WHITE LAKE PROPERTY OWNERS ASSOCIATION ENVIRONMENT VOLUNTEERS

Ever-Changing White Lake

Ten Years of White Lake Water Quality Research: 2013 to 2023

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White Lake - C. Grégoire

Introduction

Ten years is not a long time in the life of a lake. White Lake was formed after the last ice age some 12,000 years ago and parts of it may persist for an additional 9,000 years.

Our journey with White Lake started as a commitment to create a data base of measurements, observations and reports spanning at least ten years. We have now achieved this milestone.

We had help along the way. The Lake Partner Program (which is co-managed by the Ontario Ministry of the Environment and the Federation of Ontario Cottage Associations), have provided us with the sampling equipment, sample shipping supplies and the analysis of hundreds of samples for total phosphorus, chloride and calcium.

Our aim in doing this work was to better understand the nature of White Lake and how it is changing over time. This information could then be used to inform and educate anyone residing, cottaging, or using White Lake recreationally to make good choices so as to reduce human impact on the health of the lake. We recently published our State of the Lake Report and reading this document would be helpful to anyone curious about the lake and how it is faring. The White Lake Science and Information Website contains virtually every thing that is known and has been written about the lake including the nearly 2000 pages of reports we have published.

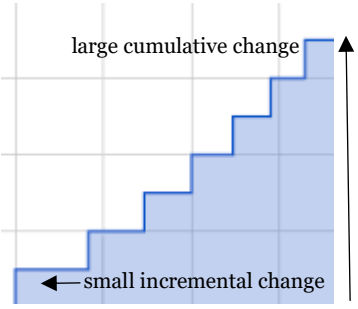
Change

Talk to almost any senior citizen who has spent her or his life on the shores of White Lake and they will tell you that the lake has changed significantly over their life time, and not for the better. Some of these conversations have been published by the White Lake Property Owners Association[1] and are worth reading.

The type of change referred to above is slow step-wise or incremental change taking place over long periods of time. There is another type of change which is more rapid and can occur over a single year. Changes in both categories can be further subdivided into changes occurring above and below the surface of White Lake.

Incremental Changes

There are at least two examples where small changes to White Lake are taking place over time, and which may not even be noticed from year to year. These small changes taken together result in a large and significant change with lasting effects on the lake.



The first of these is the appearance of cottages, residences, marinas and resorts on the lake. The first cottage lots on

[1] White Lake, The early Years, White Lake Property Owners Association, 2000, 64 pages.

White Lake were sold beginning in 1912. By 1950, there were about 50 cottages on the lake; the number had grown to about 100 in 1960[2]. The table below shows that by 2018, there were a total of 1538 cottage and resort spaces, 209 of which were permanent homes.

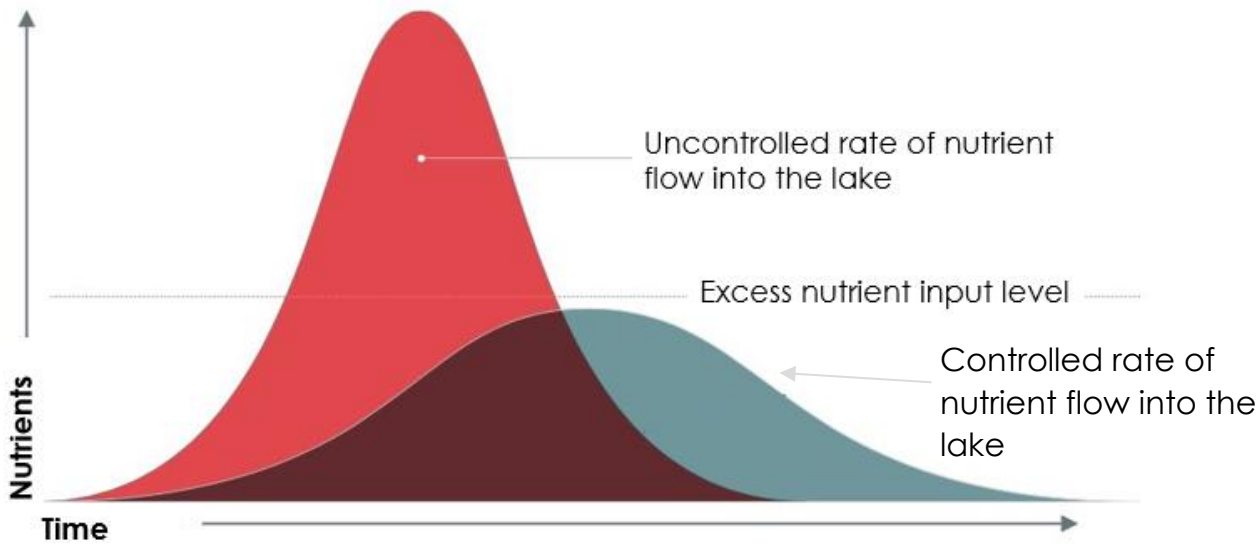
Year	Cottage and Residential	Resort and Commercial	Total	Permanent Homes
1985[3]	475	525	1000	50
2018	659	879	1538	209

