Interpretation of Water Quality Data

1. Spring phosphorus

Phosphorus is one of the key nutrients that promotes algae growth in most Ontario lakes. For this reason, any increase in phosphorus in a lake will tend to increase the risk of an algal bloom. This is commonly seen when septic systems located on waterfront properties leach into the water. Phosphorus may also increase as a result of lawn fertilizer runoff, agricultural runoff, and municipal wastewater.

High levels of phosphorus can lead to algal blooms that not only detract from recreational water quality, but can also impact the local ecosystem. When algal blooms form, they block sunlight from penetrating the water column, which prevents photosynthetic aquatic plants from producing oxygen. Additionally, when the algae eventually dies, it is consumed by bacteria in a decomposition process that further depletes dissolved oxygen. Most aquatic life relies on dissolved oxygen for survival, and coldwater fish species, such as Lake trout, are especially impacted by low oxygen due to the already low capacity of cold water for oxygen.

Phosphorus samples are collected in the spring during a period called “spring turnover”. This is the best time to sample for phosphorus because the lake is completely mixed and a water sample represents the phosphorus concentration throughout the whole lake.

By sampling spring phosphorus each year, it is possible to detect a change in the nutrient status of a lake. Several years of data must be collected to first observe the normal, between-year-differences, before a trend can be identified.

Although there are lakes in Muskoka that fall into the eutrophic (enriched) category, most lakes in Muskoka are considered mesotrophic (moderately enriched) or oligotrophic, meaning that they have low nutrient concentrations (Table 1). In general, phosphorus concentrations are decreasing across Muskoka as a result of improved environmental and planning regulations introduced in the 1970s – early 2000s. Continuing to monitor phosphorous is important to make sure this decreasing trend continues, and to ensure deviations from the trend can be identified early.

Lakes that are monitored as part of the Lake System Health (LSH) program will be designated as ‘vulnerable’ if the below criteria i) and/or ii) is confirmed to be present for 3 consecutive years of monitoring, or the below criteria iii) is confirmed to be present:

i) Significantly ($p<0.1$) increasing trend in total phosphorus concentration calculated from at least 5 spring overturn phosphorus measurements since 2001;

ii) A 10-year average total phosphorus concentration greater than 20 µg/L, calculated from at least 5 spring overturn phosphorus measurements collected within the previous 10 years;
iii) A cyanobacteria bloom confirmed and documented by the Ministry of Conservation, Environment, and Parks (MECP) and/or the Simcoe Muskoka District Health unit (SMDHU).

Once a lake has been designated as 'vulnerable', it will be added to Schedule E2 of the Muskoka Official Plan, which results in enhanced protection policies and monitoring for the waterbody. A waterbody may be removed from Schedule E2 if the vulnerable designation was originally assigned due to criteria i) and/or ii) above, but the criteria is no longer present for three consecutive years of monitoring.

Table 1: Summary of nutrient conditions and indicators.

Nutrient Conditions	Description	Phosphorus Concentration	Secchi Depth
Oligotrophic	Unenriched – low nutrient concentration	< 10 µg/L	> 5 m
Mesotrophic	Moderately enriched	10 – 20 µg/L	3 – 5 m
Eutrophic	Enriched – high nutrient concentration	> 20 µg/L	< 3 m

2. Secchi depth measurements

Secchi depth is a measurement of water clarity. In Muskoka, the major determinant of water clarity may be either natural colour or an increase in nutrient input from the surrounding watershed.

A lake may naturally be a brown colour due to high levels of dissolved organic carbon (DOC) that comes from the wetlands in a watershed. DOC colours lakes brown and reduces water clarity, but is not an indication of nutrient enrichment. Examples of lakes with naturally high DOC content include Brandy Lake and Tea Lake.

Water clarity can also decrease as nutrients from the surrounding watershed enter and enrich the lake, resulting in high levels of suspended sediments or algal growth.

Water clarity can change weekly or yearly as a result of weather, length of winter ice cover, shoreline development, natural seasonal trends or other impacts. However, when the primary determinant of water clarity is a function of nutrient enrichment, a long-term trend that indicates a reduction in water clarity is an indication of reduced water quality.

In general, where a lake is not coloured by DOC, the higher the Secchi depth reading, the clearer the lake and the less nutrients it contains (Table 1).

3. Temperature and dissolved oxygen measurements

Temperature is a measure of the intensity of heat stored in a volume of water. Temperature patterns affect the solubility of many chemical compounds and influences the effects of pollution on aquatic life.

