Township of Georgian Bay Water Quality Monitoring Program Synopsis

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GEORGIAN BAY FOREVER Putting Water First

Contents

Executive Summary

Objectives

Water quality and pristine natural systems are an important economic feature of the Township of Georgian Bay drawing recreational users and tourists to the area. Water quality monitoring programs are designed to provide the township with an understanding of the aquatic systems, indicate trends in data and produce scientific evidence to support management decisions. These objectives are well informed by ongoing scientific research looking at the impacts of a variety of ecosystem stressors. The need to encourage healthy economies and ecosystems is well described in a number of reports including the 2012 Vital Commons report by the Mowat Centre.

Program Overviews

A number of organizations have historically been involved in water quality monitoring in the coastal waters of the Township of Georgian Bay. In 2011 Georgian Bay Forever (GBF) was asked to assist in developing a new program design to improve the Coastal Monitoring Program (CMP). It was determined that a large degree of overlap existed between existing programs.

	District of Muskoka	Severn Sound Environmental Association	Georgian Bay Forever	OMOE Lake Partner Program
North Bay	●	●	●	●
South Bay	●	●	●	●
Honey Harbour		●	●	●
Church Bay			●	●
Cognashene Lake	●		●	●
Go Home Bay	●		●	●
Wah Wah Taysee	●			●
Twelve Mile Bay			●	●

To improve the science and cost efficiencies of the program, the participating organizations discussed changes to their programs. Severn Sound Environment Association (SSEA) continues to monitor the Honey Harbour, North and South Bay locations. GBF covered the Cognashene Lake, Go Home Bay and Twelve Mile Bay sites and has now migrated those sites into the Ministry of the Environment Lake Partner Program. The District of Muskoka periodically samples the coastal waters for inclusion in its reports. 2014 is a coastal monitoring field year for the District so GBF will not be sampling.

Each program has slightly different but complementary objectives and sampling frequencies. The GBF and District programs look at pre-stratification (spring) measurements of phosphorus and other chemical constituents. In addition GBF performed late fall measurements to determine surface and

deep water phosphorus levels to better understand the potential for nuisance algae blooms triggered by internal phosphorus releases due to oxygen depletion (anoxia) in the bottom waters. The SSEA program is the most extensive sampling a variety of physical, chemical and biological parameters every two weeks throughout the year to get a complete picture of the system from top to bottom and from melt to freeze. This data is providing an excellent understanding of the systems to inform the development of future monitoring programs. SSEA also recently produced depth (bathymetry) charts showing the differences in North Bay and South Bay basins and the large differences in available growing zones. These are important in explaining the community observations of increased aquatic plant growth.

In addition to the water quality monitoring programs described, GBF worked with Hutchinson Environmental on a study looking at sediment cores to determine the historic (paleolimnological) water quality in North Bay and South Bay. This work has not yet been compared with findings from earlier core sampling research. GBF also worked with York University on a study looking at the bio-chemical triggers of blue-green algae blooms. Councillor Paul Wianko and the District of Muskoka have also produced Inland Lakes reports in addition to the programs described.

Program Effectiveness

Ongoing monitoring of conditions at a regular frequency is recommended by all of the assessments competed. This ensures that baseline information is available to expose changes or trends in water quality. The basic monitoring programs are not very expensive and will provide the township with information to properly inform management decisions and the public.

Cognashene Lake is an example of how the information developed by the various programs can lead to significant improvements in water quality by stimulating local community behavioural changes. Water quality conditions have drastically improved since the community adopted voluntary standards to limit external nutrient inputs.

Bacteriological Program

Biological sampling for faecal coliforms is more complicated. One sample can vary drastically from another because contaminated material is not distributed evenly in the water. Naturally occurring coliform bacteria lives out its life in the sediments along the shorelines. Runoff from more intense rainfall and resuspension of sediments can significantly impact bacterial counts observed. The only official bacteriological testing protocol applies to public beaches and requires that bacteria like E.coli be found above defined thresholds in a number of samples collected. No public beaches were monitored as part of the program, however, intensive sampling in Church Bay was conducted using comparable methodologies in 2002 and 2012 by the Ministry of the Environment and GBF respectively. No significant changes were seen and recreational water quality was excellent with bacterial levels less than a 10^{th} of the provincial standard even in this intensely used bay.

