WHITE LAKE

2015 Lake Sampling Report

Watershed Watch

Mississippi Valley Conservation Authority

WHY DO WE MONITOR?

Lake front development typically results in a loss of forest and an increase in rooves driveways, patios and lawns. This change creates more runoff from rain events being directed to the lake. The increased runoff brings more sediment and inorganic plant nutrients into the lake from the surrounding area or catchment. Although nutrients are vital for a healthy lake, changes in their availability in the water can affect how your lake functions.

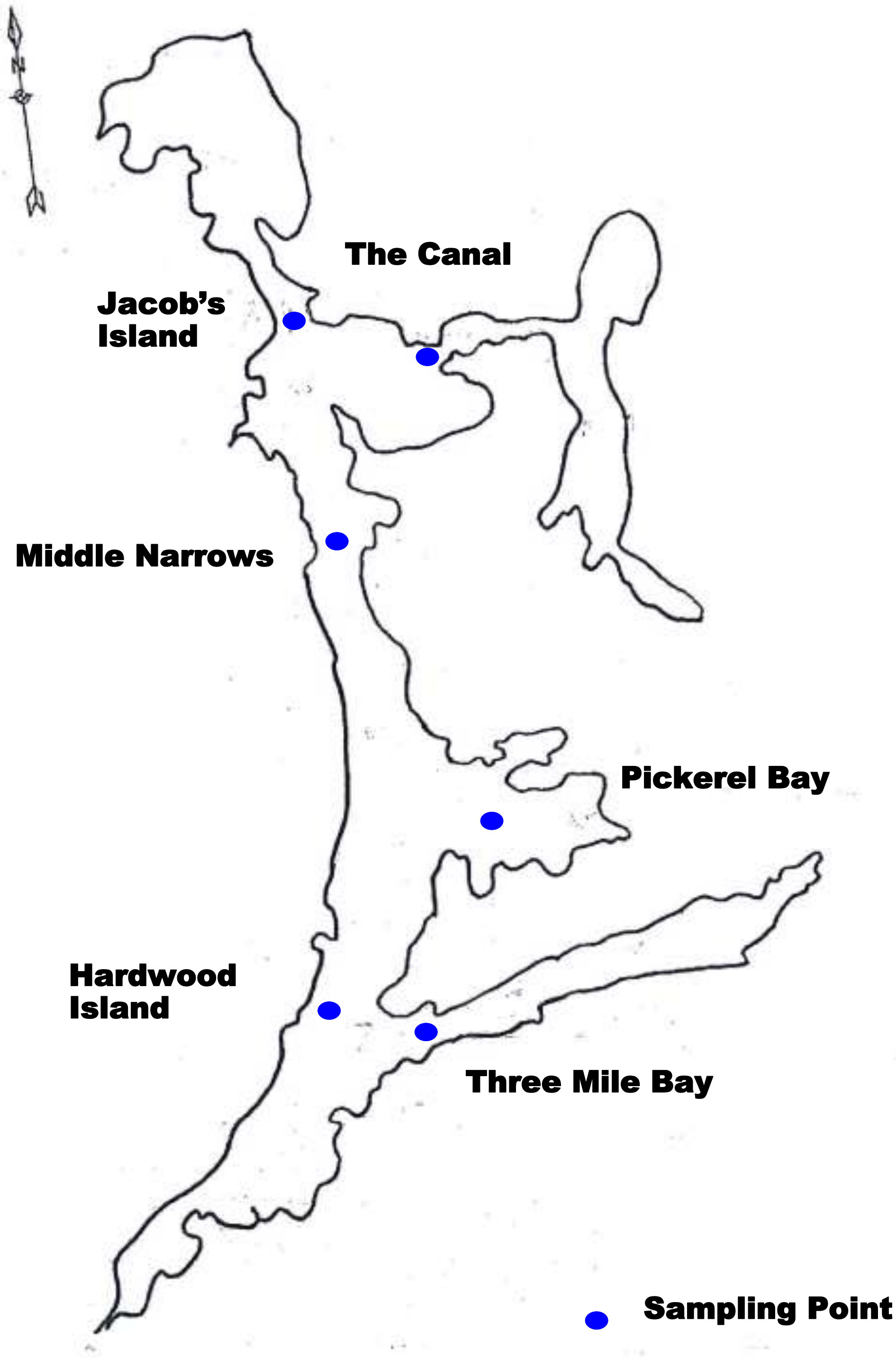
Mississippi Valley Conservation Authority (MVCA) has long recognized the recreational and aesthetic value of lakes. The White Lake Preservation Project has been collecting water quality data on White Lake since 2014. In 2015 MVCA partnered with White Lake Preservation Project, to help facilitate additional lake monitoring.

