Athabasca Watershed Council

INFO SHEET 5 **Spring 2012**

Eutrophication

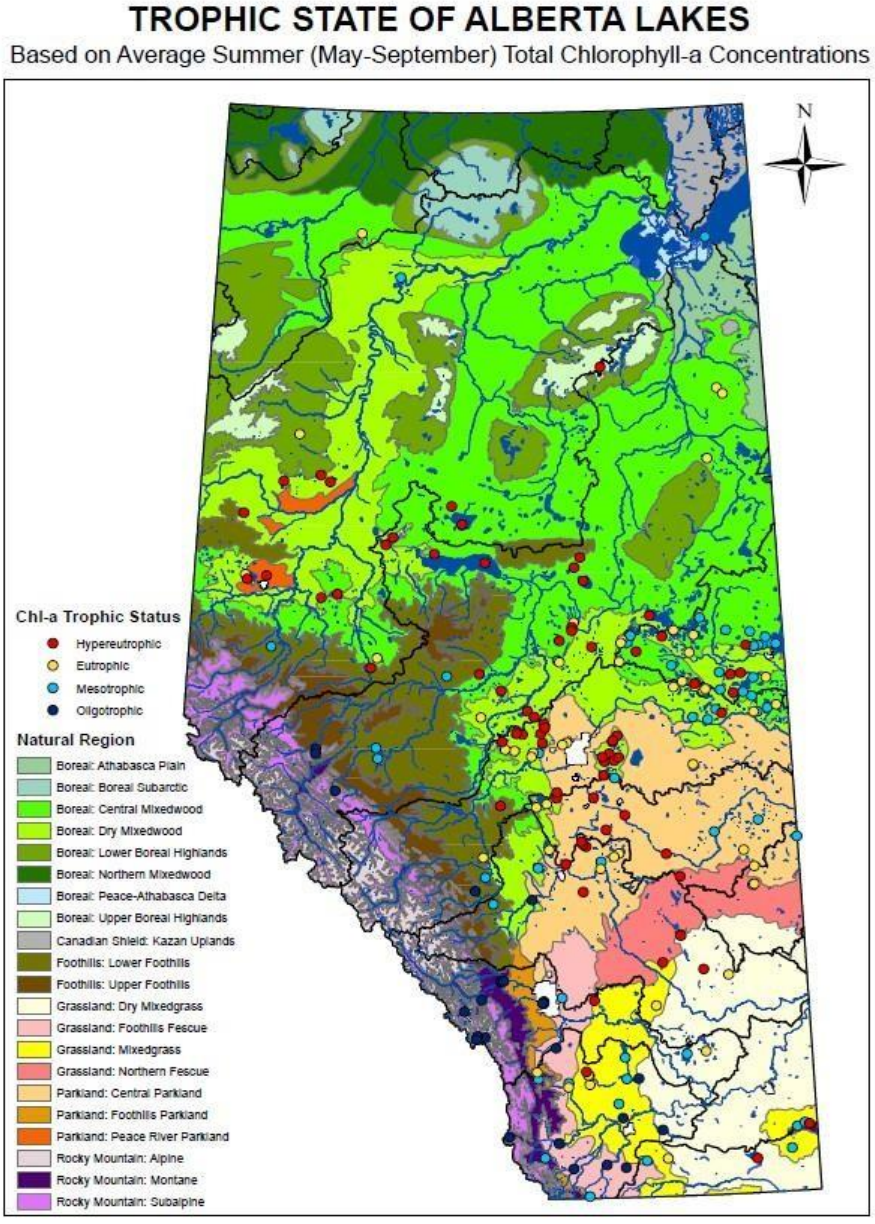
Eutrophication is the process by which a body of water is enriched with nutrients over a period of time. Nutrients, primarily **phosphorus (P)** and/or **nitrogen (N)** in the water reach high concentrations that result in excessive growth of algae, algae-like bacteria (blue-green algae), and other aquatic plants during the growing season.