Recommendations and next steps

Significant changes to the CMP have already been implemented based upon the work completed over the past three years including: a transition to a new laboratory capable of detecting much lower phosphorus levels; changes to the bacteriological testing program; execution of a study to determine historic water quality conditions present in North Bay and South Bay; execution of a study of conditions favouring blue-green algae blooms; and careful integration of the programs run by various organizations in the area.

In addition it is recommended that:

- The coastal water quality monitoring program be reviewed and modified over time using a reference to the past and ongoing results that are improving our understanding of the system. It is expected that this adaptive management approach will face significant pressure from the impacts of climate change and invasive species;
- Ongoing intense monitoring conducted by SSEA should continue subject to annual review;
- District of Muskoka should be the agency conducting testing this year;
- GBF / Lake Partner Program testing should continue in years between the District testing programs;
- Efforts to co-ordinate scientific and monitoring programs with government agencies such as environment Canada, MOE and the OMNR continue to determine what government (Environment Canada) research activities are underway in 2014 to assess if any useful data will be available for the Township to use; and
- Determine the sources of faecal indicator bacteria by exploiting the significant advances in genetic techniques now available such as Microbial Source Tracking (MST). As much of this bacteria can originate from natural sources (i.e. waterfowl) it is important to identify sources in order to develop effective management strategies. MST can identify the source host of the bacteria and is recommended for the summer 2014 program.

Township of Georgian Bay Water Quality Monitoring Program Synopsis

Water levels reached long term recorded lows during the winter of 2013. Water levels and water quality are related in the coastal archipelago of Eastern Georgian Bay. Studies funded by Georgian Bay Forever (GBF) have shown that changes in historic coastal wetlands have impacted the amount of available spawning, nursery and forage habitat for fish and wildlife but at this time no net impact has yet been determined. Recent work by the Severn Sound Environmental Association (SSEA) in North Bay and South Bay has shown that water levels changes will impact the growth (littoral) zone differently in each basin. North Bay is a deep bowl with a narrow rim that will lose submerged aquatic plants habitat with lower water levels while South Bay will experience a gain in growing area due to its shallow saucer like shape. As reported by Environment Canada, "low lake levels also contribute to the spread and establishment of invasive plants such as Phragmites at beaches and other shoreline areas and botulism is associated with low lake levels, invasive species and nutrient dynamics in the near shore zone."

The Township of Georgian Bay has been working with a number of partners for the past decade to characterize and protect the coastal water quality of the south-eastern Georgian Bay area. GBF has been a funding partner of this work. This existing program's redundancy and deficiencies were discussed in several meetings with participating stakeholders and advisors through 2011. The Township asked Georgian Bay Forever to review the programs in the area to ensure that there was no unnecessary overlap between programs and to develop recommendations for scientific and financial improvements. Georgian Bay Forever engaged Hutchinson Environmental to undertake a synthesis study to identify any gaps or overlaps in the available data.

GBF has invested about $120K on water quality testing programs during this transition time. Adding that to the Township's budget including the SSEA funding and the value of the Lake Partner Program and we have leveraged over $225K on water quality programs during this period. That is a very impressive evolution of the program but does not need to be continued at that intensity as most of these studies are one time only special investigations to fill in observed data deficiencies. It is expected that a far more modest ongoing commitment will be sufficient to monitor coastal water quality.

SSEA emerged as a scientific partner in the area following the cleanup of the Severn Sound Area of Concern. This organization conducts regular testing at a variety of stations from Port Severn to Tiny Township with compulsory contributions from the local municipalities. SSEA conducts bi-weekly sampling in North and South Bays in the Honey Harbour Area in addition to the township. SSEA 2011/12/13 SSEA Water Quality Programs examining changes in hypolimnetic chemistry with the onset of summer hypoxia in Honey Harbour are not reported herein.

Geographically, the Township Coastal Monitoring Program (CMP) is divided into two regions. Southern region includes the North and South bay Honey Harbour Areas south to Port Severn and the North region goes up to Twelve Mile Bay. Georgian Bay Forever has conducted the northern region sampling for the Coastal MP and Ontario Ministry of the Environment Lake Partner program testing and SSEA covers the southern region. Other specific project site locations related to the various research plans are covered by Georgian Bay Forever and other independent agencies.