Every year we see more cottage constructions, some for very large cottages. These builds have sometimes been accompanied by near or complete clear-cutting of trees and shrubs followed by urbanization with lawns.

The Ontario Ministry of the Environment tells us that 100% of phosphorus coming from septic systems within 300m of the lake will end up in the lake. Lands that are cleared of trees accelerate the rate at which nutrients reach the lake and disproportionally contribute to the nutrient (phosphorus, nitrate) load on the lake.

The diagram below illustrates how trees and ground cover can delay the movement of nutrients to the lake and help reduce the nutrient flow to levels which can be handled by the lake ecosystem. We believe that White Lake has reached its capacity for nutrient inputs by humans, which makes it even more important that we better respect the land so that the lake can prosper and be less affected by climate change and other stressors.

Flattening the Curve on Excess Nutrient Inputs



2 J.P. Ferris, White Lake Integrated Resources Management Plan, Part I, Ministry of Natural Resources, Lanark and Renfrew Counties, December, 1985.

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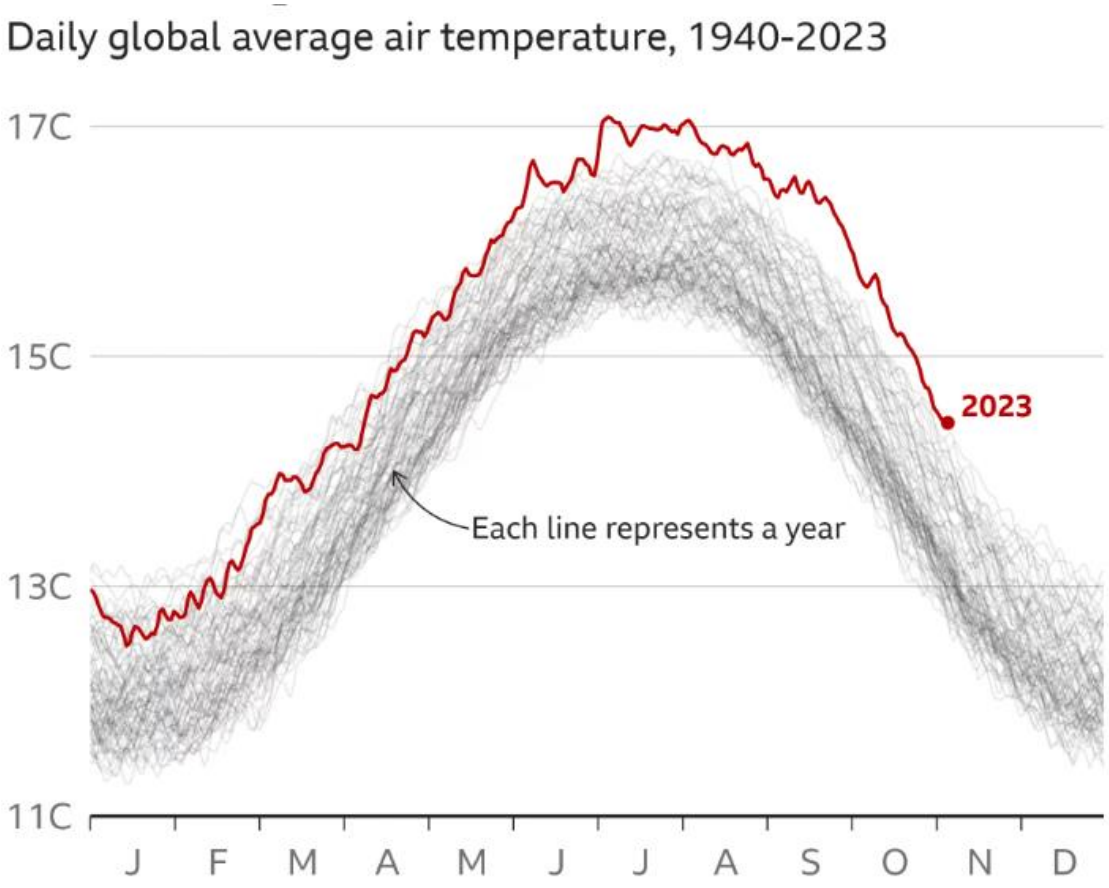
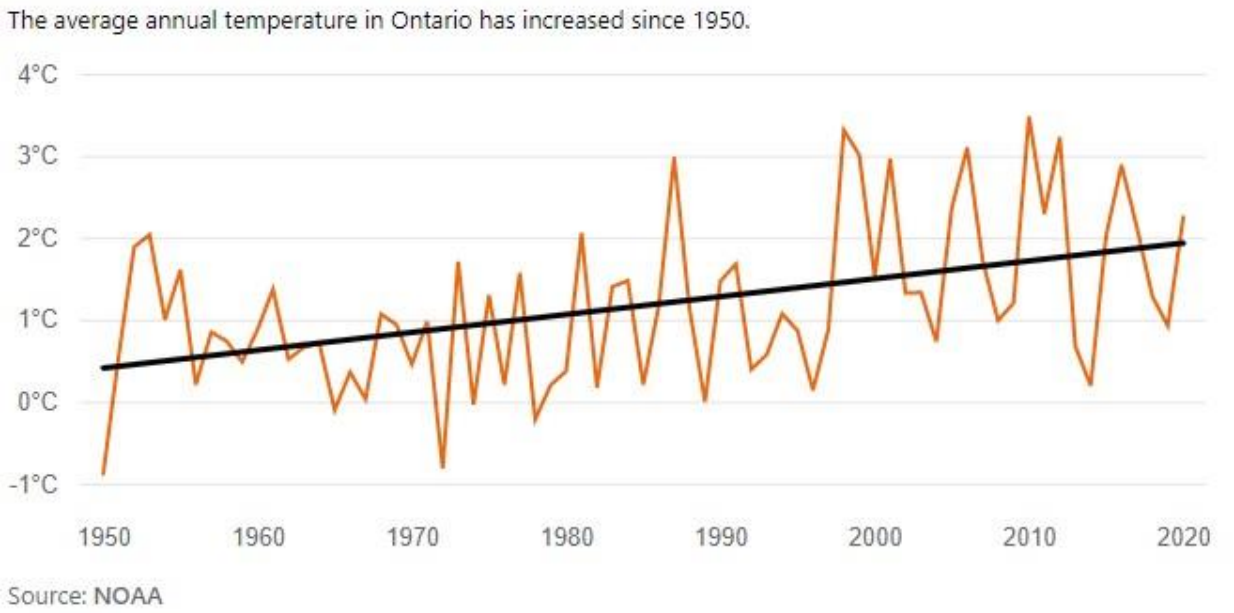
The second source of incremental change is global warming. Over 97%[4] of climate scientists around the globe know that climate change is real and that it is caused by human activity.



