Regulation under the Ontario Water Resources Act for the Protection of Lake Simcoe

Proposed Regulation Submission
For EBR Registry Number: 010-2246

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Executive Summary

Phosphorus is a naturally occurring nutrient. When phosphorus becomes over abundant, algae growth is over stimulated. One pound of phosphorus can stimulate the growth of up to 700 pounds of algae. When the algae dies and decomposes, it removes dissolved oxygen from the water (eutrophication), which is needed for the successful natural reproduction of cold water fish and for many invertebrates and vertebrates alike. Wild Lake Trout have been unable to reproduce naturally in Lake Simcoe since the late 1980s.

The Ontario Ministry of Environment is proposing a regulation under the Ontario Water Resources Act and has offered a 60 day comment period whereby submissions may be made between December 6, 2007 and February 4, 2008, (Regulation Proposal Notice: EBR Registry Number: 010-2246). The reason for this action is to, "implement a long-term governance structure that supports comprehensive Lake Simcoe environmental protection and promote recreational opportunities while protecting the health of the lake".

The 15 existing sewage treatment plants within the Basin are legally permitted under their current respective OWRA sewage works approvals to discharge up to 12.5 tonnes of phosphorus each year. As an interim cap, it is proposed that the new basin-wide permitted aggregate phosphorus loading for these existing sewage treatment plants be no greater than 7.5 tonnes/year for the period of the regulation, a reduction in permitted loading of approximately 5.0 tonnes/year for that period (Note: 1 tonne = 1 metric ton = 1000 kg).

This report calculates that Simcoe County growth projections indicate that the new set limit of 7.5 tonnes/year will be achieved in 2021. At that time, new development will be required to pay for marginal capacity and existing users will be required to pay for sewer treatment plant retrofits. By virtue of different regulations within and outside of the Lake Simcoe watershed and with land developers and homeowners being cost adverse, the natural propensity will be to push the phosphorus problem to the Great Lakes and to septic systems. The outcome of the proposed regulation will not reduce environmental phosphorus loading, it will only relocate it.

The challenge on placing a phosphorus limit on 7.5 tonnes out of a total 100 tonnes would be to develop effective policy in addressing the overall issue, which it is not consistent with Canadian Council of Ministers of the Environment Canada-wide strategy for dealing with the source of the pollution. The reduction of permitted loading for sewage treatment plants is therefore not recommended.

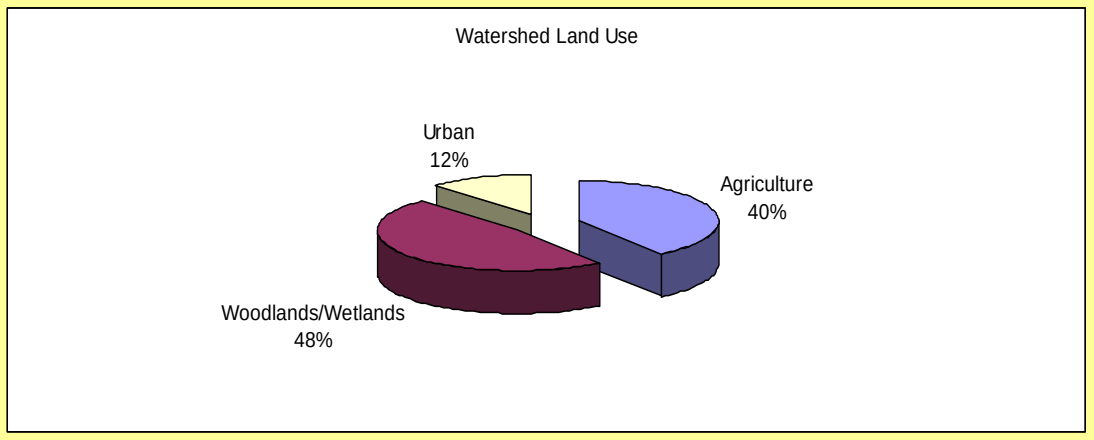
Many dishwasher detergents sold in Ontario contain over 6% phosphorus and have a direct impact on phosphorus discharge from sewer treatment plants due to design limits of the treatment facilities. The elimination of phosphorus in dishwasher detergents and household cleaning products can reduce phosphorus influents into sewage treatment plants by 52% without any cost to residents. Manitoba has already introduced legislation to ban dishwasher detergents containing phosphates by 2010 [CBC News Nov 29, 2007]. It is recommended that the Ontario Ministry of the Environment work with Environment Canada to ban the use of phosphorus in dishwater detergents and household cleaning agents.