It should be noted that Dr. Murray Charlton under contract to Environment Canada has just completed a study entitled "Science and Monitoring Synthesis for South-Eastern Georgian Bay". Georgian Bay forever provided Dr. Charlton with access to all of the work and studies we have funded. Based upon this report, EC has begun a significant monitoring program in the North Bay and South Bay area including the installation of a weather station on Picnic Island. This program has just come to the attention of the Township and Georgian Bay Forever at an Environment Canada sponsored science meeting. Further co-operation is expected and it is possible that the significant science undertaken may allow the Township to benefit from further near term cost reductions.

Summary of work completed or pending.

Based on meeting held by scientists, township stakeholders, and GBF…The major components undertaken by Georgian Bay forever to address the concerns of the Township and communities were as follows:

- ✓ 2011/12 Synthesis Study (HESL).
- ✓ 2011 Coastal Program Monitoring Results
- ✓ 2011 Coastal Monitoring Program Review (HESL)
- ✓ 2012 Coastal Monitoring Program Results (HESL)
- ✓ 2013 Paleolimnological Study (HESL)
- ✓ Assessment Of Cyanobacteria Dominance In Embayments Along The Georgian Bay Coastline with York University / Environment Canada / OMNR
- ✓ DNA Barcoding infrastructure to Monitor Biodiversity, Biostructure and Ecosystem Function with University of Guelph / OMNR
- Coastal Wetland Invasive Species Removal in South-Eastern Georgian Bay (GBF lead with Environment Canada and OMNR support)

A summary of each project and findings are provided below.

2011/12 Summary (Synthesis) Study (HESL).

HESL reviewed what was known about the aquatic environment in the Honey Harbour Area by completing a summary (synthesis) of all information that is available from various sources. They then

summarized these to identify problems and causes (where it was possible to do so) and made recommendations with respect to science and management activities that should follow.

HESL's synthesis of the available data and findings was conducted with a focus on evaluating:

- the degree to which the monitored areas have been characterized (accumulated state);
- the findings that indicate ecosystem stress or trends towards undesirable conditions;
- the identification of cause or of uncertainty around cause; and
- the identification of further required science or management steps.

The Summary Report provided the following conclusions:

An examination of the existing data makes it clear that the accumulated state in North Bay and South Bay has been well described. What is not known is how far the various ecosystem metrics have departed from natural or background conditions and this represents the largest uncertainty. SSEA have shown that there are no significant trends within the timeframe of the monitoring record but it is uncertain whether or not changes have occurred in the past.

The observed recent ecosystem shifts that have concerned shoreline property owners (aquatic plants and periphyton growth) do not have their present conditions quantified and any changes that have occurred are based on casual observation. These types of shifts will require a great deal of further work before the underlying processes can be understood. It would be premature to link these observations to any specific stressor. Aquatic plant and periphyton (a mix of algae, bacteria etc. attached to submerged substrates) proliferation is a regional phenomenon that has been linked elsewhere to external stressors such as climate change or to the presence of invading species. The current data available do not allow any insight into these types of problems. Indeed the species of periphyton shown in the reports, to our knowledge, has not been identified. In recent work by SSEA, it is generally accepted that the aquatic plants are sequestering large amounts of phosphorus that might otherwise become available for nuisance algae blooms and should therefore not be disturbed.

More data is required to develop cause and effect for ecosystem shifts and to characterize the current nutrient and oxygen conditions relative to background.

2011 Coastal Monitoring Program Review (HESL)

Hutchinson Environmental Sciences Ltd. (HESL) was retained by Georgian Bay Forever in 2011 to review Water Quality Monitoring Report Summary (2001-2009) Township of Georgian Bay and recommend improvements to the Coastal Monitoring Program (CMP). The Coastal Monitoring

Program Review (HESL 2011) resulted in a number of recommendations related to sample location, program design and data interpretation.

Findings summarized that:

1. the program has provided an accurate description of the accumulated state with data that generally agree with those collected elsewhere;
2. water quality in the enclosed bays is very similar from bay to bay with conditions that could be expected to support late summer algal blooms in many areas.