Sampling in 2015 focused around four sampling procedures to measure nutrient levels and their effects on the lake. This allows for the classification of the lake based on its level of nutrient enrichment or trophic state. The four key parameters sampled were: Secchi depth, phosphorous concentrations, chlorophyll a and, dissolved oxygen concentrations.

On one end of the scale oligotrophic lakes have the lowest concentration of nutrients and are often characterized by low plant and algal growth. On the other end of the scale eutrophic lakes have the highest concentrations of nutrients and typically have dense populations of aquatic plants and algae. Mesotrophic lakes fall in between these two extremes with a moderate level of nutrient enrichment.

The trophic state of a lake can be impacted by a variety of factors including lake shape and depth, the amount of shoreline development and the surficial geology of the surrounding area. Since lake shape, depth and surficial geology do not quickly change over time we would expect a relatively stable trophic status under natural conditions. By monitoring regularly we can identify trends and shifts in the lake and work alongside stakeholders to protect the functions of the lake.

White Lake

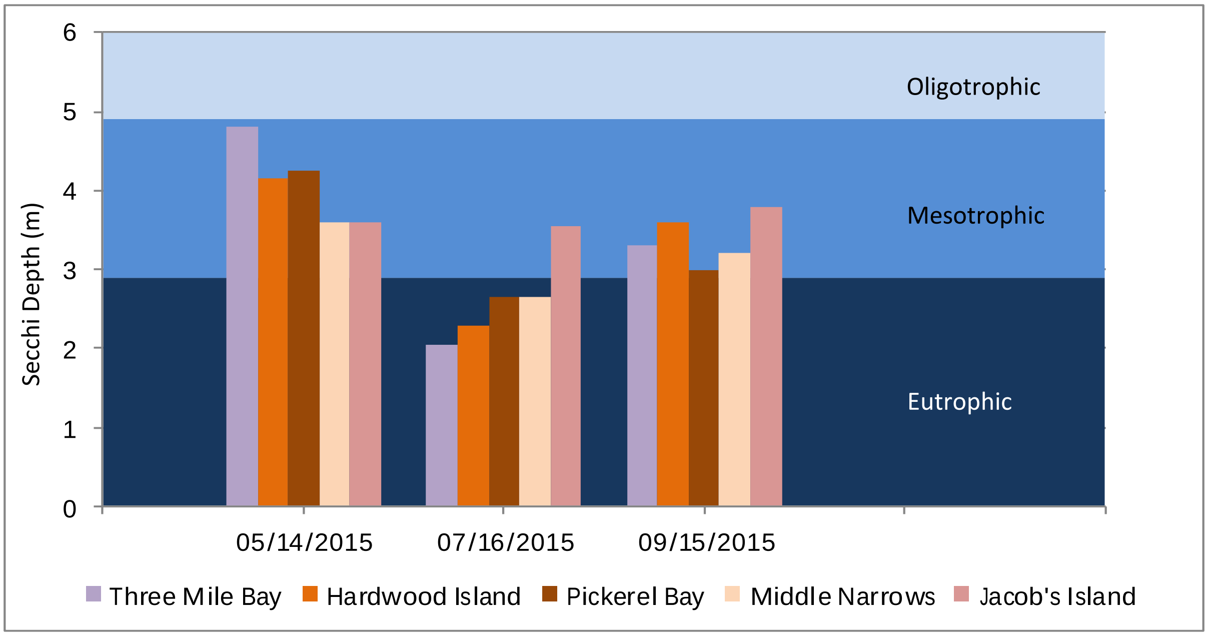

N
The Canal
Jacob's Island
Middle Narrows
Pickerel Bay
Hardwood Island
Three Mile Bay
Sampling Point

WATER CLARITY

A Secchi Disc is a black and white coloured disc used to determine water clarity. The disc is lowered into the water on the shady side of the boat. As the disk is lowered, the point when it is no longer visible is noted as well as the point at which it reappears when you bring it up. The average of these two depths is the Secchi depth. The greater the Secchi Disc measurement, the more clear your lake. Secchi depth is influenced by the concentration of algae in the water column; greater concentrations of algae in the water results in a smaller Secchi depth.