At the end of the growing season algae and plants die and decompose. Decomposition of dead algae and plants can use up the **dissolved oxygen (DO)** in water. This can lead to conditions where DO is insufficient for fish and other aquatic animals, especially over the winter months. Ice cover prevents natural aeration that replenish depleted DO. DO depletion can lead to "fish kills".

Eutrophication occurs naturally and the process may take centuries. Human activities can accelerate the process and eutrophication can occur within decades. **Accelerated eutrophication** is a form of **pollution** that needs to be managed. Lake eutrophication is an issue in Alberta and within the Athabasca watershed.

Eutrophication is indicated by the concentration of **Chlorophyll-*a*** (green pigmentation) of algae in a water sample. The range of **trophic levels** (maximum chlorophyll-*a*) are:

- Oligotrophic — less than 8 µg/L
- Mesotrophic — 8-25 µg/L
- Eutrophic — 26-75 µg/L
- Hyper-eutrophic — over 75µg/L



Three most recent years of data was used to calculate trophic status
Created July 2009

Image source: http://www.environment.gov.ab.ca/info/library/8089.pdf

In order to prevent accelerated eutrophication, it is advised that nutrient concentrations in streams and lakes do not exceed the *Surface water quality guidelines for use in Alberta*:

- Total phosphorus (**TP**) = 0.05 milligrams per litre (mg/L) or 50 micrograms per litre (µg/L)
- Total nitrogen (**TN**) = 1.0 mg/L or 1000 µg/L

Trophic state of some lakes in the Athabascawatershed*

Lake	Trophic State
Baptiste	Hyper-eutrophic
Calling	Eutrophic
Christina	No data
Gregoire	Eutrophic
Island	Meso-trophic
La Biche	Eutrophic
La Nonne	Hyper-eutrophic
Lessard	Eutrophic
Lesser Slave	Eutrophic
Long (near Athabasca)	Meso-trophic
McLeod	Meso-trophic
Nakamun	Hyper-eutrophic
Narrow	Oligo-meso trophic
Rock	No data
Steele	Hyper-eutrophic
Thunder	Eutrophic
Winagami	Hyper-eutrophic

*Atlas of Alberta Lakes. 1980s

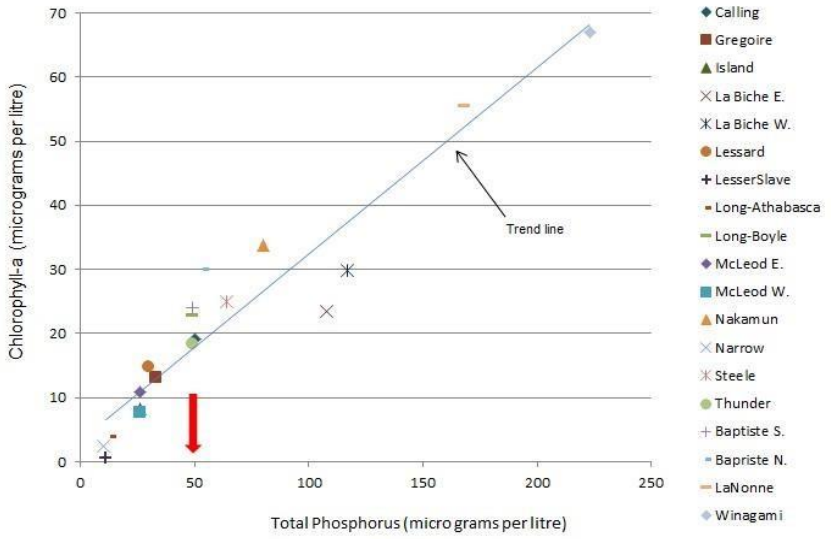


Fig. 1 Increasing concentration of Total Phosphorus and increasing concentration of chloro-phyll-*a* in freshwater lakes. Red arrow=guidelines value. Data source: Atlas of Alberta Lakes, 1980s.