It was not clear, however, whether the current conditions represented degraded water quality since there was no evidence of trends through time. Only a few changes were recommended in the program until such time as there are low level TP data to compare between:

1. to change laboratories and assay for low level TP with field filtering to allow intercomparison of results with other existing programs and more sensitivity;
2. it was also felt that the number of sites could be reduced in the future; and
3. initiate research projects that would allow the examination of current conditions (phosphorus, oxygen, periphyton etc.) relative to conditions in the past. This information will be required if the situation arises in the future where remediation is indicated for algal blooms etc. The Paleolimnological Study was designed to address this gap.

2012 Coastal Monitoring Program Results (HESL)

The recommendations from the 2011 Coastal Monitoring Program Review were incorporated into the CMP for the 2012 monitoring season. This report presented: (1) the results of the 2012 monitoring season; (2) a review of the effectiveness of the new program; and (3) provided further recommendations related to the CMP.

Summarized results showed that Total Phosphorus (TP) samples collected in spring were generally slightly greater than September values while September 2012 values were generally slightly lower than the long-term September mean from previous data. These differences were likely due to the influence of overland runoff in spring and the introduction of field filtering of samples in 2012. (Filtering removes the larger planktonic organisms present in the water that contain phosphorus and skew the results. Previous sampling methods used did not following this established test protocol.)

E. coli counts were much lower than appropriate guidelines, indicating excellent recreational water quality in terms of bacteria.

Other recommendations included:

1. It is not necessary to continue monitoring all sites, but historically sampled sites and the site with the highest bacteria counts in 2012 should be maintained periodically;
2. Submitting duplicate samples to a laboratory for colony forming unit counts may allow limited comparison with historical data collected in 2002 by MOE and assess by how much results from these two methods differ.

2013 Paleolimnological Study (HESL)

Georgian Bay Forever has recognized that the lack of background data from the time period before European settlement and shoreline development represents a critical knowledge gap for evaluating current conditions and the recent observations in the inner bays of Georgian Bay. Hutchinson Environmental Sciences was retained to design and complete a study on historical nutrient status, deep-water oxygen conditions, aquatic plant abundance and algae community composition from pre-settlement until current times by the means of paleolimnological techniques, i.e., the analysis of bottom sediments.

The Georgian Bay embayment sediment study filled an important data gap by describing conditions predating the water quality monitoring programs that started in 1980. This places existing water quality measurements into context with the natural background conditions and historic changes. By matching observed patterns in the sediment cores with known historical land use activities, and by comparing the records of the two hydrologically different bays, we gained insight into the timing and causes of water quality changes. We also identified differing sensitivity to nutrient enrichment between the bays. These pieces of information put the currently collected monitoring data into a long-term perspective and help direct future monitoring and stewardship efforts.

Summarized findings showed that:

- Before European settlement, North Bay (TP 13 ug/L) and South Bay (TP 11 ug/L) were mesotrophic, while South Bay was naturally more oxygen deficient (anoxic) than North Bay;
- With the onset of watershed deforestation in the 19th century, minor shifts in algae and midge larvae communities were observed in both bays, consistent with slight nutrient enrichment from increased overland runoff;
- The largest changes in diatom algae and midge larvae communities as well as overall algae production were observed in the 1950s/1960s and were indicative of additional but slight nutrient enrichment. These were likely related to cottage development and watershed alterations, with a stronger effect seen in South Bay than in North Bay;
- Significant shifts in algae and midge larvae assemblages to more near shore (littoral) communities in the late 1960s and again after 1980 indicate increased availability of shallow water habitat, likely due to reduced water levels, increased water clarity and increased aquatic macrophyte abundance;

- A minor, but consistent diatom algae change after 1980 indicated increased water column stability, possibly related to climate warming, and coincided with the increased abundance of chrysophyte algae, a regionally reported phenomenon;
- The more pronounced nutrient enrichment of South Bay is likely due to the influence of the Severn River watershed and the more limited water exchange with the Georgian Bay open waters compared to North Bay in addition to shoreline development;
- Overall, water quality in North and South Bays appears to be influenced by upstream influences (i.e., the Severn River for South Bay) and exchange with Georgian Bay (North Bay) as well as by local shoreline disturbance; and
- The aquatic organisms (biota) have responded as strongly to changes in habitat in the past ca. 30 years as to any water quality changes since pre-settlement times.