The Lake Simcoe Environmental Management Strategy (LSEMS) research has indicated that atmospheric disposition of phosphorus contributes to the majority of the Lake Simcoe's phosphorus loading. Lake Simcoe occupies a surface area of only 20% of the entire watershed. This translates into an overall atmospheric phosphorus loading within the entire watershed of over 200 tonnes per year. There is little empirical data available on the sources of the atmospheric phosphorus. It is recommended that the Ministry of the Environment research into the sources of atmospheric phosphorus and focus that research toward the North American steel industry that emits ~ 140,000 tonnes of phosphorus into the atmosphere as analysed in this report, which appears to be the 'smoking gun'.

With the majority of phosphorus disposition coming from the atmosphere, the regulation requiring that proposed stormwater management facilities will meet the "enhanced protection level" as specified in chapter 3 of the Ministry's Stormwater Management Planning and Design Manual 2003 is recommended. It is recommended that the regulation also apply to the construction of new stormwater facilities that are designed to service existing development and new small infill developments within an existing development.

Background

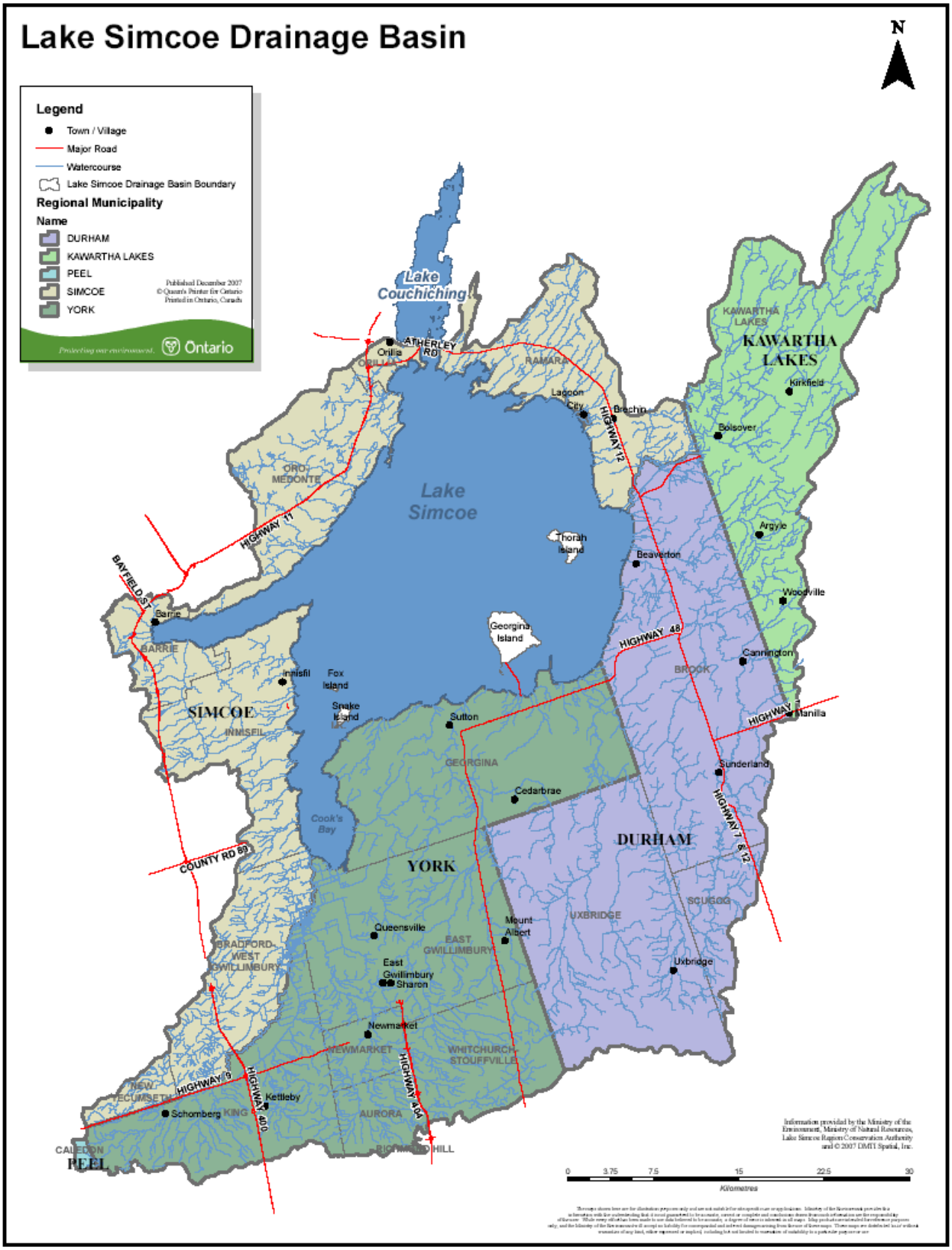
Lake Simcoe provides surface drinking water for five lakeside communities and assimilative capacity for 15 wastewater treatment plants. Land use within the watershed is shown below as follows:



