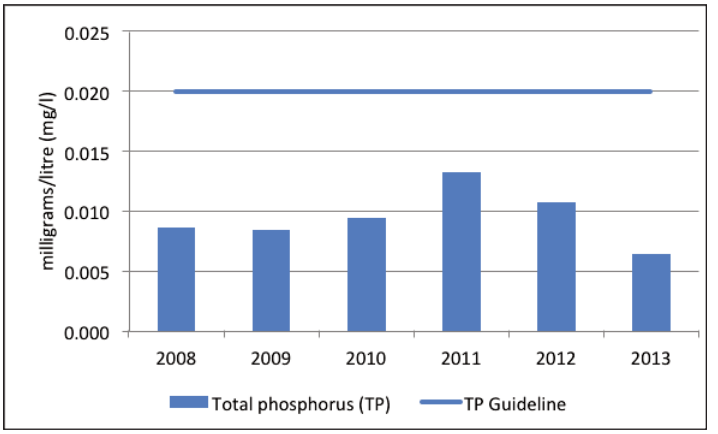


Figure 15 Average total phosphorus at the deep point in Round Lake, 2008-2013

Around the Lake

The average nutrient concentrations at monitored sites around the lake vary from year to year (Figures 17 and 18). Please note that sites A and B are monitored each year while other sites are monitored every fifth year.

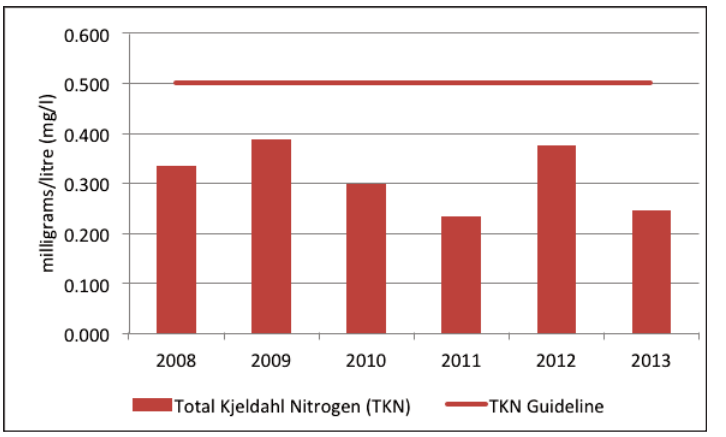


Figure 16 Average total Kjeldahl nitrogen at the deep point in Round Lake, 2008-2013

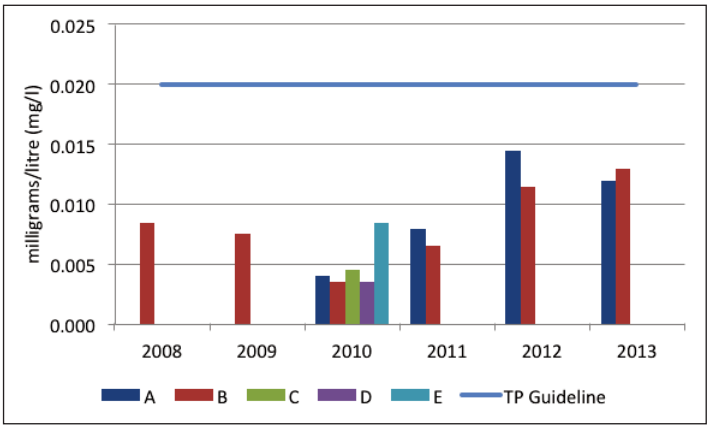


Figure 17 Average total phosphorus concentration at shoreline monitoring sites on Round Lake, 2008-2013

Total phosphorous concentrations were below the TP guideline at all sites. TKN concentrations were below the guideline at the majority of shoreline sites with the exception of site A in 2013. It is possible that elevated concentrations are due to inflow from the adjacent wetland. Wetland systems have nutrient rich soils that hold high concentrations of organic nitrogen; during periods of high flows this may result in higher concentrations at the outflow into the lake.

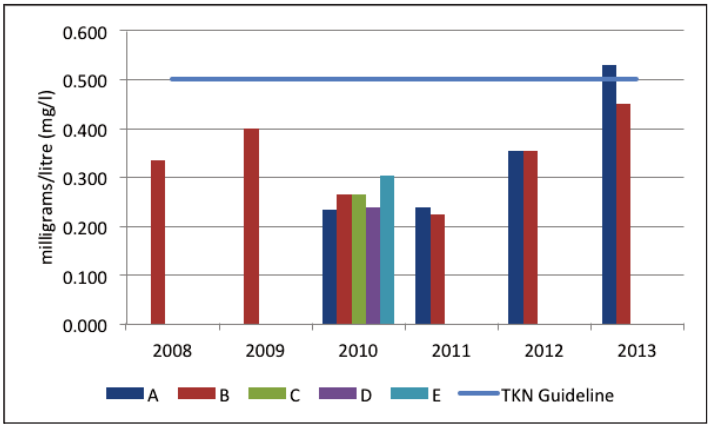


Figure 18 Average total Kjeldahl nitrogen concentration at shoreline monitoring sites on Round Lake, 2008-2013

Summary

There is little development around the lake and what does exist is isolated to the north east shoreline. The actions of current property owners and lake users to minimize nutrient inputs will continue to protect water quality. Aging of the lake can be slowed with the help of all catchment residents by reducing nutrient inputs through practices such as proper maintenance of septic systems, keeping shorelines natural, minimizing runoff and using phosphate free soaps and detergents.

Water Clarity

Water clarity is measured using a Secchi disk during each deep point sample. Table 8 summarizes the recorded depths and shows that all readings have exceeded the minimum PWQO of 2 metres indicating good water clarity; the average Secchi depth is 5.1 metres . Figure 19 shows that no individual reading has been below the guideline and measured depths range from 3 metres to 7 metres. In many cases around the watershed water clarity has been influenced by the colonization of zebra mussels; however at this time there is no evidence of an established population in Round Lake.

Table 8 Summary of Secchi depths recorded at the deep point in Round Lake, 2008-2013

Secchi depth 2008-2013			
Site	**Average (m)**	**Above Guideline**	**No. Samples**
RVL-33	5.1	100%	22

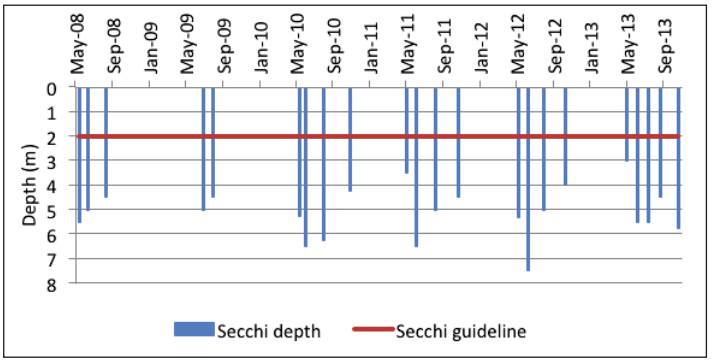


Figure 19 Recorded Secchi depths at the deep point in Round Lake, 2008-2013

Summary

This data indicates that waters are clear and adequate sunlight is able to penetrate the water column to support aquatic life and provide sufficient visibility for safe recreational use (i.e., boating, swimming).

Fish Habitat

Two other factors, dissolved oxygen/temperature and pH were also assessed to provide an overall sense of the health of Round Lake from a fish habitat perspective.

Dissolved Oxygen and Temperature

The red bars in Figure 20 show the depths where suitable conditions exist for warm water fish species (temperature less than 25°C and dissolved oxygen greater than 4 mg/l) at the monitored point. The vertical axis represents the total lake depth at each site where the profile is taken. Suitable oxygen temperatures exist over an average depth of 14 metres.

There is some evidence of a reduction of suitable habitat conditions in the late summer-early fall due to warming of surface waters and limited oxygen availability in the deep waters habitat in the late summer-early fall. This is highlighted in 2011 and 2013 (Figure 20).

pH

pH is a basic water quality parameter used to assess the acidity of water, an important factor for aquatic life. Figure 21 shows pH concentrations in Round Lake and Figure 22 summarizes average concentrations by year.

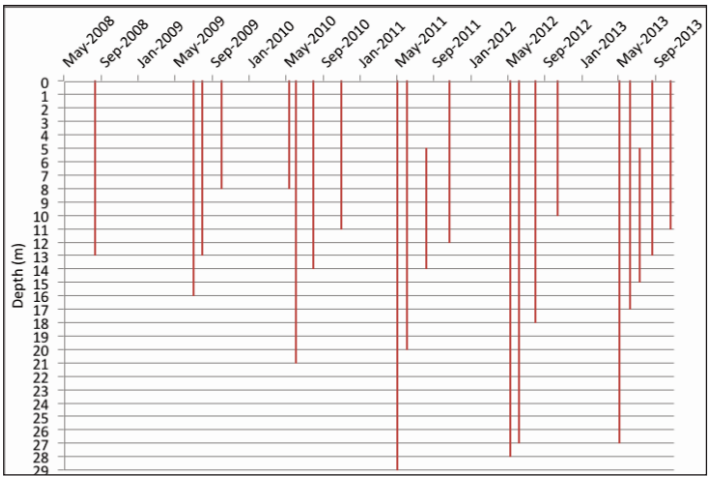


Figure 20 Depths suitable for warm water fish species at the deep point in Round Lake, 2008-2013

Fifty-eight percent of samples (Table 9) were within guidelines established by the PWQO which state that pH should be between 6.5 and 8.5 to protect aquatic life and prevent irritation for anyone using the waters for recreational purposes.

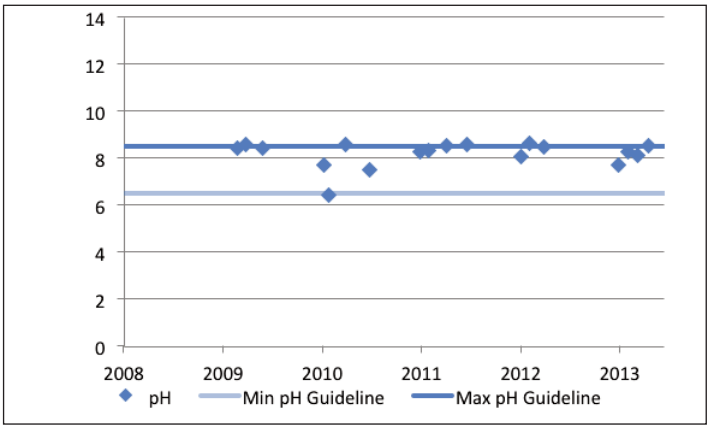


Figure 21 pH concentrations at the deep point in Round Lake, 2008-2013

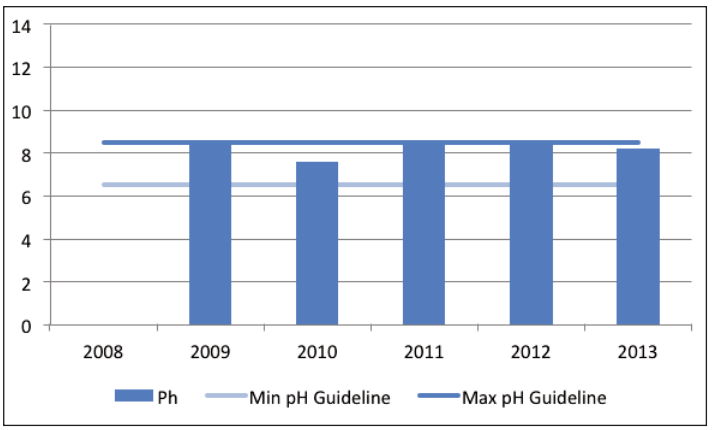


Figure 22 Average pH concentrations at the deep point in Round Lake, 2008-2013

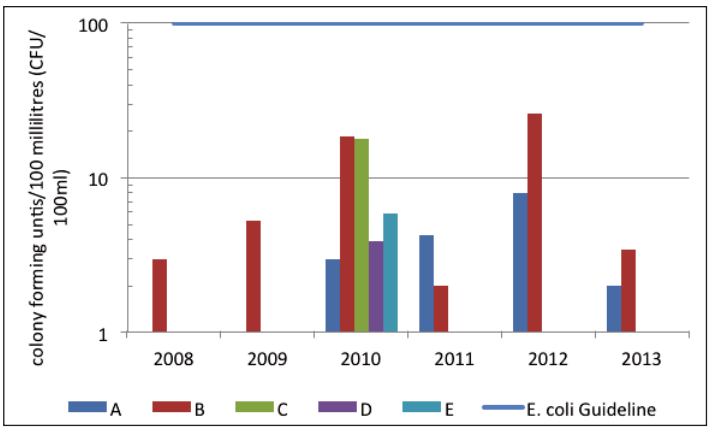


Figure 23 Geometric mean of shoreline sites monitored on Round Lake, 2008-2013

Table 9 Summary of pH results for the deep point in Round Lake

pH 2008-2013			
Site	**Average**	**Within Guidelines**	**No. Samples**
RVL-33	8.2	58%	19

In some areas of the Rideau Lakes watershed, surface waters tend to be a bit more alkaline (higher pH) which can generally be attributed to geology rather than anthropogenic activities; biological activities such as photosynthesis may also affect pH. This is observed in Round Lake as results tend to border on or exceed the upper end of the guideline.