Interpreting SECCHI DISC Results	
Secchi Depth	**Lake Nutrient Status**
Over 5 metres	Oligotrophic – unenriched, few nutrients
3.0 to 4.9 metres	Mesotrophic – moderately enriched, some nutrients
Less than 2.9 metres	Eutrophic – enriched, higher levels of nutrients

White Lake Main Basin
2015 Secchi Depth



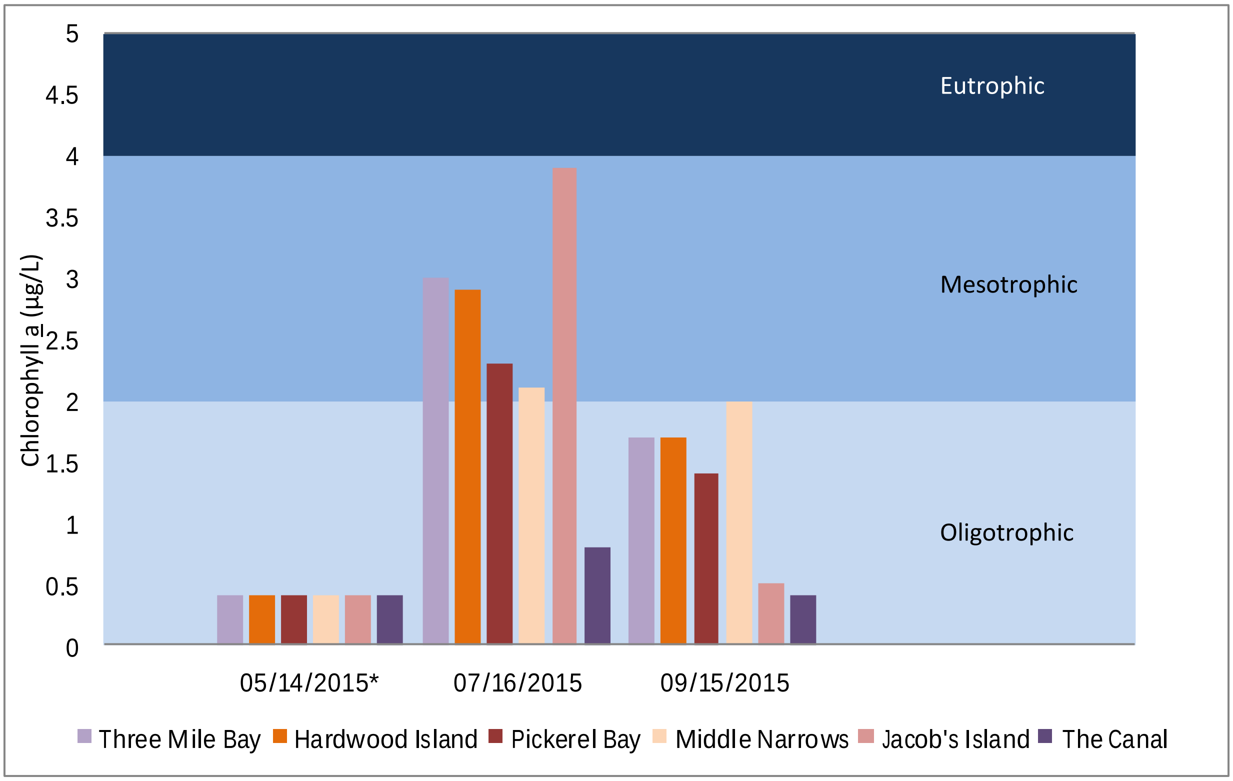
Results from the Canal are not included due to the shallow depth of the sampling site (approximately 2m)

CHLOROPHYLL a

Water clarity is influenced by the amount of phytoplankton or microscopic algae present in the water. Chlorophyll a is the green pigment in phytoplankton. The lower the chlorophyll a density in your lake, the lower the phytoplankton concentration and, the clearer your lake is. Chlorophyll a and phytoplankton concentration is affected by the amount of phosphorous in your lake. The more phosphorous there is in the water, the greater the potential for phytoplankton growth to occur.