In summary the study showed that blue green algae were present historically and increased in the 50s and 60s and while possible we can't be certain surface blooms occurred. As seen in recent work, there are a number of contributing factors involved in bloom formation. There were recorded nutrient increases in the 50s and 60s that impacted the systems. These stabilized but recent changes in water levels and climate change have caused as much impact as the nutrient levels did before. This is evolving with the ongoing climate change impacts so knowing where it will take the system is an unknown at this time. Ongoing monitoring is indicated.

Additional GBF Work

Georgian Bay Forever also undertook two separate studies beyond the coastal monitoring program including the 2013 Blue Green Algae Study (York University, Molot et. al.), and the 2013 DNA Barcoding Biodiversity Study (University of Guelph, McCann et al.).

Assessment of Cyanobacteria Dominance in Embayments along the Georgian Bay Coastline

Cyanobacterial blooms (commonly called blue-green algae) can be toxic or non-toxic and have been a persistent problem for many years in the north basin of Sturgeon Bay, a mesotrophic embayment along the Georgian Bay coast in the Pointe au Baril area. A question that has not been answered is why do cyanobacteria blooms in embayments along the Georgian Bay coast appear limited to Sturgeon Bay? Concerns have been raised that other embayments may be at risk which begs the question, what feature, or features of Sturgeon Bay and other embayments contribute to the formation of these blooms? This study was designed to address these questions – how common are cyanobacteria in embayments and what features promote them?

Summarized findings showed that *"favourable conditions for cyanobacterial growth already exist in these oligotrophic [low nutrient] embayments and mean [average] epilimnetic [above the thermocline] and metalimnetic [transition zone in the themocline] TP concentrations need*

only rise, say 50% to mesotrophic [moderate nutrient] levels of 12-15 µg/L (similar to Sturgeon Bay) from current levels of 8-9 µg/L to generate blooms of nuisance proportions."

"Favourable conditions" for cyano-bacteria growth include high nutrient levels and warm water temperatures. Climate changes are resulting in rising Great Lakes water temperatures. Cyanobacteria have small gas vesicles providing them with vertical motility floating up and down in the water column to reach nutrient rich anoxic [low oxygen] water and up to reach light eventually forming in characteristic dense surface blooms fouling the water and further inhibiting competing species from growing.

Cyanobacteria can produce a variety of hepatotoxins [a toxic chemical substance that damages the liver] and neurotoxins [damage the nervous system] that harm birds, mammals and aquatic organisms. These toxins may cause skin and eye irritation from contact or intestinal discomfort and severe illness or death if ingested. Not all blooms produce toxins, but the uncertainty of their presence while laboratory testing of effected water is conducted mandates authorities warning the public to avoid all contact or use of effected water. Boiling contaminated water does not break down or remove the toxins. Even non-toxic decomposing blooms cause a sewage-like odour that may be offensive to recreational users.

Climate change impacts are expected to result in more intense storms interspersed by longer periods of drought. Intense precipitation washes nutrients from soils into rivers and lakes. Cyanobacteria may also be more salt-tolerant than other freshwater algal species. Rising salinities due to increased evaporation and water contaminated with road salt may result in further competitive advantages.

This study indicates that in low nutrient waters, internal TP loading depends on iron and anoxia which may lead to favourable conditions for blooms to occur and these conditions are present in many of the coastal embayments in the Township. Further work to rank these embayments for risk factors is being completed by York University and the University of Waterloo for summer 2014 under an approved Environment Canada Lake Simcoe-Eastern Georgian Bay Clean Up Fund project.

Caution recommended in North and South Bays

In addition to the results of this project, recent work by SSEA has indicated that TP levels are holding constant in NB/SB even while levels are dropping elsewhere in Severn Sound. This observation requires further investigation to explain these observations, but indicates an on-going need to monitor the conditions in these bays while taking proactive precautionary steps to stabilize or reduce the introduction of TP from human sources.

DNA Barcoding infrastructure to Monitor Biodiversity, Biostructure and Ecosystem Function with University of Guelph/ OMNR).