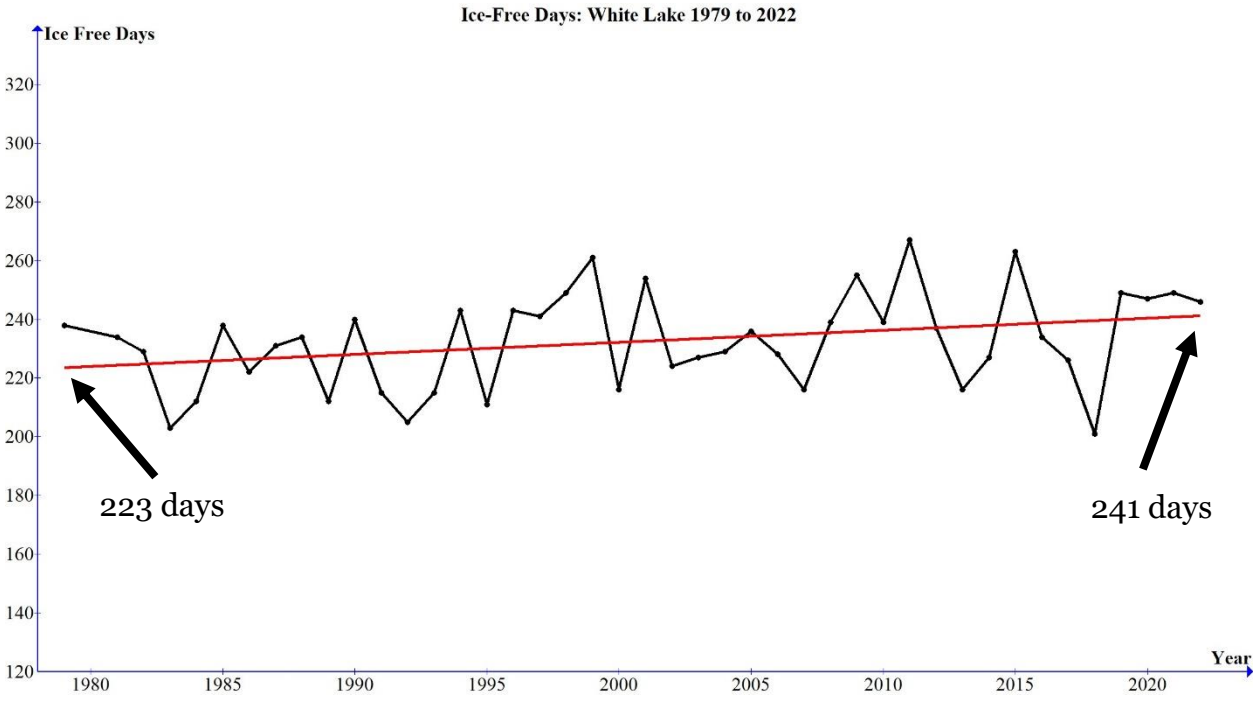
The diagram above illustrates that 2023 was the hottest year since 1940 (BBC News). The red line shows higher monthly temperatures than previous years, especially starting in May. This trend is expected to continue into the future.

It comes as no surprise to learn that local temperatures in Ontario have also risen during that time. The diagram below shows that the annual average temperature since 1950 has increased by 1.5 degrees.

[4] *Cook, John; Nuccitelli, Dana; Green, Sarah A.; Richardson, Mark; Winkler, Bärbel; Painting, Rob; Way, Robert; Jacobs, Peter; Skuce, Andrew (15 May 2013). "Quantifying the consensus on anthropogenic global warming in the scientific literature". Environ. Res. Lett. IOP Publishing Ltd.* ***8*** *(2): 024024. Bibcode:2013ERL.....8b4024C. doi:10.1088/1748-9326/8/2/024024*



In White Lake, this increase in temperature results in warmer water, and a longer ice-free season from year to year.



