Near-Shore Water Sampling Project

Conservation Committee – Kahshe Lake Ratepayers' Association

May 2021

What is this?

This is a Kahshe Lake Ratepayers' Association (KLRA) Conservation Committee near-shore water sampling and analysis project designed to provide a better understanding and evidence-based responses to the following questions:

1. Is the historical and ongoing sampling and analysis of Kahshe Lake by the District Municipality of Muskoka (DMM) and the Ontario Ministry of Environment, Conservation and Parks (MECP) providing a meaningful evaluation of the nutrient status and algal sensitivity of the lake, or are possible shoreline sources of algal friendly nutrients escaping detection by the DMM and MECP's mid-lake water chemistry findings which have remained low and constant over the almost 40 year sampling period?
2. Do the near-shore water analysis results indicate the need for a more aggressive KLRA appeal to the Town of Gravenhurst for a more robust and frequent septic re-inspection program for Kahshe Lake road and water access properties?
3. Do the near-shore analysis findings underscore the need for the KLRA to undertake a more aggressive communication program with shoreline property owners to reduce lawn fertilizer use and the disturbance of natural shorelines by beach creation, vegetation removal or construction activities that expose shoreline soils to erosion and runoff into the lake?
4. Was the Harmful Algal Bloom (HAB) identified in November 2020 along a small portion of the Oak Road shoreline an event that was likely related to elevated nutrient levels in the near shore waters and an event that is likely to be experienced in this or other areas of Kahshe Lake as our climate changes towards longer open water periods and generally warmer waters?

Are there any other benefits?

In addition to providing answers or perspectives on the above questions, the findings will provide shoreline property owners with evidence they can consider in deciding whether the shoreline water quality in the vicinity of their waterfront area has been impacted by fecal coliform contamination. And while blue-green cyanobacterial HABs are the primary focus in terms of lake vulnerability, the findings also will inform regarding the nutrient status of the near-shore water and its possible role in promoting the growth of other types of green algae that are becoming more prominent on shoreline rocks and other structures in the near-shore environment.

Background

The first confirmed blue-green algal bloom (HAB) on Kahshe Lake was documented by the MEPC on November 11, 2020 and the Oak Road area where it was located remained in an Alert status as prescribed by the Simcoe Muskoka Health Unit (SMHU) until December 4. Fortunately, the sampling and analysis of the water by the MECP did not detect any evidence of toxins (microcystin or anatoxin-A), even during the initial investigation.

The causal factors involved in the development of HABs are complex, but in general terms, the conditions that favour bloom development include:

- Abundant sunlight and low wind conditions,
- Warm, slow moving water,
- Availability of soluble phosphorous and to a lesser extent, nitrogen compounds, and in some cases,
- Nutrient rich sediments and oxygen-starved (hypoxic) or depleted (anoxic) water conditions at the lake bottom.

The complexity arises from the fact that there are basically two morphologically different types of cyanobacteria involved in the formation of HABs. One group is referred to as benthic (sediment dwelling), and derive their phosphorus primarily from levels released from the sediment to the water at the bottom of the lake as hypoxic or anoxic conditions form as the season progresses. They are able to access this nutrient rich water because of an ability to adjust their buoyancy, thereby allowing them to move up and down in the water column to gain access to the sediment-sourced nutrients at the bottom and warmer surface waters they need to accelerate their growth into a bloom.

The other group is referred to as planktonic, and derive their nutrients from the surface water. Fortunately, the HAB that was experienced on Kahshe in late 2020 involved two species that are considered planktonic and no benthic dwelling species were detected. This is fortunate, as it means that at least for now, our efforts to limit the development of future blooms can remain focussed on maintaining low levels of nutrients in the water. Had the bloom been identified as one of the benthic species, there is virtually no feasible control method, as to limit the release of phosphorus from the sediment, we'd need to consider some method of injecting oxygen at the lake bottom – and that would not be inexpensive!