Recent molecular developments have dramatically enhanced our ability to efficiently and rapidly audit biodiversity. DNA barcoding is the generation of mitochondrial DNA sequences that allow us to rapidly identify an individual at the species level. Despite this scientific advancement, many of the Great Lake's iconic ecosystems (e.g., Georgian Bay) have yet to develop the DNA barcode library that permits the use of this tool as a means to monitor environmental impacts at the species level. A successful pilot project was implemented as a fundamental biological tool to quantify the environmental infrastructure of South-Eastern Georgian Bay as a next step in scaling the techniques. The existence of this database will allow a rapid and cost-efficient method to assess human impacts as well as offer a means to measure the success of restoration efforts. Once in place, this DNA library will support environmental tools for the Great Lakes for the foreseeable future. It will also almost certainly identify DNA sequences from never before seen aquatic freshwater species.

Stable isotope analysis of carbon and nitrogen provides information about the sources of energy and major pathways of energy and material flux to determine where an organism fits in in the ecosystem. Through modelling these characterizations of the food web, we can understand at a gross scale how human modifications (e.g., species invasions, eutrophication) alter the structure, dynamics and functioning of these complex systems. While stable isotopes operate at a gross scale and can only delineate very different habitat pathways of energy (e.g., benthic versus pelagic; terrestrial versus aquatic), combining this technology with DNA barcoding will provide a more detailed assessment of ecosystem are structure and function. This is the biostructure that connects diversity and ultimately governs ecosystem functioning (e.g., water quality, secondary productivity).

To complement both the DNA barcoding and stable isotope analysis, we also monitored physiological responses of higher level organisms to see signals of physiological stress or duress in their environment. This physiological indicator, therefore, has the potential of offering us early detection of ecosystem change.

This research program developed a data-rich methodology for scientifically assessing the influence of human (anthropogenic) stressors on the structure and function of critical aquatic habitats throughout the Great Lakes starting in Georgian Bay. The creation of this methodology will provide managers with the necessary tools to respond and adapt to both short-term and long term environmental stressors. By taking this multi-level approach to assessing human impacts this research program will not only be greatly improve our ability to quantify the impacts of anthropogenic effects on Georgian Bay, it will also establish global leadership in integrative environmental management. Our research team in is the unique position to integrate these different tools to protect the iconic ecosystem that is the Great Lakes. Given the research team (U of G), it is expected that this research will be published in top-

tiered journals, and Georgian Bay Forever will collaborate with this research team to disseminate the research and monitoring to the public.

Summary of Objectives

1) DNA Barcode the invertebrates, vertebrates, aquatic plants, and cyanobacteria (blue green algae) of the South Eastern Georgian Bay ecosystem
2) Create a South Eastern Georgian Bay database of DNA Barcode information that will form the basis for monitoring and modelling of the Georgian Bay ecosystem. The database links to stable isotope and LDH information to enhance future bio-indicator studies that utilize a suite of monitoring tools within Georgian Bay.
3) Develop novel ecosystem diagnostic techniques including DNA Barcoding, Stable Isotope Analysis, and Lactose Dehydrogenase Hormone to document food web structure and function along a gradient of human impacts in South Eastern Georgian Bay.

This work is fundamental to measuring the impacts of other projects looking to create positive outcomes for the Great Lakes. This baseline data will provide centuries of useful scientific information to guide policy and regulations.

The state-of-the-art technologies developed for this project will be transferrable as an innovation in the measuring and monitoring of biodiversity related to stressors like climate change and development impacts in both Canada and the US across multiple jurisdictions.

There is a worldwide application of this technology to guide and measure the effectiveness of remediation initiatives and it will have application in assessing biodiversity impacts from industrial development and remediation more broadly. Characterisations of all lakes would be cost effective and establish baseline conditions useful for guiding policy decisions for centuries.

Coastal Wetland Invasive Species Removal in South-Eastern Georgian Bay (GBF lead with Environment Canada and OMNR support)

Georgian Bay Forever has received funding for a community based coastal invasive species eradication project. This project was undertaken with the financial support of the Government of Canada through the federal Department of the Environment. (Ce project a été réalisé avec l'appui financier du gouvernement du Canada agissant par l'entremise du ministère fédéral de l'Environnement.)