Summary

Overall the water chemistry data at the deep point describes good habitat conditions for warm water fish species such as pickerel, bass and pike. The warming of the water column in summer months may limit the amount of habitat available and cause stress to some aquatic communities. pH conditions are usually within the range recommended for the protection of aquatic life, indicating a healthy environment for aquatic species.

E. coli

E. coli is sampled at monitored shoreline sites twice each sampling season. *E. coli* data was not used in the calculations of the WQI rating for the lake due to differences in sampling frequency and site locations. Almost all samples (95 percent) were below the *E. coli* guideline of 100 colony forming units (CFU) per 100 ml set by the PWQO; across the lake the count at the geometric mean[4] was only 5 CFU/100ml (Table 10). Figure 23 shows that samples across all sites were well below the guideline.

Table 10 Summary of *E. coli* results for Round Lake, 2008-2013

E. coli 2008-2013			
Site	**Geometric mean (CFU/100ml)**	**Below Guidelines**	**No. Samples**
RVL-33	5	95%	22

Summary

The results presented above provide evidence that bacterial contamination is not a significant concern in Round Lake and the water should be safe for recreational use such as swimming and boating activities.

1) c. Loon Lake Water Quality

Surface water quality conditions in Loon Lake (RVL-34) have been monitored by RVCA's Watershed Watch Program since 2005. Data from the deep point site has been used to calculate the WQI rating for Loon Lake, which was determined to be "Poor" (Table 1). Elevated nutrient concentrations, periods of reduced oxygen availability, clear water and occasionally elevated pH levels contributed to the rating. The following discussion explains how each of the monitored water quality parameters contributes to the lake's water quality.

This report also considers data from three additional shoreline sites that are regularly monitored around the lake. These sites have not been included in the calculation of the CCME WQI rating as they are not monitored with the same frequency as deep point sites. However, they do provide important information on water quality conditions in the near shore areas. For locations of shoreline sites please see Figure 1.

Nutrients

Total phosphorus (TP) is used as a primary indicator of excessive nutrient loading and may contribute to abundant aquatic vegetation growth and depleted dissolved oxygen levels. The Provincial Water Quality Objective (PWQO) is used as the TP Guideline and states that in lakes, concentrations greater than 0.020 mg/l indicate an excessive amount of TP within the water column.

Total Kjeldahl nitrogen (TKN) is used as a secondary indicator of nutrient loading. RVCA uses a guideline of 0.500 mg/l to assess TKN[5] within surface waters.

[4] A type of mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean)
[5] No Ontario guideline for TKN is presently available; however, waters not influenced by excessive organic inputs typically range from 0.100 to 0.500 mg/l, Environment Canada (1979) *Water Quality Sourcebook, A Guide to Water Quality Parameters,* Inland Waters Directorate, Water Quality Branch, Ottawa, Canada

At the Deep Points

Average nutrient concentrations at the deep point are summarized in Table 11 as well as the proportion of results that meet the guideline.

Table 11 Summary of nutrient results for Loon Lake, 2008-2013

Total Phosphorus 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-34	0.014	86%	21
Total Kjeldahl Nitrogen 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-34	0.014	57%	21

TP and TKN sampling results are presented in Figures 24 and 25. Eighty-six percent of samples analyzed for TP were less than the TP guideline and the average concentration was 0.014 mg/l (Table 11). TKN concentrations were more frequently elevated; 57 percent of results were below the TKN guideline and the average concentration at 0.515 mg/l (Table 11). Average year to year concentrations have varied for both TP and TKN (Figure 26 and 27). Overall, the data presented indicates moderate TP concentrations, while TKN often exceeds the guideline.

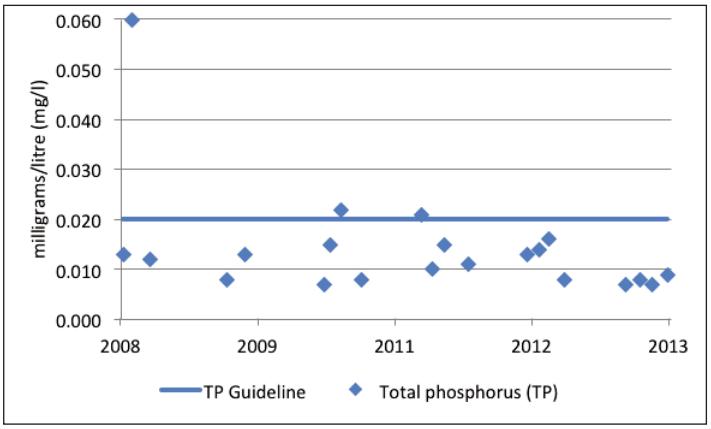


Figure 24 Total phosphorus sampling results at the deep point in Loon Lake, 2008-2013

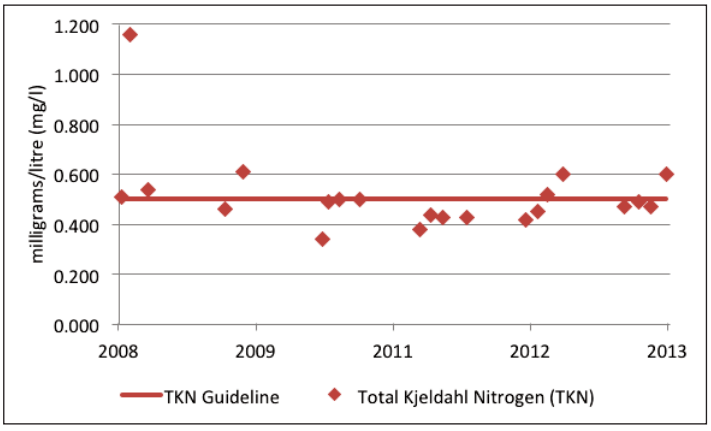


Figure 25 Total Kjeldahl nitrogen sampling results at the deep point in Loon Lake, 2008-2013

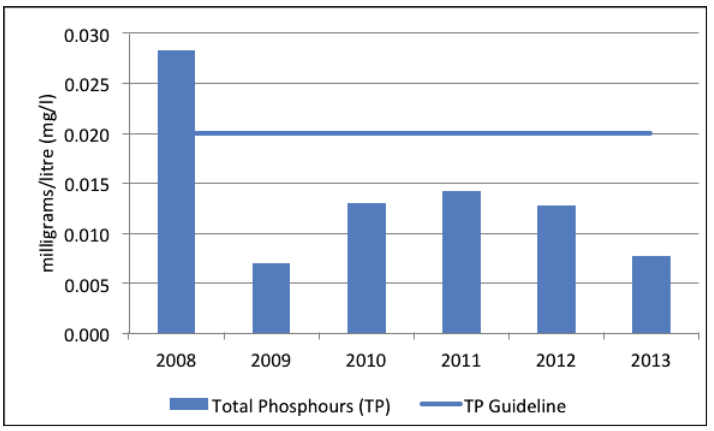


Figure 26 26 Average total phosphorus at the deep point in Loon Lake, 2008-2013

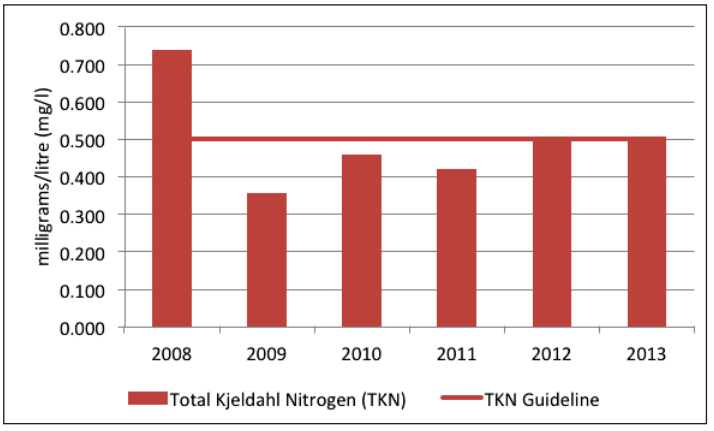


Figure 27 Average total Kjeldahl nitrogen at the deep point in Loon Lake, 2008-2013

Around the Lake

The average nutrient concentrations at monitored sites around the lake vary from year to year (Figures 28 and 29). Please note that site A is monitored each year while site B and C are monitored every fifth year.

Total phosphorous concentrations were elevated at site A more than one year; data is only available from sites B and C in 2010. As site B is located at the outflow of some large wetlands, it may be expected to have high nutrient concentrations; site C is well below the guideline.

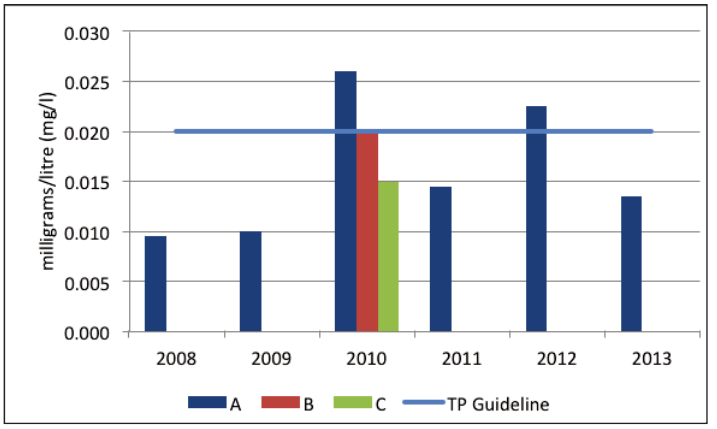


Figure 28 Average total phosphorus concentration at shoreline monitoring sites on Loon Lake, 2008-2013

TKN concentrations largely mirrored TP concentrations, although they were more likely to exceed the TKN guideline. These results provide further evidence that nutrient loading may be occurring at site A resulting in abundant plant or algal growth and low oxygen levels, particularly as both TP and TKN are persistently elevated at this site on the lake.

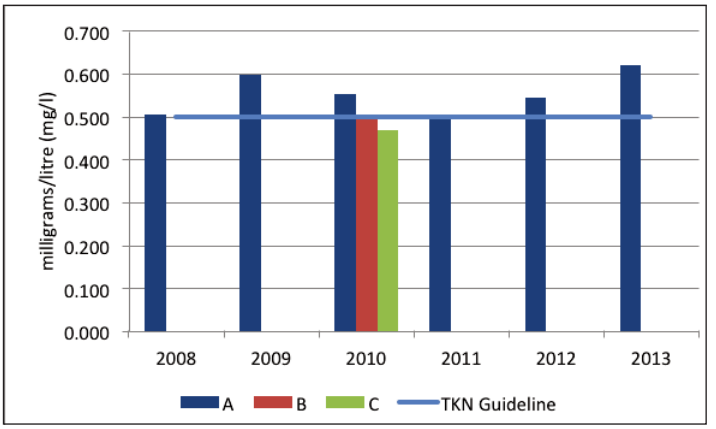


Figure 29 Average total Kjeldahl nitrogen concentration at shoreline monitoring sites on Loon Lake, 2008-2013

Summary

Within Loon Lake (RVL-34) nutrient concentrations generally meet guidelines. Sites with particularly high results are likely due to natural influences given the limited development around this lake. Nutrient exceedances may be partially attributed to the natural aging of a lake and basin characteristics; the lake is shallow and composed of portions of drowned land with rich organic soils that hold high levels of phosphorus. The shallow basin and organic rich soils make internal loading of nutrients likely; likewise the surrounding wetlands that drain into the lake further act as nutrient sources. Aging of the lake can be slowed with the help of all catchment users by reducing nutrient inputs through practices such as proper maintenance of septic systems, minimizing runoff, keeping shorelines natural and using phosphate free soaps and detergents.

Water Clarity

Water clarity is measured using a Secchi disk during each deep point sample. Table 12 summarizes the recorded depths and shows that all readings have exceeded the minimum PWQO of 2 metres indicating good water clarity with an average Secchi depth of 4.9 metres. Figure 30 shows that no individual reading has been below the guideline and measured depths range from 3 metres to 7.5 metres. It should also be noted that Secchi depths in many waterbodies have been influenced by the colonization of zebra mussels resulting in clearer waters than may have been seen prior to the introduction of this species.

Table 12 Summary of Secchi depths recorded at the deep point in Loon Lake, 2008-2013

Secchi depth 2008-2013			
Site	**Average (m)**	**Above Guideline**	**No. Samples**
RVL-34	4.9	100%	22

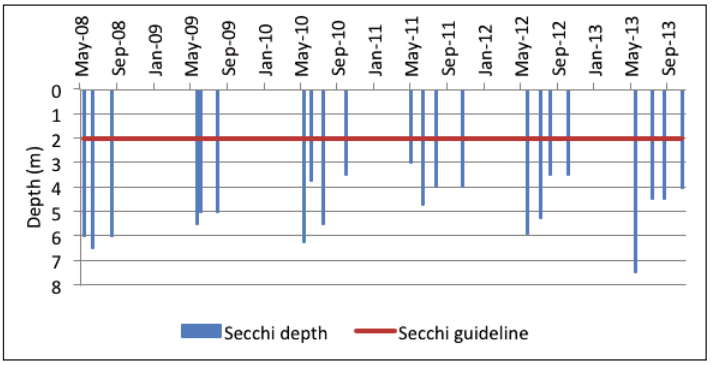


Figure 30 Recorded Secchi depths at the deep point in Loon Lake, 2008-2013

Summary

This data indicates that waters are clear and adequate sunlight is able to penetrate the water column to support aquatic life and provide sufficient visibility for safe recreational use (i.e., boating, swimming).