The above graph shows that over the period from 1979 to 2022, the number of ice-free days on White Lake have increased by 18 days. That's 18 more days of cottaging, boating, fishing and 18 more days for aquatic plants to grow and algae to propagate and bloom.

Rapid Changes

Rapid changes in the ecology of White Lake have also taken place. We discuss here two rapid change events, both of which can be attributed to human behaviour.

The first of these was the construction of a permanent dam at Waba Creek in the mid-1850s. Later modifications and improvements gave us the dam we have today.

Before the dam was built, water levels in White Lake rose to a maximum which was very close to the maximum depth we see every year during the spring melt. However, the maximum level lasted only a short while and the lake eventually drained to a level which was 1.5 metres lower than today's lowest level.

In effect, the dam extends the length of time the lake is at high water, and increases the minimum level by 1.5 metres. A fuller discussion of this subject can be found in our Environment Bulletin entitled '*White Lake: Myths and Maps*'.

Several changes in lake ecology resulted from the presence of the control dam. The length of time water remained in the lake before being flushed out increased significantly. Today, the water in the lake is flushed out only about 0.9 times per year. This allows for greater sedimentation and accumulation of nutrients such as phosphorus in lake sediments as well as increasing the rate at which White Lake is 'filling up'.

Swamps which were wet only during the spring became permanently wet. Kayakers know that there are many shallow places on the lake where submerged tree trunks can be seen. We know from Government reports that higher water levels promoted the growth of algae in the lake and affected fish spawning grounds. The water level regime followed today is a compromise between high water levels for boating and lower levels promoting fish reproduction.

The second rapid change event was the infestation of White Lake with Zebra Mussels. Zebra Mussel larvae were first detected in 2008, but it was not until 2015 that adults were found throughout the lake. The following year, the lake was supporting up to a billion mussels, each capable of filtering one litre of water per day. Over a two year period, the water clarity of the lake doubled and the amount of total phosphorus measured decreased by about 50%. Since that time, water clarity and total phosphorus conentrations have changed little indicating that there is a healthy and enduring population of Zebra Mussels in White Lake. They are here to stay.

Higher water clarity and lower nutrient concentrations unfortunately do not result in any improvement in water quality. Zebra mussels concentrate nutrients from the lake at large into a small zone near-shore where they are attached to rocks, aquatic plants or any hard material. As part of their food filtration system, they eat harmless algae and essentially spit out more dangerous blue-green alga. They also excrete the kind of phosphorus that

any algae needs to prosper. Because of this, we now have annual blooms of filamentous green algae (harmless but unsightly) occurring wherever Zebra Mussels live.

Impacts Below the Waterline

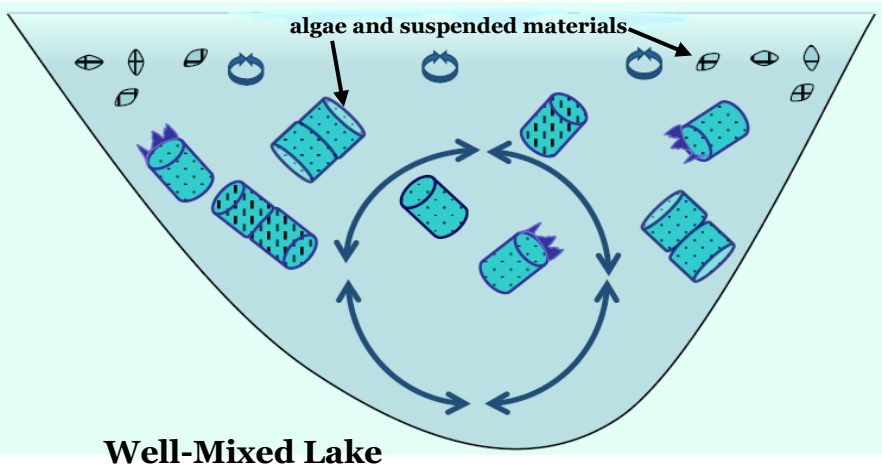
When looking at White Lake from above on a nice day, all looks perfect and right. But a lot is going on below the waterline. So, put on your snorkels, face masks and fins and have a look at some of the changes which have occurred during the past ten years.