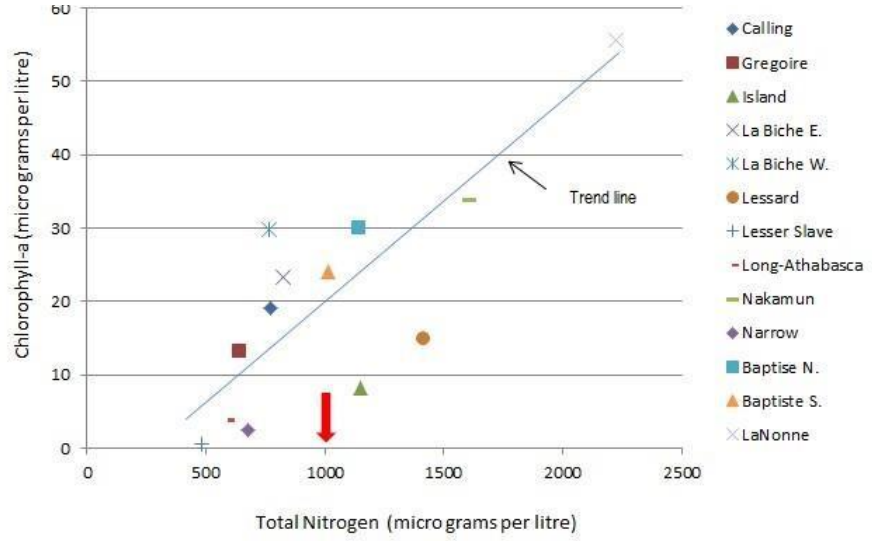


Fig. 2 Increasing concentration of Total Nitrogen and increasing concentration of chlorophyll-*a* in freshwater lakes. The relationship is weaker than in Fig. 1, indicated by data points being further away from the trend line. Red arrow=guidelines value. Data source: Atlas of Alberta Lakes, 1980s.

The ideal **Dissolved Oxygen** (**DO)** concentrations for fish is between 7 and 9 milligram per litre (mg/L). **DO** normally fluctuates during a 24-hour day; lowest early in the morning and highest towards late afternoon.

To support healthy fish populations, **DO** concentrations must not decline below 5 mg/L and should not average less than 6.5 mg/L over a seven-day period.

Nutrients that contaminate lakes and streams can come from natural and man-made **sources** such as:

- Municipal wastewater discharge
- Stormwater discharge - pet wastes and applied lawn fertilizers
- Runoff from agricultural lands & golf courses—applied fertilizers and manure
- Access of livestock to streams—manure and urine
- Leakage from nearby septic systems
- Soil or sediments from eroded stream banks or land cleared of vegetation
- Wildlife wastes & dead plants & animals
- Industrial effluents (some) and Nitrogen Oxides (NOx) emissions
- Ammonia emissions from confined feeding operations
- Ash from forest fires

In addition to nutrients, some conditions promote eutrophication such as:

- <u>W arm temperature</u> (e.g. as a result of discharge of industrial cooling water, removal of riparian vegetation)
- <u>Depth</u>—shallow lake or stream warm up quicker than deep ones
- Increase in area/volume ratio of water <u>exposed to sunlight</u> (e.g. as a result of removal of riparian vegetation)
- <u>Very slow flow</u> (in streams) - (e.g. as a result of water structures that impede flow - weirs and dams).

***TP**, **TN** and **Chlorophyll-a** concentrations are determined by laboratory analysis. Contact an environmental laboratory for guidance in collecting and transporting water samples.*

***DO** along with other physical water characteristics such as **temperature**, **pH** (acid or alkaline), and Electrical Conductivity **EC** (salinity) can be measured directly in the field using a water quality multi-meter.*

May 1, 2012