Fish Habitat

Two other factors, dissolved oxygen/temperature and pH were also assessed to provide an overall sense of the health of Loon Lake from a fish habitat perspective.

Dissolved Oxygen and Temperature

The red bars in Figure 31 show the depths where suitable conditions exist for warm water fish species (temperature less than 25°C and dissolved oxygen greater than 4 mg/l) at the monitored deep points. The vertical axis represents the total lake depth at each site where the profile is taken. Suitable oxygen and temperatures exist to an average depth of 7 metres (Figure 32).

Mid-summer high temperatures in the upper portion of the water column and limited oxygen availability in the deep water greatly limits the habitat available in some years; this is most pronounced in 2011, 2012 and 2013 (Figure 31).

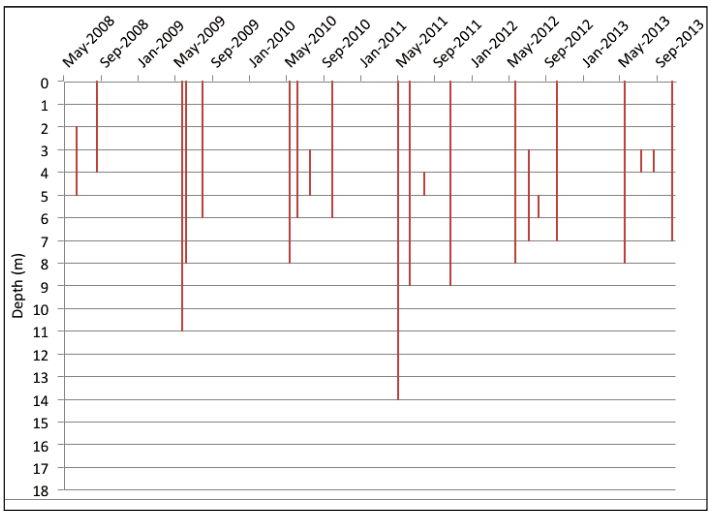


Figure 31 Depths suitable for warm water fish species in Loon Lake, 2008-2013

pH

pH is a basic water quality parameter used to assess the acidity of water, an important factor for aquatic life. Figure 32 shows pH concentrations in Loon Lake and Figure 33 summarizes average concentrations by year.

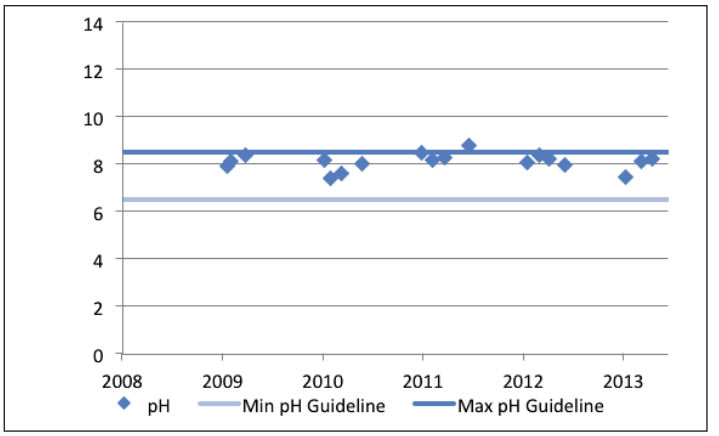


Figure 32 pH concentrations at the deep point in Loon Lake, 2008-2013

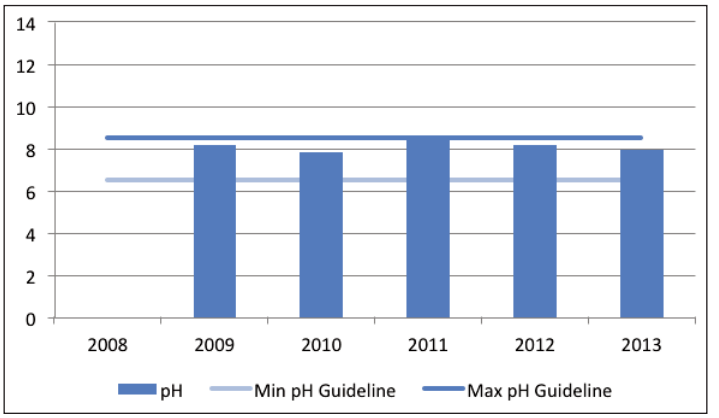


Figure 33 Average pH concentrations at the deep point in Loon Lake, 2008-2013

Eighty-nine percent of samples (Table 13) were within guidelines established by the PWQO which state that pH should be between 6.5 and 8.5 to protect aquatic life and prevent irritation for anyone using the waters for recreational purposes.

Table 13 Summary of Secchi depths recorded at the deep point in Loon Lake, 2008-2013

pH 2008-2013			
Site	**Average (m)**	**Within Guideline**	**No. Samples**
RVL-34	8.1	89%	19

In some areas of the Rideau Lakes subwatershed surface waters tend to be a bit more alkaline (higher pH), which can generally be attributed to geology rather than anthropogenic activities; biological activities such as photosynthesis may also affect pH. This appears to be the case in Loon Lake as results tend to be more to the upper end of the guideline.

Summary

Overall the water chemistry data at the deep points describes generally suitable conditions for warm water fish species such as pickerel, bass and pike. The data shows that the warming of the water column in summer months limits the amount of habitat available and may cause stress to some aquatic communities. pH conditions are typically within the range recommended for the protection of aquatic life, indicating a healthy environment for aquatic species.

E. coli

E. coli is sampled at monitored shoreline sites twice each sampling season. *E. coli* data was not used in the calculations of the WQI rating for the lake due to differences in sampling frequency and site locations. The majority of samples (93 percent) were below the *E. coli* guideline of 100 colony forming units (CFU) per 100 ml set by the PWQO; across the lake, the count at the geometric mean[6] was only 8 CFU/100ml (Table 14). Figure 34 summarizes the results from samples across all sites and shows the geometric mean was well below the guideline.

Table 14 Summary of *E. coli* results for Loon Lake, 2008-2013

E. coli 2008-2013			
Site	**Geometric mean (CFU/100ml)**	**Below Guideline**	**No. Samples**
RVL-34	8	93%	15

Summary

The results presented above provide evidence that bacterial contamination is not a significant concern in Loon Lake and the water should be safe for recreational use such as swimming and boating activities.

[6] A type of mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum). It is often used to summarize a variable that varies over several orders of magnitude, such as *E. coli* counts

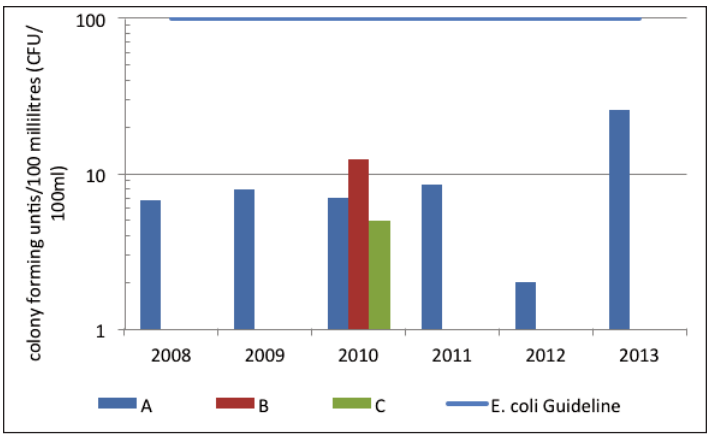


Figure 34 Geometric mean of shoreline sites monitored on Loon Lake, 2008-2013

1) d. Long Lake Water Quality

Surface water quality conditions in Long Lake (RVL-13) have been monitored by RVCA's Watershed Watch Program since 2002. Data from one deep point site has been used to calculate the WQI rating which was determined to be "Poor" (Table 1). Occasional nutrient exceedances, generally good oxygen conditions for fish habitat, clear water and occasionally elevated pH levels contributed to the rating. The following discussion explains how each of the monitored water quality parameters contributes to the lake's water quality.

This report also considers data from 7 additional sites that are monitored around the lake. These sites have not been included in the calculation of the CCME WQI rating as they are not monitored with the same frequency as deep point sites. However, they do provide important information on water quality conditions in the near shore areas. For locations of shoreline sites please see Figure 1.

The *2002 Long Lake State of the Lake Environment Report* (Rideau Valley Conservation Authority, 2003) noted that Long Lake had a moderate concentration of nutrients and suitable fish habitat was available based on oxygen and temperature data. The data presented in this report indicates that this continues to be the case and that a proactive cautionary program of best management practices is important to ensure the protection of the lake environment.

Nutrients

Total phosphorus (TP) is used as a primary indicator of excessive nutrient loading and may contribute to abundant aquatic vegetation growth and depleted dissolved oxygen levels. The Provincial Water Quality Objective (PWQO) is used as the TP Guideline and states that in lakes, concentrations greater than 0.020 mg/l indicate an excessive amount of TP within the water column.

Total Kjeldahl nitrogen (TKN) is used as a secondary indicator of nutrient loading. RVCA uses a guideline of 0.500 mg/l to assess TKN[7] within surface waters.

[7] No Ontario guideline for TKN is presently available; however, waters not influenced by excessive organic inputs typically range from 0.100 to 0.500 mg/l, Environment Canada (1979) *Water Quality Sourcebook, A Guide to Water Quality Parameters,* Inland Waters Directorate, Water Quality Branch, Ottawa, Canada

At the Deep Point

One deep point site is monitored on the lake. Average nutrient concentrations at this site are summarized in Table 15 as well as the proportion of results that meet the guideline.

Table 15 Summary of nutrient results for Long Lake, 2008-2013

Total Phosphorus 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-13	0.015	81%	26
Total Kjeldahl Nitrogen 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-13	0.390	88%	26

TP and TKN sampling results are presented in Figures 35 and 36. The majority (81 percent) of samples analyzed for TP were less than the TP guideline and the average concentration was 0.015 mg/l (Table 15). TKN concentrations were fairly minimal; 88 percent of reported results were below the TKN guideline as was the average concentration at 0.390 mg/l (Table 15). Average year to year concentrations have varied for both TP and TKN (Figure 37 and 38) but do not indicate a general trend; all average results are below guidelines. Overall the data presented indicates that nutrient concentrations may be considered moderate in the mid-lake, deep water sites of Long Lake.

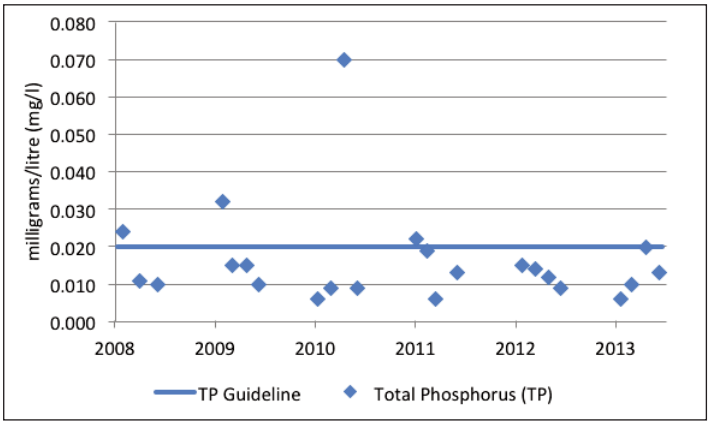


Figure 35 Total phosphorus sampling results at the deep point site in Long Lake, 2008-2013

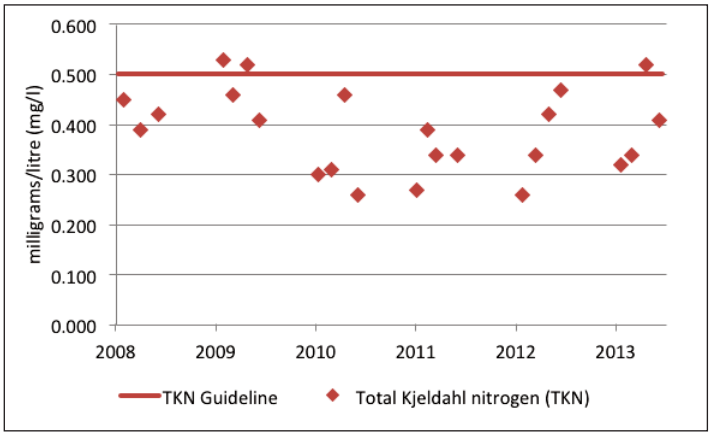


Figure 36 Total Kjeldahl nitrogen sampling results at the deep point site in Long Lake, 2008-2013

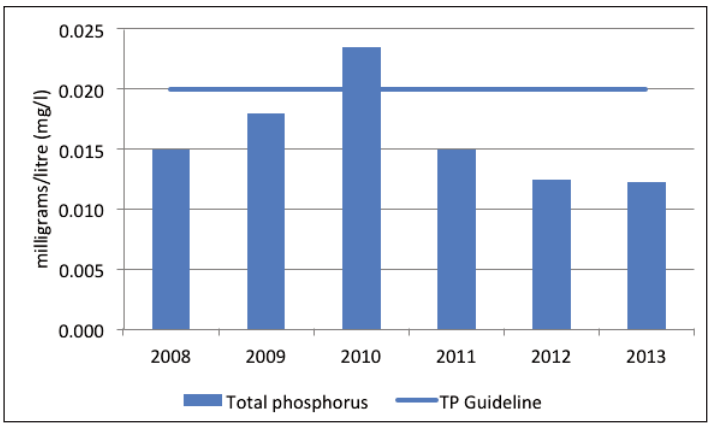


Figure 37 Average total phosphorus at the deep point site in Long Lake, 2008-2013

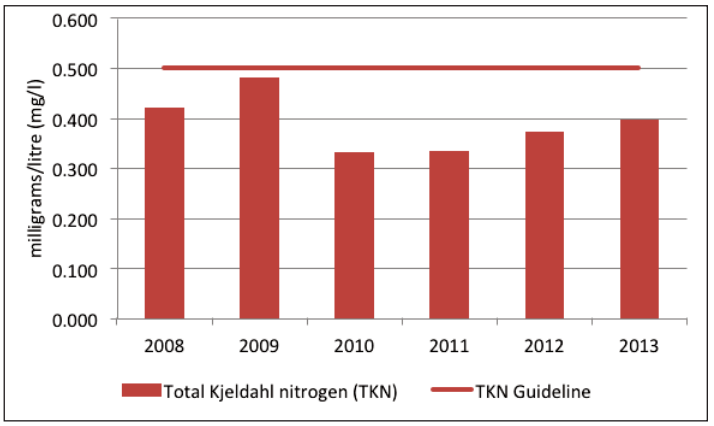


Figure 38 Average total Kjeldahl nitrogen at the deep point site in Long Lake, 2008-2013

Around the Lake

The average nutrient concentrations at monitored sites around the lake vary from year to year (Figures 39 and 40). Please note that sites A, E, and F are monitored each year while other sites (B, C, D, and G) are monitored every fifth year.