A Composite Sampler (pictured right) is used by dropping the tin container into the water. When it reaches the required depth it is slowly pulled back to the surface. The tin is filled as water enters one tube and air escapes the other. Some air remains in the tin to ensure collection throughout the haul to the surface.

WHITE LAKE 2015
CHLOROPHYLL a CONCENTRATIONS (ug/L)



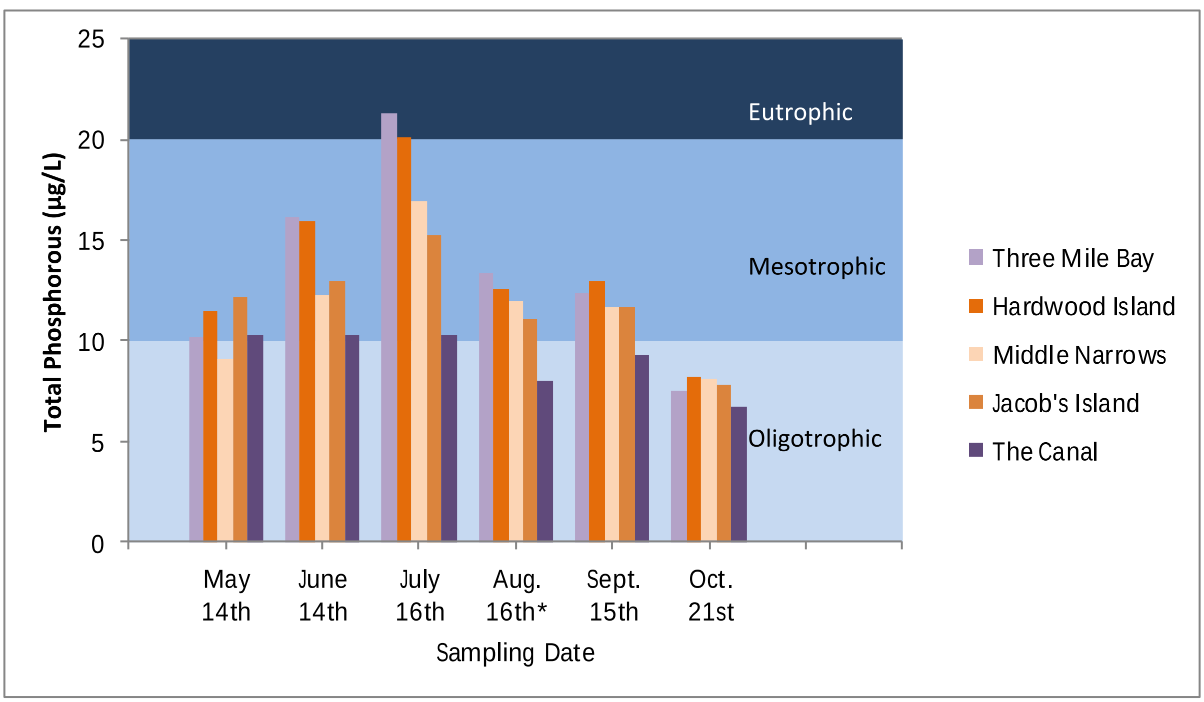
*All chlorophyll a samples taken in May were below the Reporting Detection Limit of 0.5 µg/L.

TOTAL PHOSPHOROUS CONCENTRATION

Phosphorous is the nutrient that controls the growth of algae in most Ontario lakes. For this reason increases in phosphorous levels in the lake can result in an increase in the quantity of aquatic plants and algae. High levels of phosphorus can lead to algal blooms which along with being unsightly can in some cases affect the habitat of cold water fish such as lake trout. A general guideline exists to characterize your lake's trophic status based on the total phosphorous that is measured. PWQO (Provincial Water Quality Objective) is 20µg/L of total phosphorous for lakes. This goal is to help ensure aquatic health and maintain the recreational value of our lakes.

A Kremmerer Bottle (pictured to the right) is used to sample water at specific depths. The bottle is lowered to the required depth with both ends open. A weight on the rope is dropped. When the weight hits the bottle it causes both ends to close, sealing the sample water in the bottle.