Above is a photo of submerged rocks off of Hardwood Island completely covered with Zebra Mussels. The right-hand panel shows a native lake mussel covered with Zebra Mussels. These native mussels, which were once plentiful along the shores of White Lake, are now hard to find.

Eurasian Milfoil has also invaded the lake and is now displacing our native species. In fact, aquatic plants in general are propagating in response to the increased nutrients which we are steadily pumping into the lake from our septic systems and from surface runoff coming from cottage lots, especially those which have lost their forest cover.

The authors completed an extensive Aquatic Plant Survey of White Lake in 2020 that documents the variety and extent of aquatic plants in the lake, and also compares these results with a similar survey completed by the Ministry of Natural Resources in 1977.

Other changes are taking place within White Lake which are not visible to the naked eye.



Well-Mixed Lake

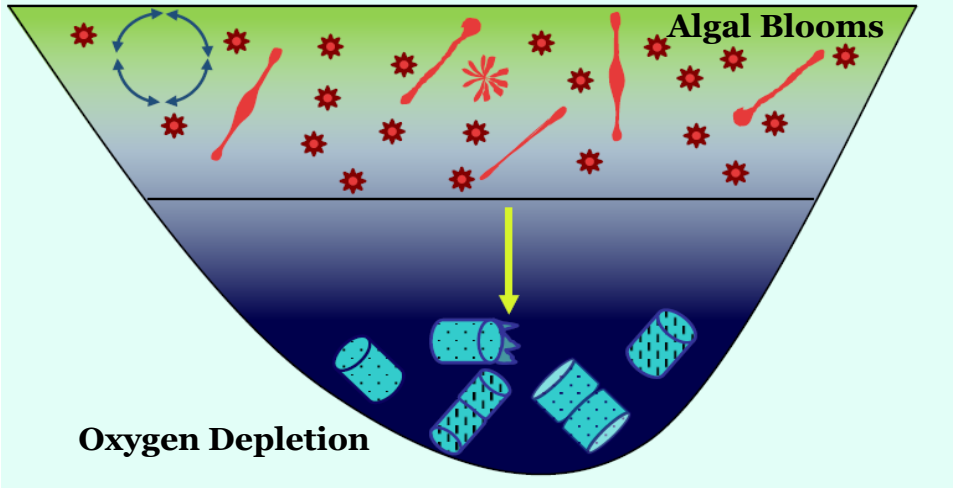
One of the collateral effects of global warming is the intensification of weather events. On White Lake we have witnessed ice storms, a microburst, tornadoes and a derecho. All of these events were intense and damaging. Another less talked about side effect of global warming is the relatively long windless periods created where the lake is calm, sometimes for weeks as occurred during September and October of 2023. When this happens, the interaction between the lake and lake sediments can trigger unwanted effects. The two diagrams[5] in this section help to explain the concept of 'internal loading' of nutrients.
White Lake is a shallow lake with a maximum depth of 9.1 m. Most of the time, the water column is well mixed from top to bottom. Wind and waves are one of the more important factors which brings oxygen down from the surface of the lake to the sediments.

Lake sediments act like a bank account with annual deposits accumulating 'money' over the years. Sediments contain a large fraction of the nutrients, such as phosphorus, which enter the lake. In fact, the concentration of phosphorus in lake sediments is about 200,000 times greater than in the lake water. This is not an issue unless something

[5] From lecture given at the 2023 FOCA Fall Seminar, November 4, 2023 by Prof. John P. Smol, Queen's University, Kingston, ON entitled *Below the waterline: Gradual Lake Changes with Potentially Major Ecosystem Impacts*.

happens to release some of these stored nutrients. That something is a lack of oxygen at the bottom of the lake.