Average total phosphorous concentrations are below the TP guideline at all sites (Figure 39), indicating nutrient enrichment does not appear to be a problem in the monitored near shore areas.

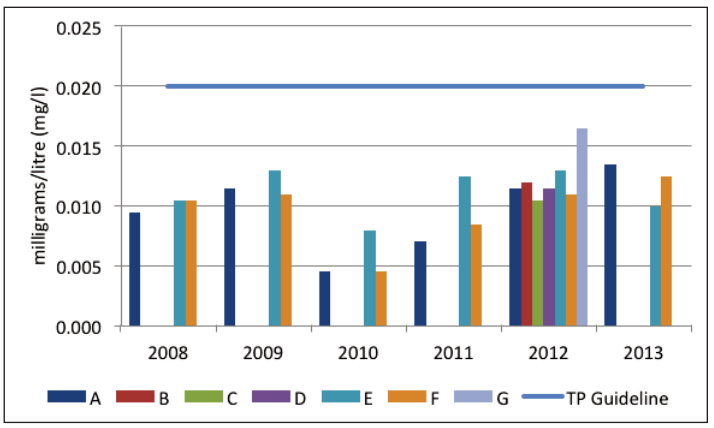


Figure 39 Average total phosphorus concentration at additional monitoring sites on Long Lake, 2008-2013

TKN concentrations were also below the guideline at all sites (Figure 40). These results provide further support that nutrient enrichment is limited along the shoreline.

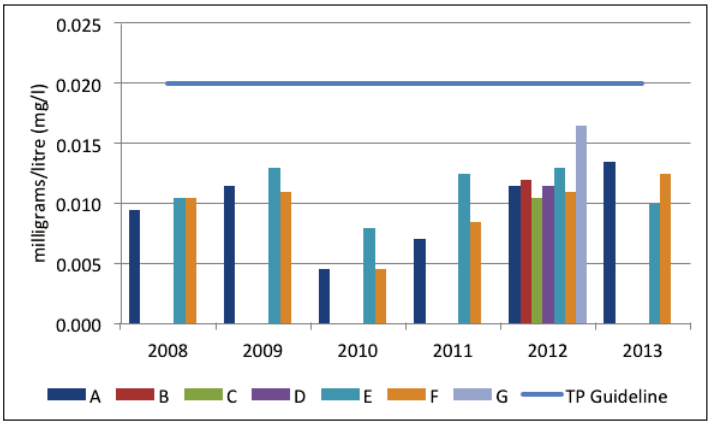


Figure 40 Average total Kjeldahl nitrogen concentration at additional monitoring sites on Long Lake, 2008-2013

Summary

Within Long Lake nutrient concentrations generally meet guidelines. Average TP concentrations (Table 15) are comparable to the *2002 Long Lake State of the Lake Environment Report* (RVCA, 2003) which reported TP concentrations of 0.014 mg/l (2002) and 0.012 mg/l (2003).

Efforts such as the diversion of runoff and enhanced shoreline buffers are important to continue to protect and enhance water quality, and reduce the frequency of nutrient exceedances. Nutrient exceedances may be partially attributed to the natural aging of a lake and basin characteristics. The lake is fairly shallow; the shallow basin and organic rich soils make internal loading of nutrients likely as oxygen becomes depleted from the deep waters. All residents can help reduce their impact on the lake by minimizing nutrient inputs through practices such as proper maintenance of septic systems, keeping shorelines natural and using phosphate free soaps and detergents.

Water Clarity

Water clarity is measured using a Secchi disk during each deep point sample. Table 16 summarizes the recorded depths and shows that all readings have exceeded the minimum PWQO of 2 metres indicating good water clarity, the average Secchi depth is 6.1 metres. Figure 41 shows that no individual reading has been below the guideline and measured depths range from 3 metres to 10.5 metres. It should be noted that Secchi depths in many waterbodies have been influenced by the colonization of zebra mussels resulting in clearer waters than may have been seen prior to the introduction of this species.

Table 16 Summary of Secchi depths recorded at the deep poin site in Long Lake, 2008-2013

Secchi depth 2008-2013			
Site	**Average (m)**	**Above Guideline**	**No. Samples**
RVL-13	6.1	100%	25

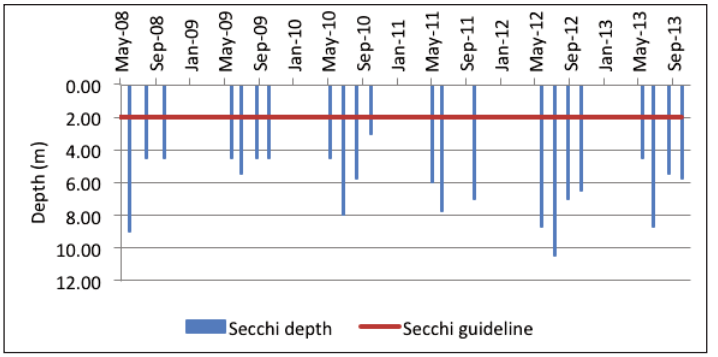


Figure 41 Recorded Secchi depths at the deep point site in Long Lake, 2008-2013

Summary

This data indicates that waters are very clear and sufficient sunlight is able to penetrate the water column to support aquatic life and provide sufficient visibility for safe recreational use (i.e., boating, swimming). The *2002 Long Lake State of the Lake Environment Report* noted Secchi depths between 3 and 4.9 metres; the increase in water clarity is likely attributed to zebra mussels which are known to be in the lake.

Fish Habitat

Two other factors, dissolved oxygen/temperature and pH were also assessed to provide an overall sense of the health of Long Lake from a fish habitat perspective.

Dissolved Oxygen and Temperature

The red bars in Figure 42 show the depths where suitable conditions exist for warm water fish species (temperature less than 25°C and dissolved oxygen greater than 4 mg/l) at the monitored deep point. The vertical axis represents the total lake depth at each site where the profile is taken. Suitable oxygen temperatures exist to an average depth of 9 metres.

There are typically good conditions for fish habitat, but as temperatures warm throughout the summer, available habitat becomes very limited in some years (i.e., 2009, 2011 and 2012) and may put stress on sensitive species.

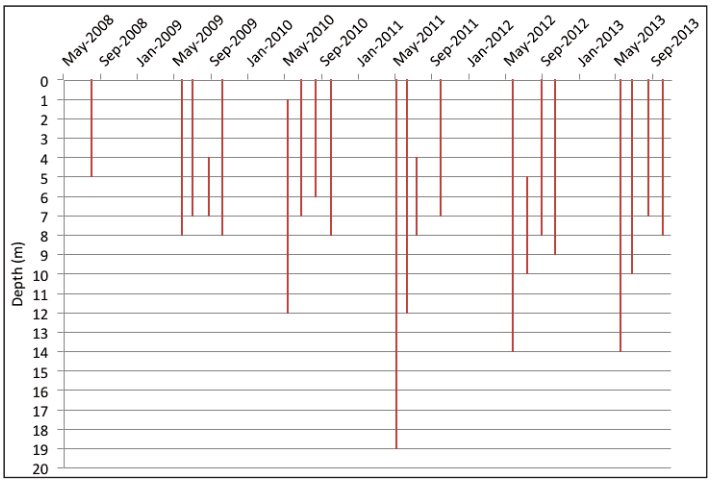


Figure 42 Depths suitable for warm water fish at the deep point in Long Lake, 2008-2013

pH

pH is a basic water quality parameter used to assess the acidity of water, an important factor for aquatic life. Figure 43 shows pH concentrations in Long Lake and Figure 44 summarizes average concentrations by year.

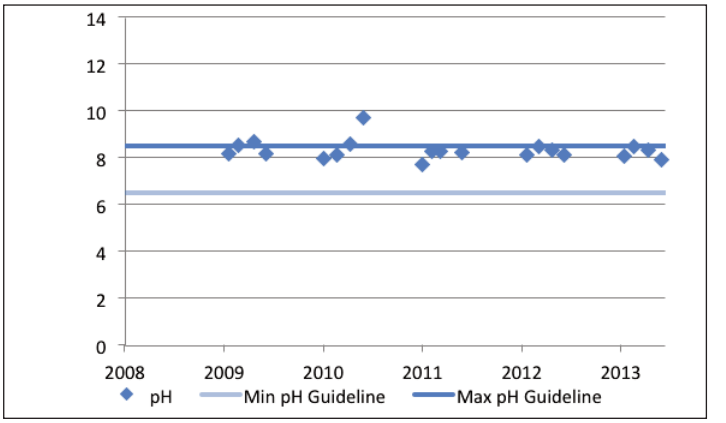


Figure 43 pH concentration at the deep point site in Long Lake, 2008-2013

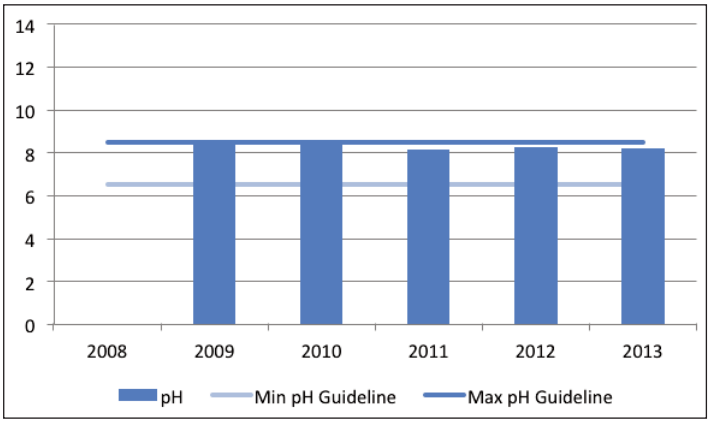


Figure 44 Average pH concentration at the deep point site in Long Lake, 2008-2013

Seventy percent of samples (Table 17) were within guidelines established by the PWQO which state that pH should be between 6.5 and 8.5 to protect aquatic life and prevent irritation for anyone using the waters for recreational purposes. Average results border on the upper limit of the guideline indicating that elevated pH is a feature of this lake.

Table 17 Summary of pH results at the deep point site in Long Lake, 2008-2013

pH 2008-2013			
Site	**Average**	**Below Guideline**	**No. Samples**
RVL-13	8.4	70%	20

In some areas of the Rideau Lakes subwatershed, surface waters tend to be a bit more alkaline (higher pH) which can generally be attributed to geology rather than anthropogenic activities; biological activities such as photosynthesis may also affect pH.

Summary

Overall the water chemistry data at the deep point describes suitable habitat conditions for warm water fish species. There is some evidence that the warming of the water column in the mid-summer may limit the amount of habitat for some sensitive species. pH conditions are typically on the upper end of the range recommended for the protection of aquatic life. Overall, the data indicates a healthy environment for aquatic species.

E. coli

E. coli is sampled at monitored shoreline sites twice each sampling season. *E. coli* data was not used in the calculations of the WQI rating for the lake due to differences in sampling frequency and site locations. All samples were below the *E. coli* guideline of 100 colony forming units (CFU) per 100 ml set by the PWQO; across the lake the count at the geometric mean[8] was only 3 CFU/100ml (Table 18). Figure 45 shows that samples across all sites were well below the guideline.