White Lake
Total Phosphorous Concentrations (µg/L)



*significant rainfall occurred for the two days prior to sampling on August 16th
Pickerel Bay was not sampled for total phosphorous

DISSOLVED OXYGEN (D.O.)

Adequate dissolved oxygen is important for good water quality and necessary to all forms of life. Poor (low) D.O. levels will cause stress on fish and may result in fish kills (mass death of a species in a season).

Many factors can influence dissolved oxygen concentration in the lake. Two key factors influencing oxygen concentration are lake stratification and the amount of phytoplankton (microscopic algae) biomass produced in the lake. Lake stratification is the separation of the lake in three layers: the epilimnion (top layer), metalimnion (middle layer) and the hypolimnion (bottom layer). Stratification is caused by changes in water temperature with depth. Summer stratification occurs from the late spring to the early fall. Lakes that stratify during the summer are characterized by a warm epilimnion separated from a cold hypolimnion by a layer of water where temperature rapidly declines with depth known as the metalimnion or thermocline. This can result in low dissolved oxygen in the hypolimnion late in the summer as the hypolimnion does not mix with the atmosphere.

The amount of the phytoplankton production also plays a role in the concentration of dissolved oxygen. When phytoplankton dies and settles to the lake bottom, it is decomposed by bacteria. As the bacteria decompose the phytoplankton, it consumes oxygen reducing the concentrations available for other organisms like fish.

Stratification was not seen at any of the sampling points in 2015. As a result, dissolved oxygen concentrations were good for the warm water fish community present in White Lake during all sampling days.

The Dissolved Oxygen metre is used to gather D.O. and temperature readings. The probe is lowered into the lake at its deepest point and readings are taken at every metre from the hand-held screen.

Dissolved Oxygen Profiles All Basins
May 14th 2015

Depth (m)	Three Mile Bay		Hardwood Island		Pickerel Bay		Middle Narrows		Jacob's Island		The Canal	
	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	15.86	10.12	15.36	10.23	16.33	10.54	15.61	10.90	16.27	10.63	16.07	11.03
1	15.66	10.17	14.95	10.30	15.55	10.66	15.49	10.84	15.44	10.57	15.51	11.24
2	15.38	10.21	14.7	10.26	14.82	10.75	15.00	10.83	14.73	10.71	15.19	11.63
3	15.23	10.18	14.57	10.24	14.67	10.66	14.93	10.85	14.53	10.67		
4	14.94	10.12	14.44	10.28	14.56	10.59	14.85	10.80	14.5	10.56		
5	14.72	10.12	14.35	10.24	14.45	10.51	14.67	10.61				
6	11.61	4.69	12.06	6.28	14.41	10.43	12.07	8.71				
7					12.91	9.37						
8					12.03	7.98						

Warm Water Fisheries Habitat (Bass, Walleye, Pike, Perch) defined as Dissolved Oxygen Concentrations greater than 4 mg/L at temperatures less than 25°C.

Dissolved Oxygen Profiles All Basins
July 16th 2015

Depth (m)	Three Mile Bay		Hardwood Island		Pickerel Bay		Middle Narrows		Jacob's Island		The Canal	
	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)
0.1	24.17	8.18	24.1	8.23	24.52	8.5	24.55	8.18	25.3	8.39	24.17	9.38
1	23.87	8.12	23.68	8.20	23.74	8.44	24.44	8.10	24.5	8.42	23.17	9.48
2	23.54	8.12	23.29	7.90	23.76	8.41	23.79	8.08	24.06	8.54	22.98	9.46
3	23.32	7.92	23.25	7.78	23.3	8.15	23.48	7.78	23.56	8.57		
4	23.25	7.67	23.18	7.63	23.21	7.75	23.43	7.67	23.41	8.47		
5	23.21	7.57			23.71	7.54	23.33	7.41				
6					23.13	7.39						
7					22.86	6.73						
8												

Warm Water Fisheries Habitat (Bass, Walleye, Pike, Perch) defined as Dissolved Oxygen Concentrations greater than 4 mg/L at temperatures less than 25°C.