The diagram on the right illustrates what happens to the lake during calm or windless periods.



When the wind stops, the lake can stop mixing and can form a layer of bottom water depleted of oxygen. Oxygen is always being consumed at the bottom of the lake by decaying plankton, pollen, plants and any other organic material. When this oxygen is consumed, conditions are created where phosphorus is released from sediments and made available to blue-green algae found everywhere. The end result of this sudden injection of nutrients into the lake is the rapid growth of algae otherwise known as an algal bloom.

This explains why in 2023 we had three blue-green algal blooms in White Lake during calm weather periods in September and October. The general areas covered by these blooms were in the deeper parts of the lake, where layering, as explained above, could occur.

Impacts Above the Waterline

White Lake Blue-Green Algal Blooms

One of the most convincing ways that nature uses to tell us that the lake we so cherish is being overwhelmed with nutrients is by the formation of an algal bloom. From 1977 to 2012 there were no reports of algal blooms on the lake. Since 2013, White Lake has experienced at least one algal bloom per year. During the last 10 years, there have been a total of 17 blue-green algal blooms, some of which were toxic.

White Lake is not the only lake experiencing annual algal blooms. There are many others, all for the same reasons: overuse, climate change, and invasive species.

A second 'above the waterline' invader is invasive Phragmites or European Common reed.

This plant takes over cattail marshes and eventually becomes the only surviving plant. These reeds can grow to over 5 m in height and affect nesting and feeding birds as well as amphibians, reptiles and fish spawning areas. There are now 7 occurrences of Phragmites on White Lake, all in Three Mile Bay. Left unchecked, they will spread to all parts of the lake and in time take over the extensive White Lake Wetlands.

LOCATIONS OF INVASIVE PHRAGMITES ON THREE MILE BAY

Changes impacting White Lake are still in progress. There are a number of aquatic and plant invasive species which may reach White Lake soon and result in even more changes both above and below the waterline.

What Can We Do?

One of the most important actions a property owner can take is to restore their shoreline to a natural state using native plants. Maintaining fully-treed lots as much as possible interrupts and/or delays movement of nutrients from septic systems to the lake. Download your own copy of the Lake Protection Workbook and assess your shoreline.

As in any society, there is always a fraction of property owners who will not fully understand the impact that they are having on the lake. It could also be that they are not interested in knowing and just want to enjoy the lake. This is when governments can intervene and take action to preserve White Lake. The people who are charged with managing the lake (with the assistance of the Ministry of the Environment Conservation and Parks), are the Councils of the four municipalities whose borders include all parts of White Lake.

White Lake needs enforcement of current by-laws and new ones to better protect its shoreline and shorelands. At present it is common to see property owners clear cut their lots and install lawns which are maintained with the help of fertilizers and pesticides, all of which ends up in the lake.

Resources are available to municipalities to help and guide them through the process of modernization of enforceable bylaws that really can protect the environment. One such resource is the recently published Watersheds Canada guide entitled 'A Regulatory Guide to Achieving Environment Net Gain at the Waterfront'. Other documents related to shoreline protection and management are available on the White Lake Science and Information Website.

One suggestion is for Lanark Highlands or any other municipality to take the lead and establish a 4-municipalty committee which could effectively manage White Lake. This committee would provide a forum for local taxpayers to bring forward concerns related to the management of the lake and allow for discussion of ways to prevent further degradation of the lake.

Conclusion

Human activity is responsible for virtually all of the important changes White Lake has gone through during the last 200 years. Looking into the future, we could equally be a positive force ensuring that White Lake is preserved for future generations.

Only the engagement of property owners, local municipalities and Government agencies can save White Lake from further degradation. Currently, White Lake is not being effectively managed.

January, 2024