Dissolved oxygen is a measure of the concentration of oxygen dissolved in water. Adequate concentrations of dissolved oxygen are necessary for the survival of fish and other aquatic organisms. Dissolved oxygen concentration is an indicator of a lake's ability to support aquatic life.

Dissolved oxygen levels above five milligrams per litre (mg/L) are considered optimal for most aquatic organisms. Most fish cannot survive if levels fall below 3 mg/L. For coldwater species, such as lake trout, a minimum of 6 mg/L is needed, along with a temperature below 10°C. Lakes with dissolved oxygen readings below 0.5 mg/L are considered anoxic.

4. Other water quality parameters

In addition to the water quality parameters above, water samples collected as part of the Lake System Health (LSH) program are assessed for a a full suite of chemical parameters, including organic and inorganic carbon, calcium, chloride, nitrogen, pH, conductivity, and metals.

Across Muskoka, concerning trends have been observed for chloride and calcium concentrations. The concentration of chloride has been increasing in the majority of Muskoka's lakes as a result of road salt usage. Simultaneously, calcium concentrations have been decreasing in the majority of Muskoka's lakes. In the 1970s and 80s, acid rain leached calcium from Muskoka's environment, which has resulted in the low concentrations observed even decades later. Although either of these trends would be concerning on their own, the combination of increasing chloride and decreasing calcium are especially concerning. Sensitive aquatic life such as crayfish and other macroinvertebrates that form the base of the food web are highly susceptible to both water quality issues. Current guidelines outline that chloride concentrations higher than 10 mg/L and calcium concentrations below 2 mg/L are harmful to sensitive aquatic life, but the combined effect of both stressors is expected to have greater impacts.

Currently, the majority of lakes in Muskoka do not have any metal concentrations above detection. Although some natural processes such as erosion and forest fires can increase the concentration of harmful metals in the environment, most significant metal contamination results from human activities like mining and industrial waste runoff. Due to this, metal contamination is not currently a concern in Muskoka, but it is important to continue monitoring for changes so they can be detected early.

In addition to phosphorus, nitrogen is another nutrient that can contribute to the formation of algal blooms, but it is not used as an indicator of bloom potential in Muskoka

for a few reasons. First, most nitrogen released into the environment from human activities originates from agricultural sources, which there are relatively few of in Muskoka. Other sources of nitrogen tend to also be sources of phosphorus (ex. Septic systems), so managing the sources of phosphorus will also help control nitrogen. Finally, some cyanobacteria (also known as blue-green algae) have adaptations that allow them to utilize atmospheric nitrogen, even when there is no bioavailable nitrogen in the system. This is why phosphorus, and not nitrogen, is often considered the limiting nutrient for algal blooms.

Sample Lake Data Sheet

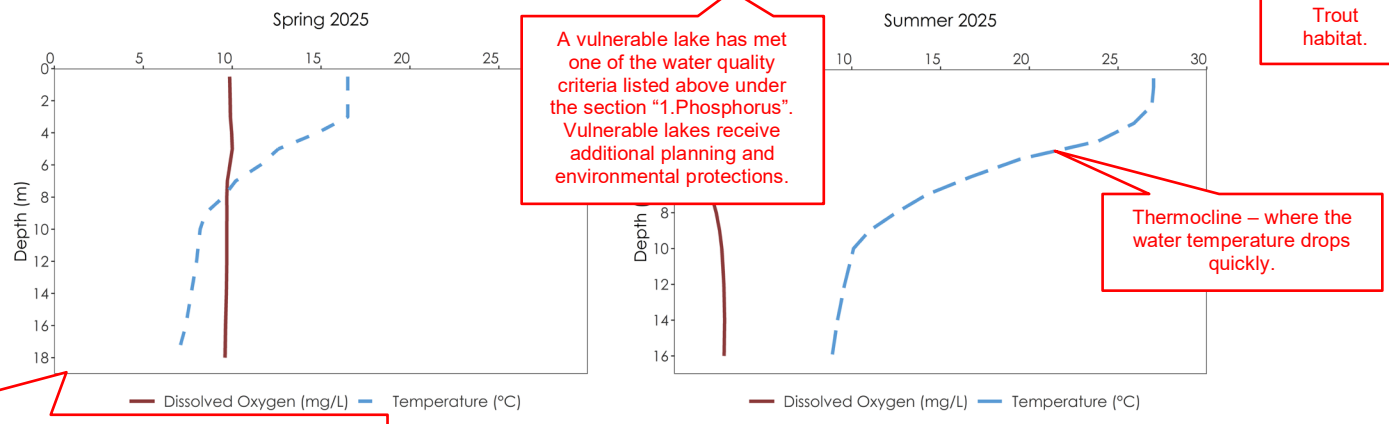
Kashe Lake – Main

Current 10-year average for phosphorus. This value should be below 20 µg/L. Some lakes will naturally have higher baselines than others, regardless of human influences.