Dissolved Oxygen Profiles All Basins
September 15th 2015

Depth (m)	Three Mile Bay		Hardwood Island		Pickerel Bay		Middle Narrows		Jacob's Island		The Canal	
	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)	Temp (˚C)	D.O. (mg/L)
0.1	20.96	8.61	21.03	7.98	21.75	8.24	21.77	8.66	21.18	8.95	20.30	9.25
1	20.87	8.29	20.98	7.99	21.4	8.12	21.51	8.08	20.67	8.53	18.45	9.54
2	20.67	8.34	20.81	8.05	21.16	8.14	21.19	8.06	20.3	8.46	18.41	9.32
3	20.56	8.29	20.76	8.01	21.01	8.1	21.04	8.10	20.1	8.54		
4	20.52	7.95	20.74	7.93	20.96	8.06	20.92	8.07				
5	20.47	7.76	20.55	7.35	20.93	7.96	20.83	7.88				
6	20.67	0.6			20.92	7.92	20.73	7.67				
7					20.88	7.97						
8												

[shaded legend box] *Warm Water Fisheries Habitat* (Bass, Walleye, Pike, Perch) defined as Dissolved Oxygen Concentrations greater than 4 mg/L at temperatures less than 25°C.

ACIDITY

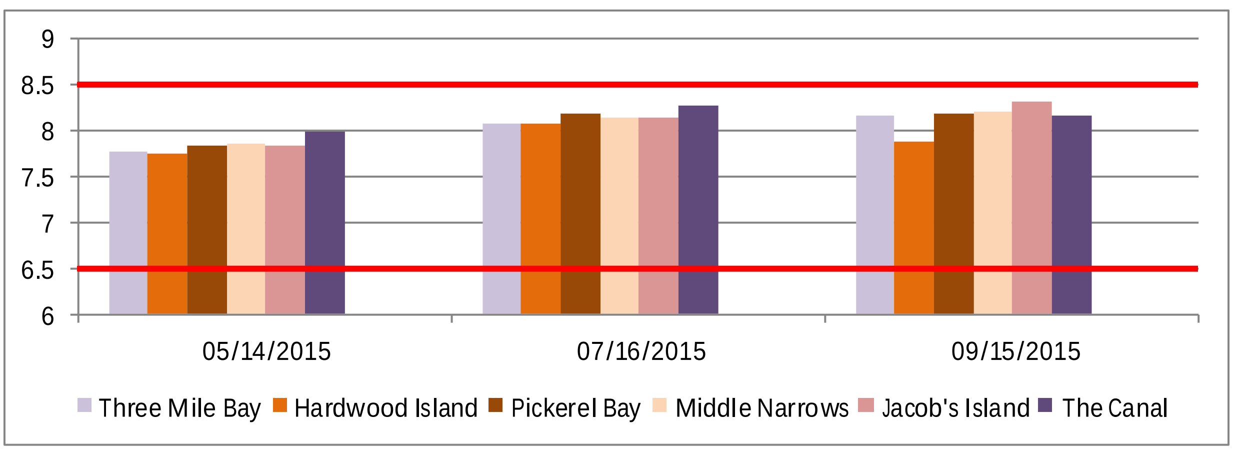
Acidity of a water body can the change the availability of metals such as Calcium and Aluminum. This has been shown to change zooplankton (small planktonic invertebrates) communities which are an important food source for many baitfish species.

The acidity of a solution is measured on the pH scale. The pH scale is a logarithmic measure of the concentration of hydrogen ions in solution. This means that a change from pH 7 to pH 8 is a ten-fold change in the concentration of hydrogen ions in solution.

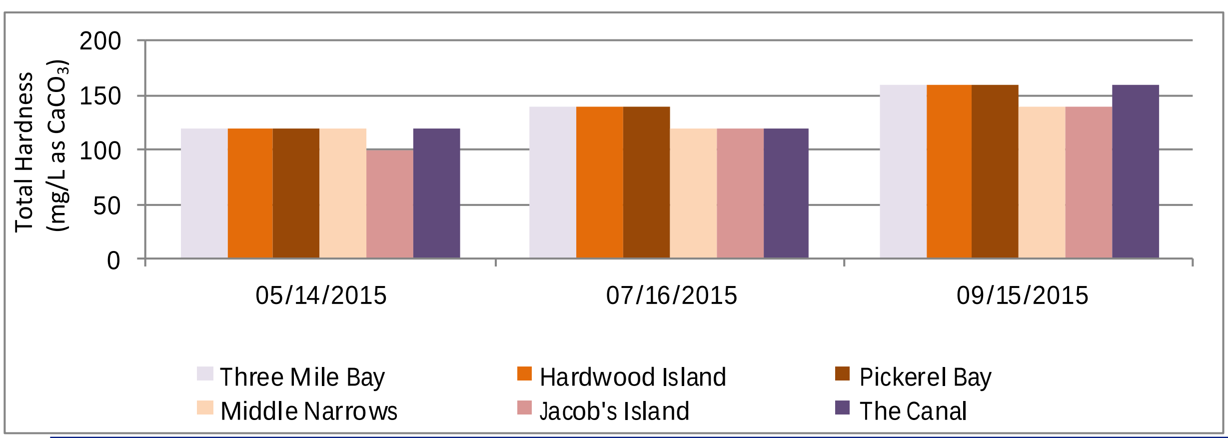
Monitoring the pH of our lakes allows us to identify when changes are occurring. The Provincial Water Quality Objective for pH is between 6.5-8.5 in order to protect aquatic life.

