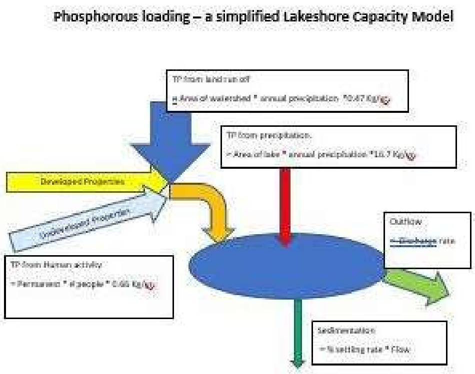
A NATURAL HISTORY OF PHOSPHATES, FROM SINK TO THE LAKE

Editor's Note: Through the Lake Networking Group I met Frank Johnson. Frank seemed very knowledgeable of phosphates. I contacted him with questions, and that was the beginning of an email exchange that eventually resulted in this wonderful (and simplified) article, that helps homeowners and cottagers such as me, better understand the complex story of how phosphates get into our lakes. But Frank has taken it a bit further, illustrating how one could calculate the shoreline capacity of a lake, otherwise the number of homes/cottages, that can be located around a lake's perimeter, without pushing phosphate levels over what the lake can handle, and remain healthy. Frank is a volunteer and is working with his Lake Association and Township to aid in planning.



little silver and rainbow lakes property owners association

What is Phosphorous?
Phosphorous is a key element of life, an essential component of bones, teeth, shells and cell walls. Typically combined with oxygen as a phosphate ion, the chemistry of phosphates is almost as complex and diverse as life itself. This article gives an engineer's overview of the journey of phosphates from kitchen sink and toilet to the lake, with a glance at the efforts of beavers to help flush it out.

Origins
Mirroring the origins of life, phosphorous in nature is both omnipresent and complex. Rain and snow contain measurable amounts of phosphorous in one form or another. The result of precipitation on the land is to wash out phosphates that lurk in the soil from minerals, rotting vegetation, animal waste and fertilizer. Because of the variety of forms and chemistries, phosphates are lumped together as "Total Phosphates" (TP). In Little Silver Lake about 15% TP comes direct from rain and snow, the rest is runoff from the land.

Man-made contributions from detergents, soaps and excreta
For about 100 cottages around Little Silver Lake in Tay Valley Township the contribution equals that from the natural sources. All of this TP descends monotonically from soap to septic, from septic to groundwater and then seeps inevitably downhill to the lakes.

Phosphates in the lake
A little phosphate feeds the algae, which feed the daphnia, which feed the fish. Too much phosphate and there are too many algae, which blooms and dies, sinks to the bottom, decomposes, uses up the oxygen and the fish die. As with all nature there needs to be a balance.

So, what can be done?
There is little we can do about rainfall except change the climate. That is topic for another day. Soon.
There are simple ways to reduce the direct runoff caused by rainfall: Drain roofs away from the lake; do not makes hard surfaces near the lake; have a good vegetation buffer zone; etc. And do not use lawn fertilizers. (nor insecticides or pesticides since they too will get into the lake and cause havoc).

There are two human activities that we can do something about. About 30% of anthropogenic phosphates come from soaps and detergents. Use phosphate-free products, of which there are many.

The remaining 70%, or 0.5kg/person/year, come from excreta. Phosphates are present in both urine and feces. A typical "traditional" septic does not do a great job of removing the phosphates from excreta, and so the inevitable result is the phosphate leaches into the groundwater, and then on, eventually, into the lake. It may take a year or more, but it will surely arrive. The official position is "all of the P deposited in septic systems will eventually migrate to lake ecosystems." Not much help there. Even more guidance may be found in the Lakeshore Capacity Assessment Handbook, section 5.2 on shoreline setbacks. Typically, 30m is required, but 300m is suggested if the lake is at capacity.

Most phosphates are water soluble, but it is possible to convince the phosphate ion to combine with elements such as iron which are insoluble and will then precipitate out. There are septic systems that attempt to do this – the "Waterloo" system is one example. Common to all is the need for annual maintenance, removal of the precipitate and replenishing the chemical for precipitation.

PHOSPHATES CONT'D...

LCM Results for Little Silver Lake	
TP Background	7.34 µg/L
TP Background +50%	11.01 µg/L
TP Measured	11.79 µ/L
TP Future (if all vacant lots developed)	18.07 µg/L

And if all else fails
Downstream of the septic where the groundwater finally emerges, we still have one more chance to mitigate the phosphorous load on the lake. Plants at the lakeshore will be delighted by the ready supply of fertilizer. Use as many as you can in rampant abundance. Do not install a lawn that goes to the edge of the lake. The Lake Protection Handbook is an invaluable resource in teaching us how to build a buffer to catch the phosphate.

Finally, we arrive at Phosphates in the Lake
Just as the terrestrial plants welcome the life-giving phosphates, so do those in the water. Especially the algae at the bottom of the food chain. Too little P and the lake is dead. Too much P and fecundity takes over, overpopulation strikes, the population crashes and dead algae rot consuming the oxygen in the water and the lake dies. Just right and Goldilocks is happy. So are the fish.

What is "Just right"?
This all depends. In the last two decades understanding of lakes on the Pre-Cambrian Shield of eastern and northern Ontario has been refined. What is now considered ideal is a level which is not more than 50% above the background level before development.

Where the background value is determined by the area, precipitation, the mix of land use, (wetlands, forest, and agriculture). All these data can be input to the model to predict the natural background Total Phosphate (TPbk) level.

Then add 50% to that and that gives the limit for anthropomorphic input of TP.

Phosphates and the Lakeshore Capacity Model
The figure for acceptable development is derived this way. In studies of lakes in our Township it has been found that many are already at the limit of capacity. Little Silver and Rainbow Lakes were recently evaluated by the Ministry of Environment, Conservation and Parks and it was found that the above phosphate levels were predicted by the Lakeshore Capacity Model for Little Silver Lake (table above).

In this table, the TP measured in the lake is already over the TPbk+50% figure, so the lake is considered to be over capacity. The expected future TP level if all the lots in the watershed were developed would be well over the limit. In this case strict mitigation measures are needed, with setbacks of 300m.

One last hope
The only natural recourse once TP are in the lake is to flush it out. Beaver have been managing water quality for eons. A beaver dam at the end of the lake can appreciably improve TP levels by maintaining flow year-round, flushing out the lake. But that is broad tail for another day.

Dr Frank Johnson is an engineer with a professional interest in environmental water quality. He was president of RBR Ltd, a world leading manufacturer of water quality monitoring equipment and has worked on projects around the world from the Yangtze River to Lake Baikal. He has a cottage on Little Silver Lake and is currently President of the Little Silver and Rainbow Lakes Property Owners' Association. Thank you so much Frank for all you do and for sharing this information with our members.

Volunteers monitor threatened Western Chorus Frog again

The Frogs are calling loud and clear in swamps and wetlands around our lakes! CALA has two volunteers again this year enjoying some quiet listening in interesting places. They will be seeking the call of the Western Chorus Frog once again.

The threatened western chorus frog (WCF) has recently experienced population declines. In response, a long-term monitoring program has been created by Blazing Star Environmental, Environment and Climate Change Canada and Trent University. This program will help them understand the changing WCF distribution. Data collected will allow the conservation community to detect and respond to WCF range declines over time.

This is the last year of a five-year program to collect this data. Thank you for your help CALA!

Photo Credit – Scott Gillingwater