Table 18 Summary of *E. coli* results for Long Lake, 2008-2013

***E. coli* 2008-2013**			
Site	**Geometric mean (CFU/100ml)**	**Below Guideline**	**No. Samples**
RVL-13	3	100%	41

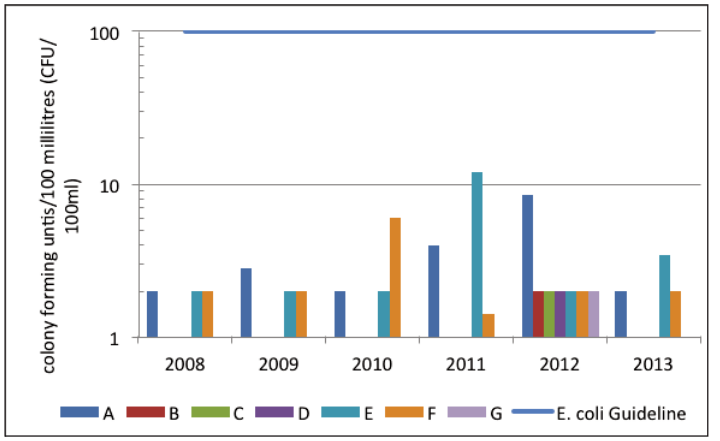


Figure 45 Geometric mean of shoreline sites monitored on Long Lake, 2008-2013

Summary

The results presented above provide evidence that bacterial contamination is not a significant concern in Long Lake and the water should be safe for recreational use such as swimming and boating activities.

1) e. Adam Lake Water Quality

Surface water quality conditions in Adam Lake (RVL-32) have been monitored by RVCA's Watershed Watch Program since 2005. Data from one deep point site has been used to calculate the WQI rating for Adam Lake, which was determined to be "Poor" (Table 1). Few nutrient exceedances, periods of limited oxygen conditions for fish habitat, clear water and occasionally elevated pH levels contributed to the rating. The following discussion explains how each of the monitored water quality parameters contributes to the lake's water quality.

This report also considers data from 7 additional sites that are monitored around the lake. These sites have not been included in the calculation of the CCME WQI rating as they are not monitored with the same frequency as deep point sites. However, they do provide important information on water quality conditions in the near shore areas. For locations of shoreline sites please see Figure 1.

The *2005 Adam Lake State of the Lake Environment Report* (RVCA, 2006) stated that Adam Lake had a moderate concentration of nutrients and limited oxygen availability throughout the summer. The *2009 Rideau Lakes Watershed Plan* (RVCA, 2009) stated that nutrient concentrations did not show a declining trend. The data presented in this report provides evidence that this continues to be the case and that a proactive cautionary program of best management practices is important to ensure the protection of the lake environment.

Nutrients

Total phosphorus (TP) is used as a primary indicator of excessive nutrient loading and may contribute to abundant aquatic vegetation growth and depleted dissolved oxygen levels. The Provincial Water Quality Objective (PWQO) is used as the TP Guideline and states that in lakes, concentrations greater than 0.020 mg/l indicate an excessive amount of TP within the water column.

Total Kjeldahl nitrogen (TKN) is used as a secondary indicator of nutrient loading. RVCA uses a guideline of 0.500 mg/l to assess TKN[9] within surface waters.

At the Deep Point

One deep point site is monitored on the lake. The average nutrient concentration at this site is summarized in Table 19 as well as the proportion of results that meet the guideline.

Table 19 Summary of nutrient results for Adam Lake, 2008-2013

Total Phosphorus 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-32	0.013	86%	22
Total Kjeldahl Nitrogen 2008-2013			
Site	**Average (mg/l)**	**Below Guideline**	**No. Samples**
RVL-32	0.381	95%	22

[8] A type of mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum). It is often used to summarize a variable that varies over several orders of magnitude, such as *E. coli* counts

[9] No Ontario guideline for TKN is presently available; however, waters not influenced by excessive organic inputs typically range from 0.100 to 0.500 mg/l, Environment Canada (1979) *Water Quality Sourcebook, A Guide to Water Quality Parameters,* Inland Waters Directorate, Water Quality Branch, Ottawa, Canada

TP and TKN sampling results are presented in Figures 46 and 47. The majority (86 percent) of samples analyzed for TP were less than the TP guideline and the average concentration was 0.013 mg/l (Table 19). TKN concentrations were fairly minimal; 95 percent of reported results were below the TKN guideline as was the average concentration at 0.381 mg/l (Table 19). Average year to year concentrations have varied for both TP and TKN (Figure 48 and 49) but do not indicate a general trend; all average results are below guidelines. Overall the data presented indicates that moderate nutrient levels characterize the mid-lake, deep water sites of Adam Lake.

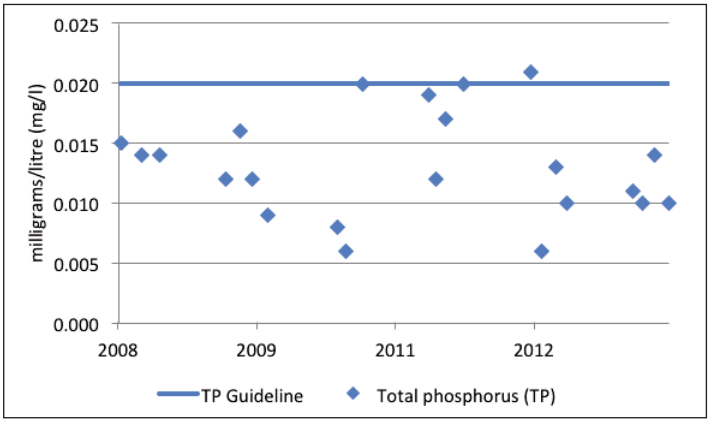


Figure 46 Total phosphorus sampling results at the deep point site in Adam Lake, 2008-2013

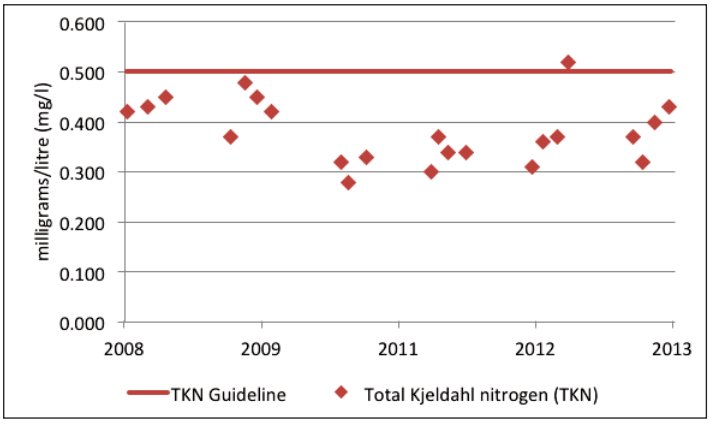


Figure 47 Total Kjeldahl nitrogen sampling results at the deep point site in Adam Lake, 2008-2013

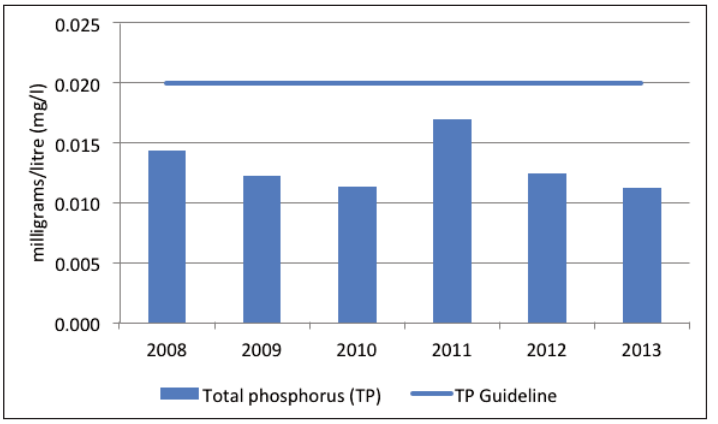


Figure 48 Average total phosphorus at the deep point site in Adam Lake, 2008-2013

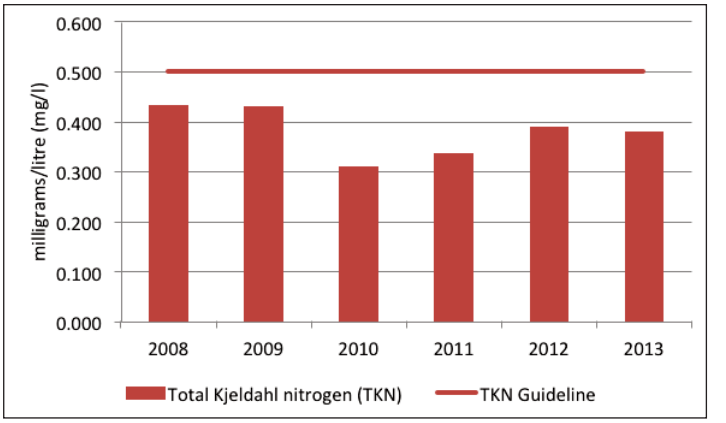


Figure 49 Average total Kjeldahl nitrogen at the deep point site in Adam Lake, 2008-2013

Around the Lake

The average nutrient concentrations at monitored sites around the lake vary from year to year (Figures 50 and 51). Please note that sites A, C, and E are monitored each year while other sites (B, D, E, F and G) are monitored every fifth year.

Average total phosphorous concentrations are below the TP guideline at all sites (Figure 50), indicating nutrient enrichment does not appear to be a problem in the monitored near shore areas.

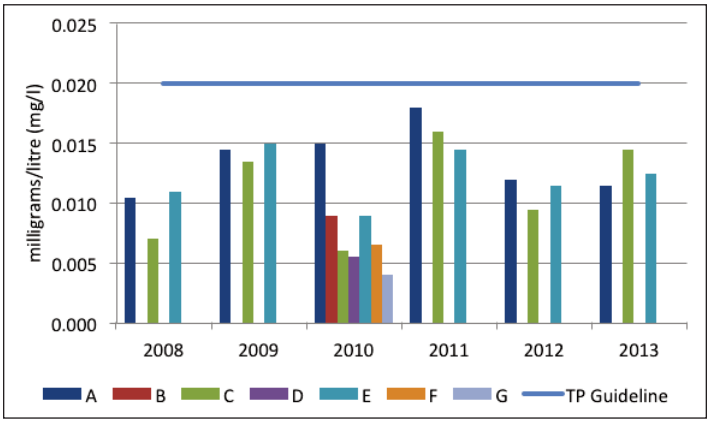


Figure 50 Average total phosphorus concentration at additional monitoring sites on Adam Lake, 2008-2013

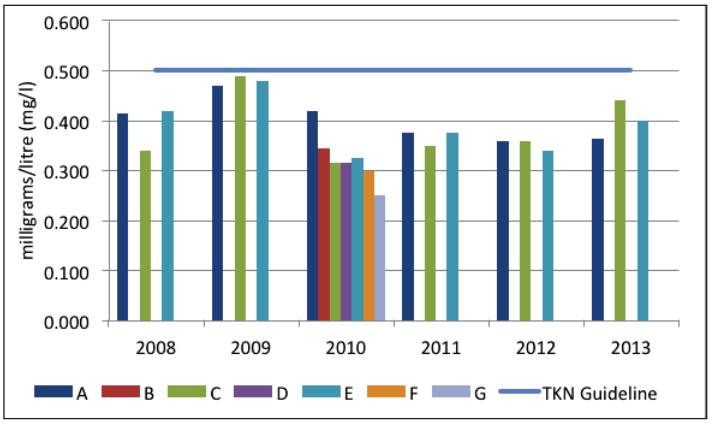


Figure 51 Average total Kjeldahl nitrogen concentration at additional monitoring sites on Adam Lake, 2008-2013

TKN concentrations were also below the guideline at all sites (Figure 51). These results provide further support that nutrient enrichment is limited along the shoreline.

Summary

Within Adam Lake nutrient concentrations generally meet guidelines. Average TP concentrations (Table 19) are comparable to the 2005 results which ranged from 0.011 mg/l to 0.015 mg/l.

Efforts such as the diversion of runoff and enhanced shoreline buffers are important to continue to protect and enhance water quality. Nutrient concentrations are also affected by the natural aging of a lake and basin characteristics; the lake is shallow and composed of portions of drowned land with rich organic soils that contain high levels of nutrients. The shallow basin and organic rich soils make loading of nutrients likely. All residents can help reduce their impact on the lake by reducing nutrient inputs through practices such as proper maintenance of septic systems, keeping shorelines natural and using phosphate free soaps and detergents.

Water Clarity

Water clarity is measured using a Secchi disk during each deep point sample. Table 20 summarizes the recorded depths and shows that all readings have exceeded the minimum PWQO of 2 metres indicating good water clarity; the average Secchi depth is 4.9 metres. Figure 52 shows that no individual reading has been below the guideline and measured depths range from 3.8 metres to 6.0 metres. It should be noted that Secchi depths in many waterbodies have been influenced by the colonization of zebra mussels resulting in clearer waters than may have been seen prior to the introduction of this species. The *2005 Adam Lake State of the Lake Environment Report* reported the average Secchi depth to be 3.6 metres.