In 2005, researchers at Agriculture and Agri-food Canada ranked Phragmites australis (an invasive version of the common reed) as Canada's worst terrestrial invasive plant. This plant is easily observed in the ditches along major highway corridors and throughout southern Ontario. This project will allow the community to directly intervene in selected wetlands experiencing an invasive plant incursion. Phragmites australis forms a dense monoculture displacing native plant species and disrupting natural ecosystem uses of these important coastal areas. The invasion is established in some locations, but just starting in others. Eradicating established infestations will drastically reduce the number of new

incursions and eradicating new invasions will prevent Phragmites from becoming established in the coastal wetlands.

The community will be engaged in an education and hands on project to identify, monitor, log and track the progress of this plant and then assist in direct intervention to eliminate this invasive plant from the wetland using best practices to be determined and approved. Those with the least ecological impact will be favoured. These efforts will build upon the experiences of other communities and agencies such as Parks Canada, the Ontario Invasive Plant Council, the Ontario Ministry of the Environment, and the Ontario Phragmites Working Group.

Phragmites has a direct impact on wetlands by displacing the native plants and forming an impenetrable monoculture. This plant is beginning to establish itself in the coastal wetlands of Eastern Georgian Bay. Eradication of established stands of this plant is very difficult but will help to protect the biodiversity of the wetlands as well as protecting habitat used by birds, waterfowl, mammals, reptile and other species including numerous threatened species. Acting now to eliminate new sprouts before they are established stands will also greatly enhance the effectiveness of controls. Teaching the community to identify the plant and how to take action to minimize impacts on the native plants will establish a culture of stewardship and responsibility for protecting our environment.

This project will educate 40% of the local population and eradicate 80% of the Phragmites australis in Georgian Bay. There will be a GIS mapping of the existing stands of Phragmites in the defined area. Following the education and eradication effort, the locations will again be assessed. Recurring infestations will be addressed and final spatial measures of the protected wetland area will be recorded. There will be a number of sentinel monitors established. The sooner we can begin to eradicate this invasive plant, the easier it will be to control. While this will very likely remain an ongoing vigilance and quick response activity, engaging landowners, cottage associations and the Township in this program will result in a culture of stewardship of the environment as each party becomes more aware of what is at stake. The project will focus on the eastern coast of Georgian Bay, where infestations are currently occurring. The project will activate local community resources in this activity through education and hands on components. Georgian Bay Forever is presently working on other scientific research projects in this area and will oversee the scientific nature of the work and liaise with appropriate government agencies. We will also undertake the educational roles as per our charity's mandate and assist the community with the work.

There is an opportunity for educating the community on invasive species, biodiversity, wetland functions and stewardship activities. This is the first step in transforming how the community thinks about and values the ecosystem. There is an opportunity for all ages to participate. Families will be encouraged to work together on their properties and in their local wetlands to achieve these results. There is an opportunity for the entire community to work together towards a common goal of

protecting biodiversity and the coastal wetlands. The project also includes hands on eradication efforts to reduce the invasive plant's biomass. This is direct action and empowers the community in restoring its ecosystems. There is an ongoing surveillance component of this project that will engage people in the protection of their environment and an awareness and vigilance against other harmful plants like giant hogweed. The coastal wetlands of Georgian Bay were historically pristine and provided nursery habitat to many of the fish species in the Great Lakes. This project will directly protect and restore many of these important areas.

Recommendations and next steps

- The coastal water quality monitoring program will be reviewed and modified over time using a reference to the past and ongoing results that are improving our understanding of the system. It is expected that this adaptive management approach will face significant pressure from the impacts of climate change and invasive species.
- Ongoing intense monitoring conducted by SSEA should continue subject to annual review.
- District of Muskoka testing should be conducted this year
- GBF / Lake Partner Program testing should continue in years between the District testing programs.
- Significant advances in genetic techniques are now available to determine sources of faecal contamination. As much of this bacteria can originate from natural sources (i.e. waterfowl) it is important to identify sources in order to develop effective management strategies. Microbial Source Tracking (MST) can identify the source host of the bacteria and is recommended for the summer 2014 program to better understand the origins of the bacteria found in the environment.
- Determine what government (Environment Canada) research activities are underway in 2014 to determine if any useful data will be available for the Township to use.