Municipality:	**Gravenhurst**	Watershed:	**Kashe River**
Surface Area:	**8.21 km²**	Watershed Area (excluding lake):	**32.53 km²**
Maximum Depth:	**20 m**	Lake Trout Lake?	**No**
Wetland Area:	**14%**	Secchi Depth (10-year average):	**2.5 m**
Phosphorus (10-year average):	**11.4 µg/L**	Listed as Vulnerable?	**Yes**

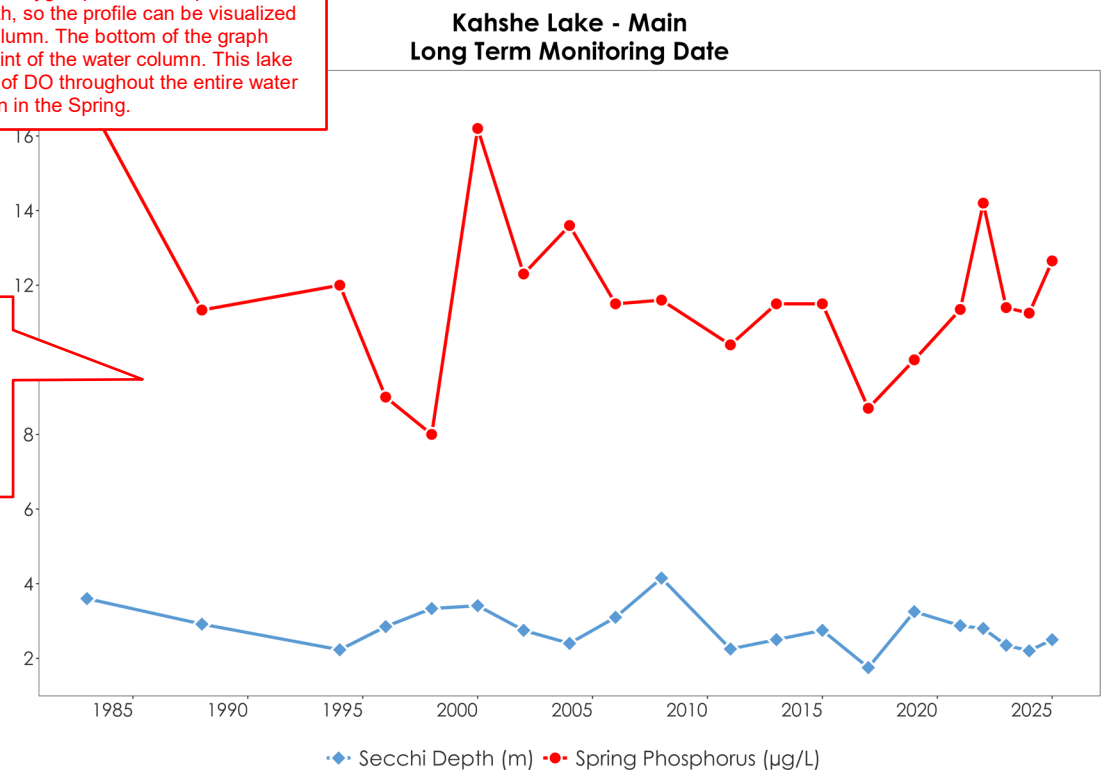
A Lake Trout lake is managed by the Ministry of Natural Resources for Lake Trout habitat.

A vulnerable lake has met one of the water quality criteria listed above under the section "1.Phosphorus". Vulnerable lakes receive additional planning and environmental protections.



Thermocline – where the water temperature drops quickly.

Temperature + Dissolved Oxygen profile. Both parameters are graphed against depth, so the profile can be visualized for the entire water column. The bottom of the graph represents the lowest point of the water column. This lake has a high concentration of DO throughout the entire water column in the Spring.



Phosphorus and Secchi depth measurements over time. An increase in phosphorus usually results in a decrease in Secchi depth and vice versa (Table 1).