Table 20 Summary of Secchi depths recorded at deep point in Adam Lake, 2008-2013

Secchi depth 2008-2013			
Site	**Average**	**Above Guideline**	**No. Samples**
RVL-32	4.9	100%	21

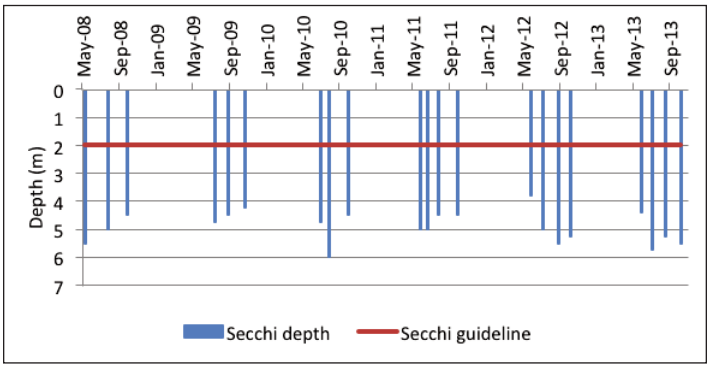


Figure 52 Recorded Secchi depths at the deep point site in Adam Lake, 2008-2013

Summary

This data indicates that waters are very clear and sufficient sunlight is able to penetrate the water column to support aquatic life and provide sufficient visibility for safe recreational use (i.e., boating, swimming). There is evidence of an increase in Secchi depth possibly due to zebra mussels which have been noted in Adam Lake.

Fish Habitat

Two other factors, dissolved oxygen/temperature and pH were also assessed to provide an overall sense of the health of Adam Lake from a fish habitat perspective.

Dissolved Oxygen and Temperature

The red bars in Figure 53 show the depths where suitable conditions exist for warm water fish species (temperature less than 25°C and dissolved oxygen greater than 4 mg/l) at the monitored deep point. The vertical axis represents the total lake depth at each site where the profile is taken. Suitable oxygen temperatures exist to an average depth of 8 metres.

There is typically very limited fish habitat available in the summer months; more suitable conditions are observed in the spring and fall.

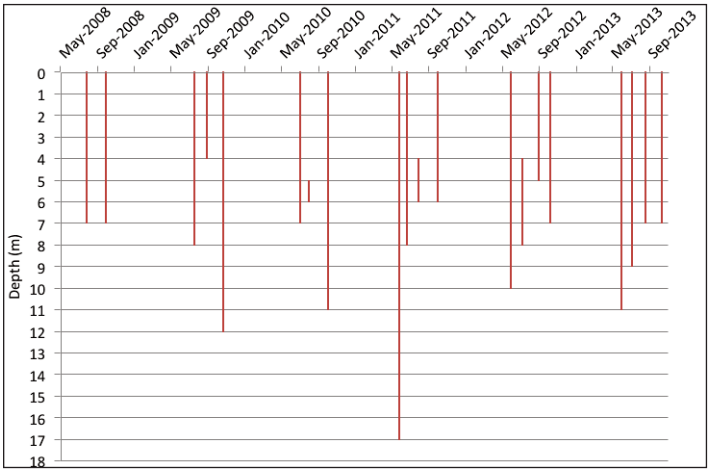


Figure 53 Depths suitable for warm water fish at the deep point in Adam Lake, 2008-2013

pH

pH is a basic water quality parameter used to assess the acidity of water, an important factor for aquatic life. Figure 54 shows pH concentrations in Adam Lake and Figure 55 summarizes average concentrations by year.

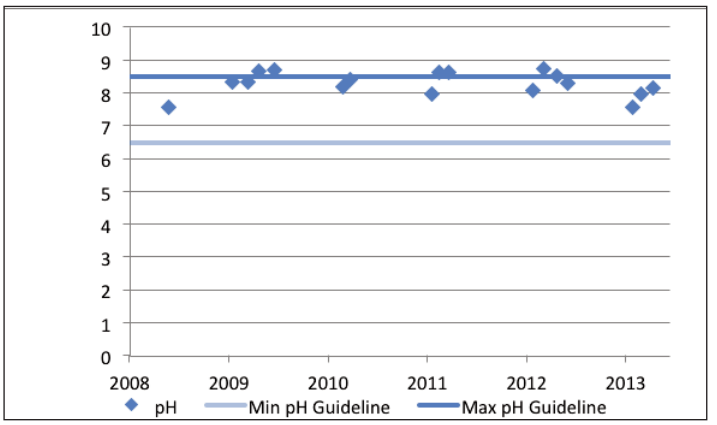


Figure 54 pH concentration at the deep point site in Adam Lake, 2008-2013

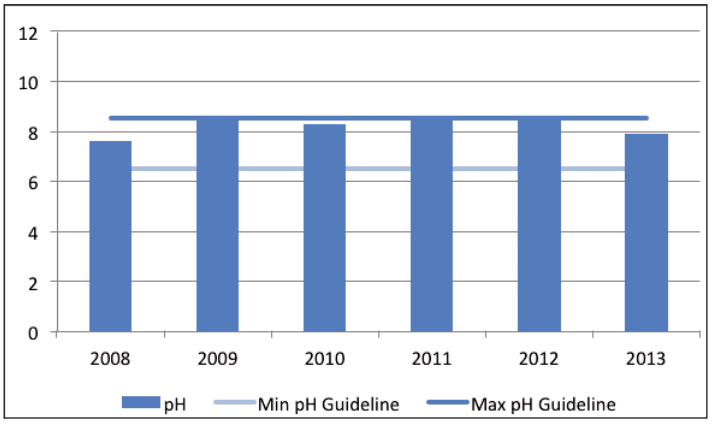


Figure 55 Average pH concentrations at the deep point site in Adam Lake, 2008-2013

Sixty-five percent of samples (Table 21) were within guidelines established by the PWQO which state that pH should be between 6.5 and 8.5 to protect aquatic life and prevent irritation for anyone using the waters for recreational purposes. Average results border on the upper limit of the guideline indicating that elevated pH is a feature of this lake.

Table 21 Summary of pH results for the deep point site in Adam Lake, 2008-2013

pH 2008-2013			
Site	**Average**	**Within Guideline**	**No. Samples**
RVL-32	8.3	65%	17

In some areas of the Rideau Lakes subwatershed, surface waters tend to be a bit more alkaline (higher pH) which can generally be attributed to geology rather than anthropogenic activities; biological activities such as photosynthesis may also affect pH.

Summary

Overall the water chemistry data at the deep point describes suitable habitat conditions for warm water fish species in the spring and fall. There is evidence that the warming of the upper portion of the water column and oxygen depletion in the deep waters in the summer (2010, 2011 and 2012) may limit the amount of habitat and put stress on sensitive species. pH conditions are typically on the upper end of the range recommended for the protection of aquatic life.

E. coli

E. coli is sampled at monitored shoreline sites twice each sampling season. *E. coli* data was not used in the calculations of the WQI rating for the lake due to differences in sampling frequency and site locations. All samples were below the *E. coli* guideline of 100 colony forming units (CFU) per 100 ml set by the PWQO; across the lake the count at the geometric mean[10] was only 2 CFU/100ml (Table 22). Figure 56 shows that samples across all sites were well below the guideline.

Table 22 Summary of *E. coli* results for Adam Lake, from 2008-2013

E. coli 2008-2013			
Site	**Geometric mean (CFU/100ml)**	**Below Guideline**	**No. Samples**
RVL-32	2	100%	39

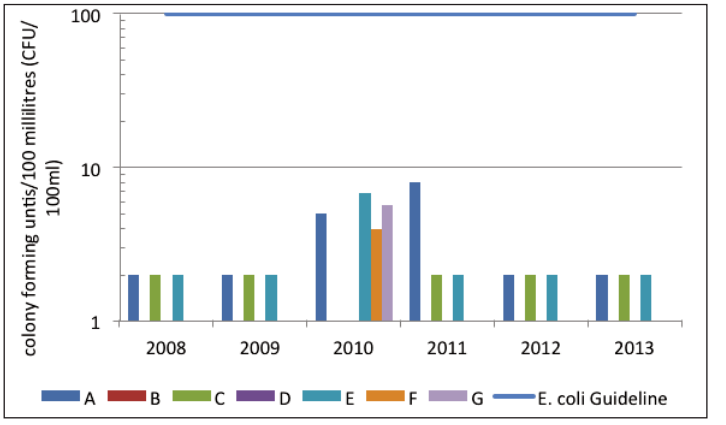


Figure 56 Geometric mean of shoreline sites monitored on Adam Lake, 2008-2013

Summary

The results presented above provide evidence that bacterial contamination is not a significant concern in Adam Lake and the water should be safe for recreational use such as swimming and boating activities.

[10] A type of mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum). It is often used to summarize a variable that varies over several orders of magnitude, such as *E. coli* counts

2. Riparian Conditions

Shoreline Buffer Land Cover Evalutation

The riparian or shoreline zone is that special area where the land meets the water. Well-vegetated shorelines are critically important in protecting water quality and creating healthy aquatic habitats, lakes and rivers. Natural shorelines intercept sediments and contaminants that could impact water quality conditions and harm fish habitat in streams. Well established buffers protect the banks against erosion, improve habitat for fish by shading and cooling the water and provide protection for birds and other wildlife that feed and rear young near water. A recommended target (from Environment Canada's Guideline: *How Much Habitat is Enough?)* is to maintain a minimum 30 meter wide vegetated buffer along at least 75 percent of the length of both sides of rivers, creeks and streams.

Figure 57 shows the extent of the naturally vegetated riparian zone in the catchment, 30 meters along the shoreline of waterbodies and watercourses. This analysis from the RVCA's Land Cover Classification Program (derived from 2008 DRAPE imagery) shows that the riparian buffer (30 metre wide strip) in the catchment is comprised of woodland (46 percent), wetland (34 percent), settlement areas (12 percent), crop and pastureland (six percent), and transportation routes (two percent)

Around **Big Rideau Lake** itself (in the catchment), the shoreline buffer is made up of woodland (46 percent), settlement areas (31 percent), wetland (21 percent), transportation routes (one percent) and crop and pastureland (one percent).

Around **Adam Lake**, the shoreline buffer is made up of woodland (61 percent), settlement areas (26 percent), wetland (10 percent), transportation routes (two percent) and crop and pastureland (one percent). Around **Long Lake**, the shoreline buffer is made up of woodland (63 percent), wetland (20 percent) and settlement areas (17 percent). Around **Round Lake**, the shoreline buffer is made up of woodland (83 percent), wetland (10 percent), settlement areas (four percent) and transportation routes (three percent)

Along streams in the catchment, the riparian buffer is comprised of wetland (46 percent), woodland (38 percent), crop and pastureland (11 percent), transportation routes (three percent) and settlement areas (two percent).

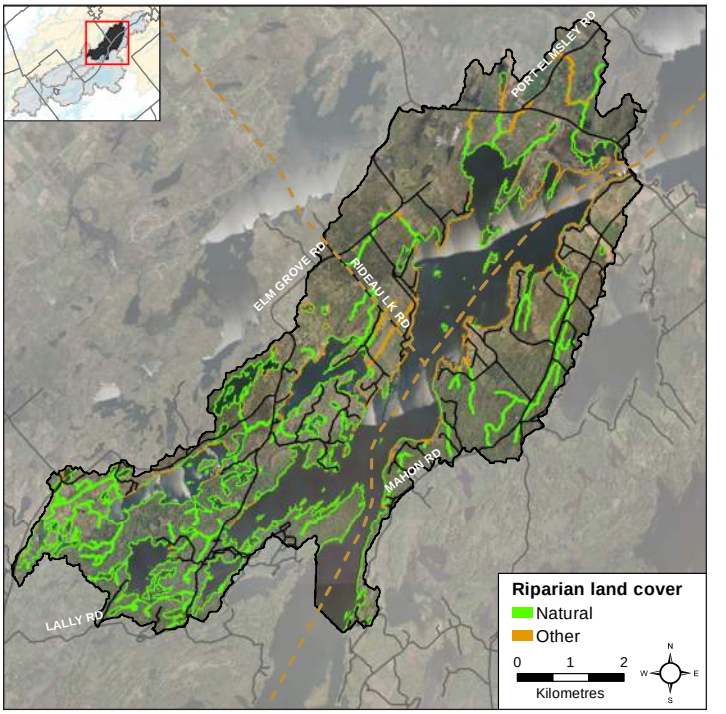


Figure 57 Natural and other riparian land cover around Big Rideau Lake

Headwaters Drainage Features Assessment

The RVCA Stream Characterization program assessed Headwater Drainage Features for the Rideau Lakes subwatershed in 2013. This protocol measures zero, first and second order headwater drainage features (HDF). It is a rapid assessment method characterizing the amount of water, sediment transport, and storage capacity within headwater drainage features (HDF). RVCA is working with TRCA and the MNR to implement the protocol with the goal of providing standard datasets to support science development and monitoring on both the interim guideline for headwater drainage features and existing mitigation strategies. An HDF is a depression in the land that conveys surface flow. Additionally, this module provides a means of characterizing the connectivity, form and unique features associated with each HDF (OSAP Protocol, 2013). An initiative is underway to evaluate how these data can help understand the cumulative contributions of individual headwater drainage features on the downstream watershed state (see Stanfield et al., 2013). In 2013 the program sampled 18 sites in the Big Rideau Lake-Rideau Ferry catchment area. Figure 58 shows the headwater drainage features sampling locations in the catchment.