Regardless of the cyanobacteria HAB type, once a bloom colony develops on the surface, it can then drift with wind and currents to shoreline locations with slow moving and shallow, warm water. This complicates the identification of the source or sources of the nutrients associated with the development of the bloom, as without daily observations, it is difficult to pinpoint the location and origin of the bloom and the likely source of the nutrient supply.

Will the results identify shoreline sources of nutrient enrichment?

The answer to that question is no, the findings from this near-shore sampling program will not identify specific sources of nutrients (mainly phosphorus) that are typically associated with algal bloom development. However, they will provide Kahshe-specific water quality information that will advance our understanding of whether shoreline development is playing a role in the appearance of greater algal growth now being observed along the shores of Kahshe Lake.

At present, our current database of water quality information for Kahshe Lake consists of sampling in May during lake turnover from two locations by the DMM and from three locations via the MECP's Lake Partner program. In all cases, these samples are from the surface to the Secchi depth (approx. 0-3m) of the mid-lake locations, well removed from the shorelines where phosphorous and other nutrients are known to originate. The data from these locations provide an excellent base upon which to evaluate long term trends in lake chemistry; however, they are of limited use in characterizing water chemistry and nutrient loading in the vicinity of shoreline nutrient sources related to land development. As such, this study has been designed to explore and characterize water chemistry in much closer proximity to the three development-related sources of nutrient loading (septic effluents, lawn fertilizer leaching and soil erosion/runoff) and to examine how water chemistry close to the shore changes as the season progresses.

In our review of the literature, it has been noted that research studies have been conducted to evaluate the relationship between shoreline sources of algal friendly nutrients and surface water chemistry. And, while surface

water dilution will complicate attempts to identify the origin of the nutrient enrichment, some studies have been successful in tracing septic effluent discharge and impacts on surface waters. In a 2017 study (Richards et al.) the results revealed that several tracer concentration ratios (Chloride/Electrical Conductivity; Chloride/NH4-Nitrogen and Chloride/Total Nitrogen) had potential as septic effluent tracers in surface water bodies where lake/stream dilution was low. They identified other tracers of septic effluents like caffeine, artificial sweeteners, but these parameters are costly to analyze and are not uniformly associated with septic effluents. Taken together, results suggested that a single tracer alone was not sufficient to reliably identify septic effluent contamination of a watercourse, but rather a combination of multiple chemicals and physical tracing approaches need to be employed. Unfortunately, because phosphorous and nitrogen are common to all three potential sources, it will be difficult to differentiate among them based solely on water quality analysis or ratios of individual chemicals. One possible exception to this general finding is that septic effluents are typically high in ammonia-N and low in nitrate-N while lawn fertilizer/soil runoff is more typically nitrate-N rich. Another differentiator is fecal coliform analysis, as it is specific to septic system effluents. However, even this needs to be qualified, as fecal coliform also are associated with the feces of birds and other aquatic warm blooded animals.

Based on this information, the main goal of this near-shore sampling program will be to better characterize surface water chemistry of Kahshe Lake in the near-shore environment and to include chemical parameters that will be of use down the road in a more detailed causation study that will be funded by the DMM as part of the vulnerable lake identification process.

How will the study be conducted?

Based on a land use study of shoreline properties in 2015, a pilot sampling plan has been developed to focus on shoreline areas with the most densely populated cottage development as well as shorelines where lawn areas and sandy beaches have been identified. And while it would be ideal to have a surface water sample specific to each shoreline property, it was recognized that this was beyond the financial resources that could be made available. As such, a total of 22 near-shore sampling locations were identified and are shown on the attached map of Kahshe Lake. These sites are not cast in stone; they are simply located where they are to try to provide coverage of two areas of the lake (Oak Road and North shoreline) with a more densely populated shoreline. For comparison purposes, several locations also are located in non-developed shoreline areas with similar shoreline classification as well as a few sites in other areas of the lake to give some perspective on how other developed areas compare to the more densely populated Oak Road and North shore study areas. In addition to these locations, the sampling also will include two of the four central, deep water sampling locations where the DMM and MECP have traditionally taken their surface water samples and are likely to continue their sampling programs in 2021. To ensure that our findings from these two mid-lake sampling locations are comparable to the sampling results from these two deep water locations two samples (0-0.1m and 0-3m) will be collected at each of the two mid-lake sampling locations.