Related to pH is the total hardness of the water. Total hardness is a measure of the polyvalent cations mainly Ca^{+2} and Mg^{+2} in the water. These ions are important because they are a good indicator of lake ability to resist or buffer pH changes.

White Lake 2015
pH Values



White Lake 2015
Total Hardness





Help MVCA and the Ontario Federation of Anglers and Hunters

Stop the Invasion!

White Lake was tested for invasive species, particularly zebra mussels and, spiny water flea, in partnership with the Ontario Federation of Anglers and Hunters (OFAH). In 2008, zebra mussel veligers (larvae) were present in the samples collected; adult zebra mussels were confirmed on the lake in October 2015. It is likely that zebra mussels will become well established on the lake as conditions are favourable for their growth. Spiny water flea has not been found in any samples taken on White Lake.

Residents and property owners need to ensure that all access points to the lake have posted signs indicating the precautions that boaters and anglers can take to prevent the spread of invasive species into White Lake. Residents are also invited to participate in the Invading Species Awareness Program. (www.invadingspecies.com) through MVCA and OFAH.

Pictured Top left—Rusty Crayfish Photo; Doug Watkinson, DFO
Middle left—Zebra Mussels Photo; Amy J. Benson
Bottom left– Spiny Waterflea Photo: Cathy Darnell

Check and clean watercraft every time it is moved to a different water body!

For more information on these and other invasive species, visit www.invadingspecies.com/invaders or call the Invading Species Hotline at 1-800-563-7711. If you would like to help monitor and prevent the spread of invasive species in the Mississippi Valley watershed, email monitoring@mvc.on.ca or call us at 613-253-0006.

MVCA and OFAH promote a proactive approach to invasive species management. This includes education and outreach about invasive species and how they are transported. Stop signs such as the one pictured above remind boaters to Inspect, Clean and Drain their boats so that they don't give invasive species a free ride.

WHITE LAKE SUMMARY

Lake clarity on White Lake in 2015 was considered fair with an annual mean Secchi depth of 3.4m. All sites show a decline in Secchi depth as chlorophyll a concentrations increase. At all sites, Secchi depth was at its lowest (mean=2.6m) and chlorophyll a was its highest (mean=2.84µg/L) during the July sample. Between sites, the response of Secchi depth to changes in chlorophyll a always resulted in reduced Secchi depth but the strength of the response varied. Pikerel Bay, Hardwood Island and Three Mile Bay showed more similar responses to increases in chlorophyll a concentrations. These sites showed a 1.06m to 0.85m reduction in Secchi depth per 1 µg/L increase in chlorophyll a concentration. Middle Narrows and Jacob's Island also exhibited reductions in Secchi depth as chlorophyll a concentrations increased but the response was much less pronounced with a 0.42m and 0.04m reduction in Secchi depth per 1µg/L chlorophyll a increase. In general as the sites get closer to Three Mile Bay the effect of chlorophyll a on Secchi depth gets stronger. This trend could result from a variety or reasons from differing algal communities to increased non-algal turbidity (sediment) in these basins. No relationship between Secchi depth and chlorophyll a was explored for the Canal site as Secchi depth was consistently to the bottom of the lake at this site.