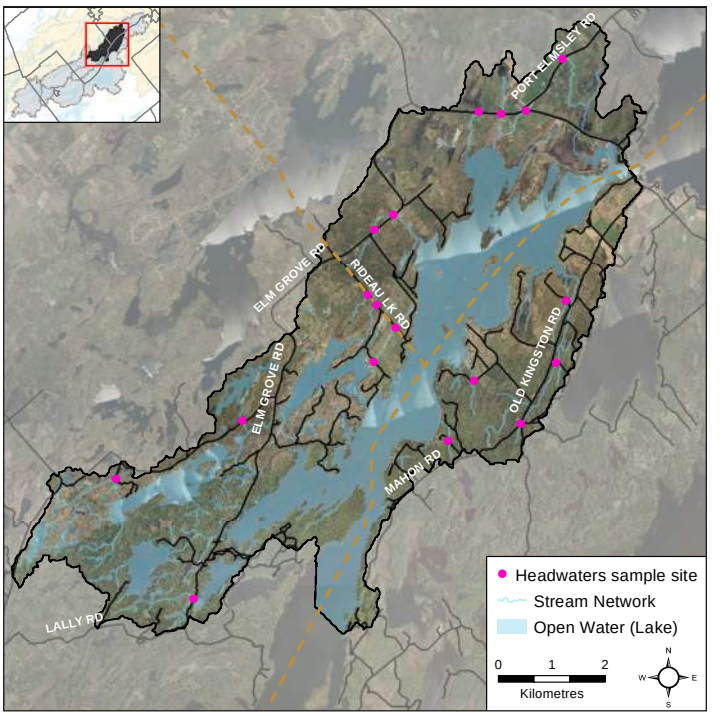


Figure 58 Headwater drainage feature sampling locations around Big Rideau Lake

Two photos of Headwaters Assessments in the Big Rideau Lake-Rideau Ferry catchment

Fisheries

The Big Rideau Lake-Rideau Ferry catchment is comprised of a mixed fish community of warm, cool and cold water species. A total of 27 species of recreational and baitfish support the Rideau Lakes fishery in the catchment. The following is a list of known species in the catchment (Source: MNR/RVCA).

lake trout
northern pike
smallmouth bass
largemouth bass
walleye
yellow perch
rock bass
black crappie
pumpkinseed
bluegill
brown bullhead
yellow bullhead
white sucker
lake whitefish
lake herring
fallfish
shorthead redhorse
blackchin shiner
burbot
brook silverside
alewife
bluntnose minnow
banded killifish
golden shiner
blacknose shiner
fathead minnow
Iowa darter

Smallmouth Bass *(Micropterus dolomieu)*

3. Land Cover

Woodland is the dominant land cover type in the catchment along with water, as shown in Table 23 and displayed in the map on the front cover of the report.

Table 23 Catchment land cover type

Cover Type	Area (ha)	Area (% of Cover)
Woodland*	2133	39
Water	1415	26
Wetland**	825	15
Crop & Pasture	646	12
Settlement	81	5
Transportation	192	3

* Does not include treed swamps ** Includes treed swamps

Woodland Cover

The Big Rideau Lake-Rideau Ferry catchment contains 2132 hectares of upland forest and 99 hectares of lowland forest (treed swamps) (Fig.59) that occupies 40 percent of the drainage area (versus the 44 percent of woodland cover in the Rideau Lakes subwatershed). This figure is greater than the 30 percent of woodland area required to sustain forest birds, according to Environment Canada's Guideline: *How Much Habitat is Enough?* When forest cover declines below 30 percent, forest birds tend to disappear as breeders across the landscape.

One hundred and twenty six (53 percent) of the 239 woodland patches in the catchment are very small, being less than one hectare in size. Another 89 (37 percent) of the wooded patches ranging from one to less than 20 hectares in size tend to be dominated by edge-tolerant bird species. The remaining 24 (10 percent of) woodland patches range between 21 and 397 hectares. Eighteen of these patches contain woodland between 20 and 100 hectares and may support a few area-sensitive species and some edge intolerant species, but will be dominated by edge tolerant species.

Conversely, six (two percent) of the 239 woodland patches in the drainage area exceed the 100 plus hectare size needed to support most forest dependent, area sensitive birds and are large enough to support approximately 60 percent of edge-intolerant species. One of these patches tops 200 hectares, which according to the Environment Canada Guideline will support 80 percent of edge-intolerant forest bird species (including most area sensitive species) that prefer interior forest habitat conditions.

Forest Interior

The same 239 woodlands contain 88 forest interior patches (Fig.59) that occupy less than one percent (279 ha.) of the catchment land area (versus the five percent of interior forest in the Rideau Lakes subwatershed). This is below the ten percent figure referred to in the Environment Canada Guideline that is considered to be the minimum threshold for supporting edge intolerant bird species and other forest dwelling species in the landscape.

Most patches (81) have less than 10 hectares of interior forest, 52 of which have small areas of interior forest habitat less than one hectare in size. Another six patches contain between 10 and 30 hectares of interior forest. Conversely, one patch has greater than 30 hectares of interior forest (at 40 ha.).

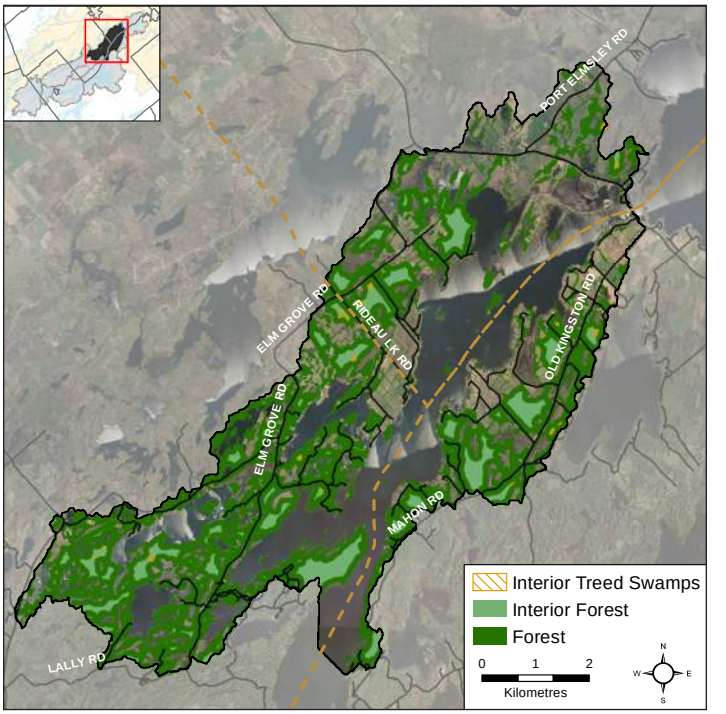
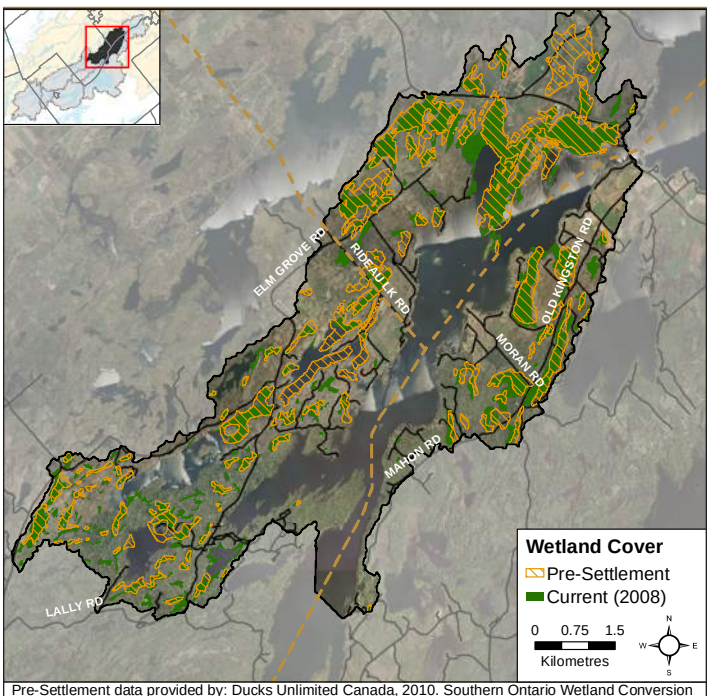


Figure 59 Catchment woodland cover and forest interior

Wetland Cover

Figure 60 shows pre-settlement versus current (2008) wetland cover in the catchment.



Pre-Settlement data provided by: Ducks Unlimited Canada, 2010. Southern Ontario Wetland Conversion Analysis, http://www.ducks.ca/aboutduc/news/archives/prov2010/pdf/duc_ontariowca.pdf, (March 2010)

Figure 60 Catchment wetland cover

4. Stewardship and Protection

The RVCA and its partners are working to protect and enhance environmental conditions in the Rideau Lakes subwatershed.

Rural Clean Water Projects

Figure 61 shows the location of all Rural Clean Water Projects in the Big Rideau-Rideau Ferry drainage area. From 2008 to 2013, landowners completed 11 projects: five septic system repairs/replacements, two livestock water restriction fencing projects, two well decommissionings, one erosion control project and one well replacement. RVCA contributed $13,484 in grant dollars towards the total project cost of $84,606.dollars.

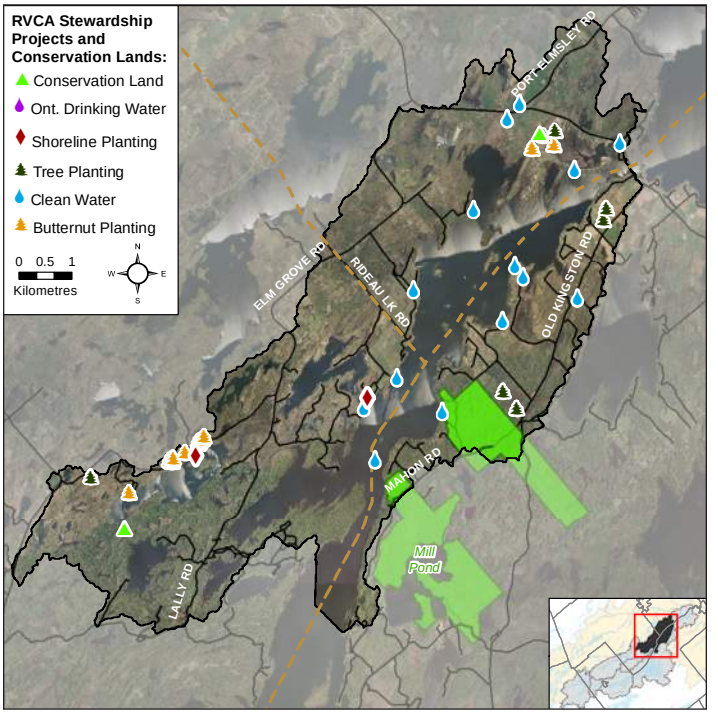


Figure 61 RVCA stewardship program project locations

Prior to 2008, the RVCA completed five projects in the area consisting of two well upgrades, one erosion control project, one livestock water restriction fencing project and one chemical/fuel handling and storage facility. In total, RVCA contributed $8,921 in grant dollars to projects valued at $43,691.

Tree Planting Projects

The location of all tree planting projects is also shown in Figure 61. Prior to 2008, landowners helped plant 53,850 trees, valued at $49,334, at six project sites, using the RVCA Tree Planting Program; fundraising dollars accounted for $29,257 of that amount. From 2008 to 2013, no trees were planted in the catchment (under the program).

Shoreline Naturalization Projects

With the assistance of the RVCA's Shoreline Naturalization Program, 280 trees and shrubs were planted at two project locations from 2008 to 2013 to create a 152 metre long shoreline buffer at a total project value of $1.534.

Septic System Re-Inspections

From 2009 to 2014, the Mississippi Rideau Septic System Office performed 47 septic system re-inspections (35 cottages, 11 houses and one business): 21 on Adam Lake, 15 on Big Rideau Lake and 10 on Long Lake in Tay Valley Township within the Rideau Ferry catchment. Remedial/maintenance work (i.e. pump outs, baffle replacement, work that generally does not require a permit) was recommended for 26 (or 55 percent) of those properties that were inspected, a septic system replacement at another property with more information provided to a further three landowners with identified septic system concerns.

From 2008 to 2009, the Mississippi Rideau Septic System Office performed 20 septic system re-inspections (11 cottages and 9 houses) on Big Rideau Lake in the Township of Rideau Lakes within the Rideau Ferry catchment. Remedial/maintenance work (i.e. pump outs, baffle replacement, work that generally does not require a permit) was recommended for 10 (or 50 percent) of those properties that were inspected along with a septic system replacement at another property.

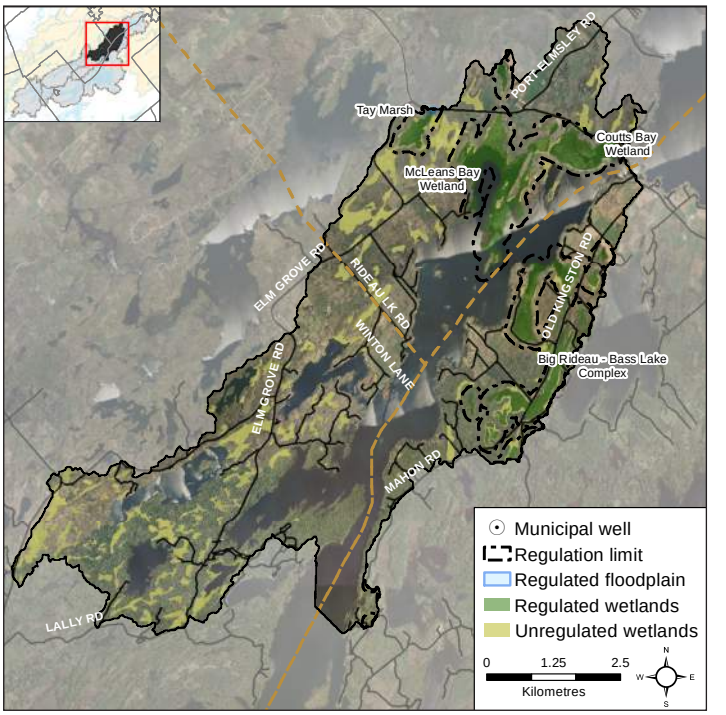


Figure 62 RVCA regulation limits

Valley, Stream, Wetland and Hazard Land Regulation

Nine square kilometres or 16 percent of the catchment drainage area is within the regulation limit of Ontario Regulation 174/06 (Fig.62), giving protection to wetland areas and river or stream valleys that are affected by flooding and erosion hazards.