This sampling will take place in mid-May, 2021 to ensure that the results are captured at the approximate same time as the spring lake-turnover samples are taken by the other two agencies. The two mid-lake sampling locations also will be collected in mid-July and September, but the sampling at these two times will be limited to the 0-0.1m depths, as there are no DMM or MECP analysis results at these times for the Secchi depths.

Although the near-shore sampling in mid-May will generate a lot of useful information, we believe that two additional rounds of sampling will prove even more useful, as we would get a better picture of temporal changes in water quality as the season progresses. To do this, we will re-sample 11 of the 22 mid-May sampling sites in mid-July and again in late-September. These sites would be those with the highest and lowest concentrations of total phosphorus, nitrogen and fecal coliform contamination from the mid-May sampling.

As the DMM and MECP collect and analyze a duplicate water sample for total phosphorus, this study also will include this duplicate analysis.

The parameters for analysis will include: Fecal coliform (E. coli), total phosphorus (duplicate samples), nitrate-nitrogen, ammonium-nitrogen, potassium, chloride, barium and iron. All samples will be collected in laboratory-supplied sampling containers and kept on ice until delivery to the lab. This will include the completion of chain-of-custody forms and delivery to the lab within the allowed 24 hour holding times. The laboratory selected for the analysis is ALS Laboratories and they were selected based on their participation in lake chemistry studies undertaken by the Muskoka Lakes Association. As these findings need to be comparable to those generated by the MECP and DMM programs, both of which are carried out by the MECP's Dorset Environmental Science Centre (DESC), the Coordinator of the MECP's Lake Partner Program was contacted and provided the analytical methodology for total phosphorus analysis, and this has been forwarded to ALS to ensure that their analysis of our samples is consistent with the analysis methodology used by the MECP.

A breakout of the sampling program follows:

Sampling Date	No. of Near Shore Sites	No. Mid-Lake Samples		Total No. Samples
Mid-May	20	4 (2@KM and 2@GB)		24
Mid-July	10	2 (KM and GB)		12
Late September	10	2 (KM and GB)		12
Total				**48**

Legend: KM means Kahshe Main; GB means Grant Bay

At each sampling site, the samples will be collected from the same depth (approx. 0-10 cm) and the following additional information will be recorded;

- Wind direction
- Water current direction and approx. speed
- Water temperature at 10 and 50 cm
- Description of shoreline (e.g. rock, sandy, lawn, other)
- Distance from shore (2-5m)
- Depth of water at sampling location (minimum of 80cm)
- Latitude and longitude
- A picture of the shoreline from the site

To carry out the sampling, the Lake Steward will assemble a team of volunteers and train them in the sampling method. The Lake Steward will arrange for transport of the samples to the laboratory and will compile the findings and prepare a report with recommended management or communication actions the KLRA could pursue.

How much will it cost?

There are three types of costs associated with the above sampling plan as shown below:

Type of Cost	Amount	Notes
Laboratory Analysis	48 samples = $9,432	Estimate based on quote by ALS Laboratories, Toronto
Tax on Lab Analysis	$1,226	13% on the lab analysis