Source: http://www.lsems.info/techreports/Print/state_hr.pdf

The Lake Simcoe watershed has a total area of 3,576 km² with the lake itself occupying 20% or 722 km². There are 35 tributary rivers (3,950 km of streams) with 60% of Lake Simcoe's drainage area made up from five rivers flowing north from the Oak Ridges Moraine. Excluding the Great Lakes, Lake Simcoe is next largest lake in Ontario.

Within 10 years between 1991 and 2001, the population in Lake Simcoe's watershed grew by 116,500 people or 30% [LSEMS 2003]. Municipal growth projections estimate that the population within the Lake Simcoe watershed will increase to 500,000 people by 2021 [LSEMS 2003]. There is an estimated 12,000 cottages around Lake Simcoe which places an additional 50,000 people within the watershed every summer [LSEMS 2003]. Lake Simcoe has been estimated to generate over 200 million dollars per year in recreational activities with an estimated 130,000 anglers (15% of the province's angling efforts) have been attracted to Lake Simcoe in year 2000 [LSEMS 2003].


Lake Simcoe Drainage Basin
N
Legend
Town / Village
Major Road
Watercourse
Lake Simcoe Drainage Basin Boundary
Regional Municipality
Name
DURHAM
KAWARTHA LAKES
PEEL
SIMCOE
YORK
Published December 2007
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Printed in Ontario, Canada
Protecting our environment.
Ontario
Lake Couchiching
Lake Simcoe
Orillia
ATHERLEY RD
RAMARA
Lagoon City
Brechin
HIGHWAY 12
KAWARTHA LAKES
Kirkfield
Bolsover
ORO-MEDONTE
HIGHWAY 11
Thorah Island
Beaverton
Argyle
Woodville
BAYFIELD ST
Barrie
BARRIE
Georgina Island
HIGHWAY 48
Cannington
BROOK
Innisfil
Fox Island
Snake Island
SIMCOE
INNISFIL
Sutton
HIGHWAY
Manilla
GEORGINA
Sunderland
Cedarbrae
HIGHWAY 7 & 12
Cook's Bay
DURHAM
COUNTY RD 89
YORK
SCUGOG
UXBRIDGE
Mount Albert
Queensville
EAST GWILLIMBURY
BRADFORD-WEST GWILLIMBURY
East Gwillimbury
Sharon
Uxbridge
Newmarket
NEWMARKET
WHITCHURCH-STOUFFVILLE
HIGHWAY 9
HIGHWAY 400
HIGHWAY 404
NEW TECUMSETH
Kettleby
Schomberg
KING
AURORA
CALEDON
PEEL
RICHMOND HILL
0 3.75 7.5 15 22.5 30
Kilometres
Information provided by the Ministry of the Environment, Ministry of Natural Resources, Lake Simcoe Region Conservation Authority and © 2007 DMTI Spatial, Inc.