Natural features within the regulation limit include 3.5 sq. km. of wetlands (representing 42 percent of all wetlands in the catchment) and 19.6 kilometers of streams (representing 18 percent of all streams in the catchment). Some of these regulated watercourses (14.5 km or 13 percent of all streams) flow through regulated wetlands.

Regulation limit mapping has been plotted along 5.1 km (or 26 percent) of the streams that are outside of wetlands. Plotting of the regulation limit on the remaining 87.4 km (or 82 percent) of streams requires identification of flood and erosion hazards and valley systems.

Within the regulation limit, “development” and “site alteration” require RVCA permission. The “alteration to waterways” provision of Ontario Regulation 174/06 applies to all watercourses.

Vulnerable Drinking Water Areas

The catchment area is considered to have a Highly Vulnerable Aquifer. This means that the nature of the overburden (thin soils, fractured bedrock) does not provide a high level of protection for the underlying groundwater making the aquifer more vulnerable to contaminants released on the surface. The Mississippi-Rideau Source Protection Plan includes policies that focus on the protection of groundwater region-wide due to the fact that most of the region, which encompasses the Mississippi and Rideau watersheds, is considered Highly Vulnerable Aquifer.

The northeast portion of the catchment area (north of Adams Lake and west of Otty Lake) is also considered a Significant Groundwater Recharge Area. This means that there is a volume of water moving from the surface into the ground and groundwater serves either as a municipal drinking water source or supplies a cool/cold water stream. The Plan was not required to include policies to specifically address Significant Groundwater Recharge Areas.

Basking turtles

5. Issues

Water Quality

- Recent findings for the RVCA's surface water quality monitoring program indicate that Adam Lake has a "Poor" surface water quality rating (for the 2008-2013 period) and is generally characterized with moderate levels of nutrients and periods of limited oxygen availability, which likely result from decomposition of aquatic plants and algae. Physical features such as the lake's long expanse of shoreline in relation to its surface water area (versus other lakes in the area), nutrient rich organic sediments and a shallow lake basin may make Adam Lake more vulnerable to additional nutrient inputs from waterfront development (existing and future)
- Recent findings for the RVCA's surface water quality monitoring program indicate that Loon Lake has a "Poor" surface water quality rating (for the 2008-2013 period). Given the limited development around it, this result can be largely attributed to physical conditions such as the lake's shallow lake basin and nutrient rich organic sediment found within the waterbody and associated wetlands
- Recent findings for the RVCA's surface water quality monitoring program indicate that Long Lake has a "Poor" surface water quality rating (for the 2008-2013 period) and is generally characterized with moderate levels of nutrients which may contribute to occasional algal blooms and profuse aquatic plant growth in some areas of the lake. Physical features such as a relatively natural lake basin and nutrient rich organic sediments may make this lake more vulnerable to additional nutrient inputs from developed areas
- RVCA's 2013 Algae and Aquatic Plant Survey for Eastern Ontario Lakes and Rivers found that a majority of the survey respondents in the Rideau Lakes subwatershed have noticed an increase in algae and aquatic plants on their waterbody
- Thirty (of 47) Tay Valley Township septic system re-inspections conducted from 2009 to 2014 revealed the need for additional maintenance/remedial/replacement works to be performed. Those properties with concerns are identified in the yearly report submitted by the Mississippi Rideau Septic System Office to the Township
- Eleven (of 20) Township of Rideau Lakes septic system re-inspections conducted from 2009 to 2013 revealed the need for additional maintenance/remedial/replacement works to be performed. Those properties with concerns are identified in the yearly report submitted by the Mississippi Rideau Septic System Office to the Township
- Construction of new septic systems along with the maintenance and operation of existing septic systems is often a challenge on the many islands that are located on Big Rideau Lake due to the complexities inherent in accessing waterfront properties along with the costs associated with such works

Development

- Traditional cottage character of the Rideau Lakes is being slowly altered by the scale of development and the trend toward larger year-round dwellings. This transition is taking place either through re-development of an existing cottage lot or incremental alterations (additions, sleeping cabins, gazebos, decks, sheds, boat houses, garages, lawns, docks)
- Many waterfront properties contain existing non-complying dwellings with respect to minimum water frontage and lot area and are often located within 30 metres of the water that require minor variances for expansion and/or reconstruction of dwellings where standard development setbacks from water are difficult to achieve. In these cases, of which there are many, municipal staff and the Conservation Authority often meet with resistance and push back when attempts are made to implement standards for development setbacks, vegetated shorelines and septic systems
- Monitoring implementation of conditions of planning and regulatory approvals is challenging due to a lack of resources
- Access to waterfront properties along private roads/rights-of-way is becoming more of a municipal liability for emergency vehicle access (ambulance, fire and police)

Shorelines

- No clear picture of the physical condition of the shoreline of Big Rideau Lake is available. Consideration should be given to conducting a shoreline survey of Big Rideau Lake using the MAPLE Shoreline Classification Survey (as has been done on Adam Lake and Upper Rideau Lake) to help assess its shoreline health
- Emerald ash borer poses a significant threat to the ecology of the area, given the prominence of ash trees along shorelines and in riparian and wetland natural areas. Many tree stands are predominantly ash and with their anticipated loss, it is unclear what will replace them and the overall effect of their collective demise on the physical and natural functions/values they provide for erosion, water quality and fish and wildlife habitat protection

Water Levels

- Fluctuations above/below the expected/typical range in water levels due to cool and wet or hot and dry conditions cause concern amongst property owners around the Rideau Lakes. Information about water level management is available on various websites; however, timely communication about the manipulation of water level control structures and specific conditions is not always forthcoming during high water events

Fisheries

- There is limited information available about the state of the fisheries resource in this catchment. Fisheries studies were completed on most Rideau Lakes in the late 1960s or early 1970s revealing a diverse fishery resource with cold, cool and warm aquatic habitats present. Since then, no other studies have been completed on the local lakes with the exception of Big Rideau Lake where landscape level, broadscale, creel surveys are conducted by MNR on a five year cycle

Lake Planning

- This report outlines some issues and concerns regarding the health of the Big Rideau Lake-Rideau Ferry catchment. However, there is limited knowledge of the overall issues and concerns about natural resource management, use and the health of the Big Rideau Lake and its subwatershed
- The Big Rideau Lake community might consider working together to undergo the lake planning process. The lake planning process allows for valuable information about the current health of the lake and its watershed, as well as an overview of all the issues and concerns facing the lake to be collected together. The lake planning process requires involvement and input from the whole lake community which includes lake residents, users, businesses, municipalities, non-governmental organizations, agency partners and other stakeholders. The process ensures that the lake community's issues and concerns are gathered into one action-oriented document, which can guide the many stakeholders that care about Big Rideau Lake to help tackle lake health concerns in partnership

6. Opportunities

Water Quality

- Reduce pollutant loadings to Big Rideau Lake, Adam Lake and Long Lake through application of shoreline, stormwater and agricultural best management practices; also consider using low impact development (LID) methods to improve the quality and reduce the amount of stormwater runoff reaching the lake ecosystem. This may be particularly benificial in areas of high density development with extensive impervious surfaces (i.e., asphalt, concrete, buildings and severely compacted soils) or on sensitive waterfront properties (with steep slopes/banks, shallow/impermeable soils)
- Continue to promote the protection of the Rideau Lakes water resources through implementation of municipal and agency land use and development policies and practices
- Continue to promote septic system re-inspections by the Mississippi Rideau Septic System Office to ensure that sewage disposal systems are functioning properly and advocate for the replacement of faulty septic systems in accordance with current *Ontario Building Code* standards
- Continue to offer septic repair/replacement project funding provided by the Rideau Valley Rural Clean Water Program to waterfront landowners
- Encourage residents of Adam Lake to work on the 20 Action Items listed in the *Adam Lake Stewardship Plan* (many of which have already been acted upon and/or are currently underway)
- Continue efforts to educate boaters about the need to properly dispose of on-board grey and black water and the availability of environmentally conscious marinas with sewage pump-out facilities that have been certified by the Clean Marinas Program
- Review RVCA monitoring of surface water quality in the Big Rideau Lake, along with other Rideau Lakes before the next round of the Watershed Watch monitoring cycle begins in 2016 to determine if there is a need to "develop a more intensive and coordinated water quality monitoring program for all Rideau Lakes" (an identified action in the 2009 *Rideau Lakes Watershed Plan*)

Development

- Collectively work with approval authorities (Tay Valley Township, Township of Rideau Lakes, Conservation Authority, the Health Unit, and Mississippi-Rideau Septic System Office) to consistently implement current land use planning and development policies for water quality and shoreline protection adjacent to lakes and streams (e.g., a minimum 30 metre development setback from water)
- Explore ways and means to more effectively enforce and implement conditions of land-use planning and development approval to achieve net environmental gains (particularly with respect to rehabilitating or protecting naturally vegetated shorelines and water quality)
- Encourage Committees of Adjustment to take advantage of technical and environmental information and recommendations forthcoming from planning and environmental professionals
- Municipal and agency planners together with development proponents are to continue using the *Rideau Lakes Basin Carrying Capacity Study* (1992) and associated 2014 *Site Evaluation Guidelines*[11] to inform decision-making about the application of development setbacks on lots with shallow soils/bedrock, steep slopes and sparse vegetation cover along with the use of the appropriate, development related, best management practices
- Utilize RVCA subwatershed and catchment reports to help develop/revise official plan policies to protect surface water resources and the natural environment (including woodlands, wetlands and shoreline cover)
- New development around Big Rideau Lake should take into account a first floor elevation of 124.81 metres (using the 124.51 metre 100 year flood elevation plus 0.3 metre freeboard) above sea level so as to ensure the safety and integrity of buildings and their contents; this figure should also be taken into account in the design and placement of septic systems and well heads so that they are not adversely impacted during flood events

Shorelines

- RVCA and its partners (including the municipalities of Rideau Lakes and Tay Valley and the Big Rideau Lake Association) are to continue educating landowners about waterfront property best management practices with respect to shoreline use and development, septic system installation/maintenance and shoreline vegetation retention and enhancement
- Protect the riparian buffer along the shoreline of Big Rideau Lake and its tributaries during the development approvals process through adherence to and enforcement of municipal land-use policies and zoning standards
- Consider a comprehensive assessment of shoreline conditions around Big Rideau Lake (using the MAPLE protocol) to monitor the effect of future changes in the lake ecosystem
- RVCA and partners are to continue promoting the RVCA's Shoreline Naturalization Program and other similar initiatives to enhance vegetation cover around Big Rideau Lake
- Continue to educate boaters about the effect of excessive speeding and ensuing boat wake on the shoreline and wildlife of Big Rideau Lake; also consider enforcement of speeding watercraft in close proximity to the shoreline
- Target riparian/shoreline restoration at sites identified in this report (as show in Figure 57 as "Other" riparian cover)

Water Levels

- Forge connections amongst water resources management agencies, businesses, municipalities and lake residents to continually improve water level management activities. This will include the pooling of resources where possible and regular communications about how, when and why water levels are manipulated and what the impacts will be on navigation, fisheries, recreation and flood attenuation
- In 2014, lake levels were higher than most years and more attention was required from RVCA and municipal staff. Only general flood information was available for municipalities to address landowner concerns. In response, a review of the RVCA Flood Forecasting and Warning Program in the Upper Rideau Valley is underway to address this need

Fisheries

- Implement multiple objectives outlined in the Draft Fisheries Management Zone 18 Bass and Walleye Management Plans

[11] Hutchinson Environmental Sciences Ltd. 2014. *Assessment of Municipal Site Evaluation Guidelines in Eastern Ontario's Lake Country*. Prepared for Mississippi Valley Conservation Authority, Rideau Valley Conservation Authority and Cataraqui Region Conservation Authority

Lake Planning

A Lake Plan:

- Is an action plan developed by a lake community (which includes lake residents, users, businesses, municipalities, non-governmental organizations, agency partners and other stakeholders) that identifies and preserves the natural and social characteristics that are valued by the lake community for future generations
- Helps to promote community discussion, education and action
- Sets goals and objectives for the protection and enhancement of the lake
- Recommends land use policies/practices that influence development on the lake
- Promotes stewardship actions to improve the environmental conditions of a lake so it can be enjoyed by future generations

Consider the need for a community-driven lake management plan for Big Rideau Lake that can:

- Bring the lake community together
- Engage the community beyond the lake residents and lake association members and develop partnerships
- Identify and bring together common values and concerns
- Provide a baseline of data on water quality, land-use activities, shoreline development, fisheries management, etc., that can help to inform water resources management, land use planning and stewardship actions
- Range in complexity from a comprehensive living document to a simplified list of priorities that can be carried out by the lake community to protect the lake environment

Rideau Ferry Yatch Club Conservation Area