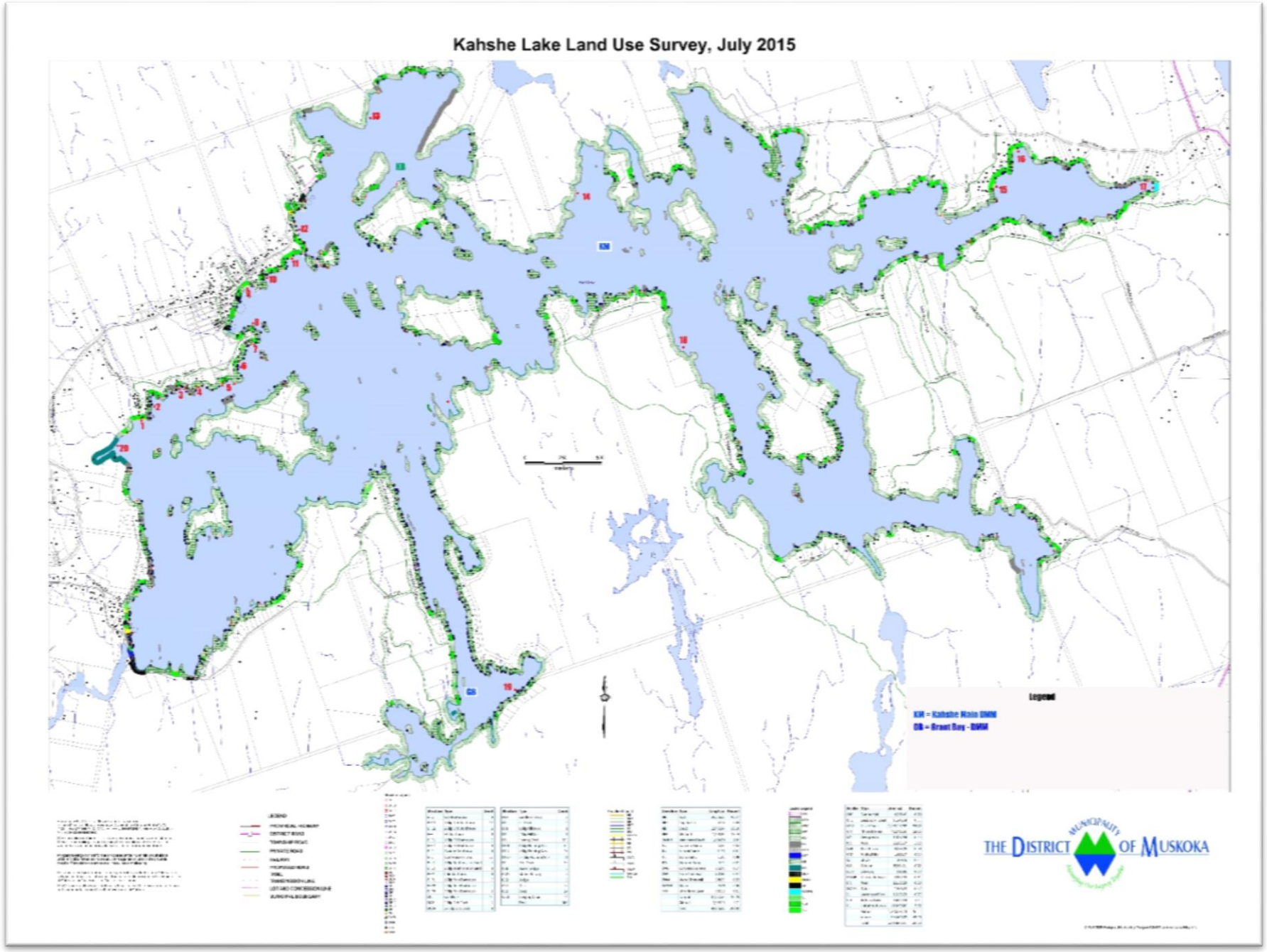
Type of Cost	Amount	Notes
Miscellaneous	Approx. $250	Thermometers, tape measures, boat gas, transportation to lab (3 trips)
Total	**$10,908**	

Ron Pearson, Kahshe Lake Steward

For the KLRA's Conservation Committee

March 15, 2021

Attach: the tentative location of the near shore and mid-lake sampling sites is attached


Kahshe Lake Land Use Survey, July 2015
Legend
KM = Kahshe Main DMM
DB = Grant Bay - DMM
THE DISTRICT OF MUSKOKA