Source:MOE

The two basins of this lake were separated by a plastic curtain. The lower basin received additions of carbon, nitrogen and phosphorus; the upper basin received carbon and nitrogen only. The bright green colour is from a surface scum of algae resulting from phosphorus additions

Source: Fisheries and Oceans Canada

The example above shows the visual impact of how phosphorus stimulates the growth of algae in lakes. The health of the lake has been compromised over time by the contamination of phosphorous into the lake from a number of sources. In 2001, approximately 6,000 boaters have entered Lake Simcoe through the Trent-Severn Waterway and the dumping of waste and grey water into the lake by boaters has been documented [LSEMS 2003].

One pound of phosphorous has the ability of stimulating the growth of up to 700 pounds of algae. When the abundant algae dies and decomposes, dissolved oxygen in the water gets consumed (eutrophication) which in turn has contributed to the inability of the lake to naturally support a natural cold water fishery and many invertebrates and vertebrates alike. Wild Lake Trout have been unable to reproduce naturally in Lake Simcoe since the late 1980s. Cold water fish must be bred in hatcheries and are 'stocked' into the lake. The average cost for the Lake Simcoe stocking program is $96,000 per year to support the sport fishing industry (LSEMS 2007).

Lake Simcoe Environmental Management Strategy (LSEMS)

As a response to the deteriorating water quality of Lake Simcoe in 1990, the Lake Simcoe Region Conservation Authority and the Province of Ontario developed a Memorandum of Understanding to:

"Restore a self-sustaining coldwater fishery in Lake Simcoe by improving water quality".

Phase I of LSEMS took place between 1990 and 1994 involving the completion of more than 300 landowner environmental assistance projects with an estimated reduction of 14 tonnes of phosphorus [LSEMS 2007]. Phase II took place between 1996 and 2000 and included the completion of 55 additional water quality improvement projects. There were more than 800 environmental projects initiated between 1990 and 2000 and a possible phosphorus reduction of 16.5 tonnes was noted [LSEMS 2003]. Phase III was underway between 2001 and 2007 with an increased effort in public awareness, reducing water pollution and protecting the natural heritage features of the lake. Of the 392 remedial projects in the agriculture and urban program, $4.9 million was invested to reduce 1.5 tonnes of phosphorus at a cost reduction of $3.3 million per tonne. [LSEMS 2007]

The Assimilative Capacity Study 2006 indicated that a target of 75 tonnes of phosphorus (maximum annual loading) would need to be achieved to restore a self-sustaining coldwater fishery in Lake Simcoe. The cost to implement the target reduction through best practices is estimated at $163 million [LSEMS 2007]. The current budget for the Lake Simcoe Region Conservation Authority is $1.4 million per year [LSEMS 2007].

The Lake Simcoe Environmental Management Strategy (LSEMS) has formed the following mission:

> *"To improve and protect the health of the Lake Simcoe watershed ecosystem and improve associated recreational opportunities by:*
>
> - *Restoring a self-sustaining coldwater fishery;*
> - *Improving water quality;*
> - *Reducing phosphorus loads to Lake Simcoe; and*
> - *Protecting natural heritage features and functions."*

The list of partners for the Lake Simcoe Environmental Management Strategy includes:

- Chippewas of Georgina First Nations
- Department of Fisheries and Oceans
- Ministry of Agriculture and Food
- Ministry of the Environment
- Ministry of Municipal Affairs and Housing
- Ministry of Natural Resources
- Regional Municipality of Durham
- Regional Municipality of York
- County of Simcoe
- City of Barrie
- City of Kawartha Lakes
- City of Orillia
- Town of Bradford West Gwillimbury
- Town of Innisfil
- Town of New Tecumseth
- Township of Oro-Medonte
- Township of Ramara
- Lake Simcoe Region Conservation Authority
- Lake Simcoe Region Conservation Foundation