Sampling of total phosphorous on White Lake was done through the Lake Partner Program run by the Ministry of the Environment and Climate Change. All sites except Pickerel Bay were sampled 6 times (once a month from May-October) during the ice-free season for total phosphorous. Total phosphorous concentrations taken on White Lake during the 2015 season show an interesting trend. With the exception of the Canal site which remained consistent throughout the year, phosphorus concentrations showed steady increase from May-July before declining to the lowest concentrations of the year in October. Concentrations were highest at the Three Mile Bay (21.3µg/L) and Hardwood Island (20.1µg/L) sampling points where concentrations exceeded the Provincial Water Quality Objective of 20µg/L during the July samplings. Sampling results spanned all three trophic classifications during 2015 but most consistently fell within the mesotrophic range, between 10µg/L and 20µg/L.

In general phosphorous concentrations appear to decline as you move away from Three Mile Bay. The annual average total phosphorous concentrations with the closest sites to Three Mile Bay are: Three Mile Bay 13.5 µg/L, Hardwood Island 13.5 µg/L, Middle Narrows 11.7 µg/L, Jacob's Island 11.9 µg/L, the Canal 9.2 µg/L. Phosphorous concentrations in a lake are a balance between phosphorous coming in from the catchments and inflowing streams, storage of phosphorous in lake sediments, release of phosphorous from lake sediments and phosphorus going out of the lake outlet. Changes in these processes create shifts in lake phosphorous concentrations. Annual monitoring of phosphorous concentrations should be conducted in order to assess trends in lake phosphorous and identify potential issues of excessive phosphorous loading.

Continued on page 14

WHITE LAKE SUMMARY continued

None of the sites sampled in 2015 showed stratification during any of the sampling days although past studies have shown stratification in the deepest basin of the lake near Pickerel Bay which was not sampled in 2015. Since only a small area of the lake stratifies, most of the lake mixes with the atmosphere and dissolved oxygen concentrations are excellent for the warm water fish community present in White Lake. Consideration should be given to monitoring the deepest points to monitor for oxygen depletion in the deepest water. If conditions were favourable (low wind, high temperature) it is also possible that some of the deeper sites surveyed in 2015 (Pickerel Bay, Middle Narrows, Three Mile Bay) may stratify and oxygen depletion could occur.

pH values were relatively consistent across all sampling sites by season with the May sample having the lowest values (all site mean= 7.84). All pH values fell within the range of the Provincial Water Quality Objective of 6.5-8.5. This suggests the pH of White Lake is ideal for aquatic life. The high pH and total hardness (annual average of all sites= 133mg/L as $CaCO_3$) also indicates that White Lake has a low sensitivity to acidification. Although White Lake has low sensitivity to acidification, the same conditions make it a very conducive environment to the propagation of zebra mussels which recently have been confirmed on the lake.

Weather conditions can change water quality from year to year on a lake even under natural conditions (no human impacts). For this reason, parameter values can show a high degree of variability between sample years and sample days. For this reason the methods used for sampling in 2015 are best used to help identify long terms trends in water quality on lakes. Continued monitoring should be conducted to help identify emerging issues and changing conditions on the White Lake.

WHAT CAN YOU DO?

The major impact of lake front development on water quality is caused by the change in land use from forest to low density residential development. This increases the amount of water that is directed to the lake during rainfall events, carrying sediments, nutrients and contaminants into the water.

These impacts can be limited by temporarily storing water (eg. rain barrels), directing runoff away from the lake (eg. installing properly working eavestroughs), and infiltrating more water (eg. using rain gardens). These methods are ways to help limit the effects of development, however the best way to avoid impacts is to reduce the land use change. This can be accomplished by re-planting or maintaining current vegetated buffers and reducing the vegetation cleared for buildings.



ALGAE WATCH

Eurasian water milfoil is an invasive aquatic plant that forms dense mats

Over the last few decades algae and plant growth appear to be increasing in our lakes. MVCA in partnership with Friends of the Tay Watershed Association, Carleton University and Rideau Valley Conservation Authority, are trying to better understand aquatic plant and algae growth in Eastern Ontario lakes. Phosphorous, climate change and zebra mussels are all being examined for their possible effects.

You can help us get a handle on this issue by reporting algae blooms and excessive plant growth on your lake at www.citizenwaterwatch.ca.

For more information about MVC Monitoring Programs
please call: Caleb Yee at
613.253.0006 ext. 253 or
email: cyee@mvc.on.ca
or
visit: www.mvc.on.ca

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