The list of partners is extensive, focusing primarily on agencies with jurisdictions within the watershed. As a policy initiative, it is recommended that the list of partners also take on the following resources:

1. The U.S. Environmental Protection Agency (EPA) – The EPA has established the National Emission Standards for Hazardous Air Pollutants for Iron and

Steel Foundries in 2004 (EPA 2004). Standards were implemented under Section 12 (d) of the *Federal Clean Air Act* to address hazardous air pollutants resulting from the production of iron and steel. The focus for the standards is towards the emissions of heavy metals and organic compounds that cause adverse health effects involving the central nervous system, respiratory problems and cancer. Achievable control technologies for phosphorous removal were not implemented and the health effects of atmospheric phosphorous were not identified. Environmental impacts of atmospheric phosphorous is within the EPA's sphere of responsibility so their cooperation as a resource with LSEMS would be beneficial.

2. Environment Canada – To investigate socioeconomic and environmental impacts, Environment Canada has set aside $68,000 to hire experts to study the possibility of a total ban on phosphorus in dish detergents and cleaning products. This report is expected to be released in May 2008. Quebec and Manitoba have announced plans to limit phosphates in dishwasher detergents to 0.5% by 2010 and have lobbied Ottawa to do the same. The banning of phosphorus in dish detergents and cleaning products has the ability of reducing sewer treatment phosphorus influent by 52% [LSRCA]. Environment Canada would be an important resource in establishing a ban on phosphorus in dish detergents and cleaning products.

It is estimated that before the European settlers had inhabited the Lake Simcoe watershed area in year 1800, there was 30 tonnes of phosphorus naturally entering Lake Simcoe. Present day phosphorus loading is estimated to be 102 tonnes, broken down from the following 1998 sources (LSEMS 2003):

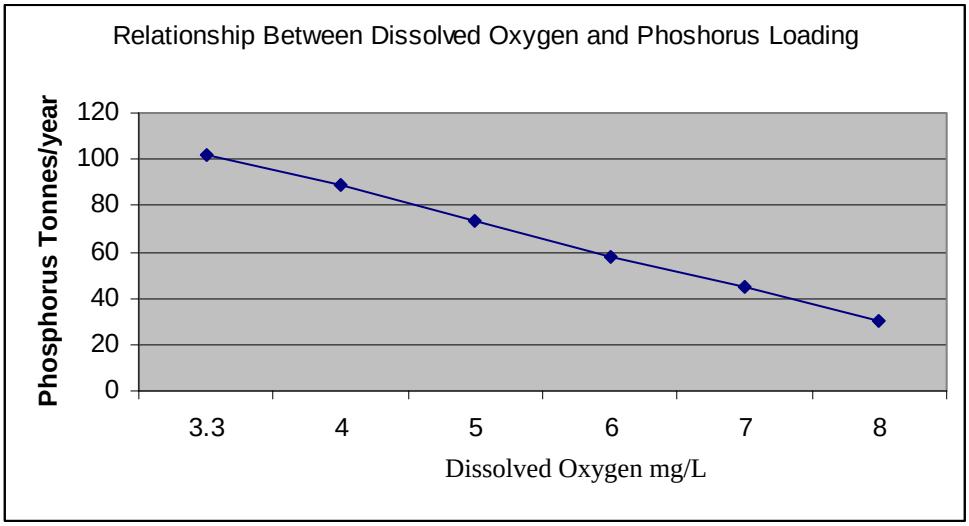
- Atmospheric 40.1 tonnes
- Tributary 27.6 tonnes
- Urban Runoff 21.9 tonnes
- Sewage Treatment Plants 5.7 tonnes
- Vegetable Polder 5.6 tonnes

The relationship between dissolved oxygen and phosphorus loading rate has been calculated by [Winter, J.,] as follows:

DO = dissolved oxygen (mg/L)

P_L = phosphorus loading rate (metric T/yr)

$DO = 10.73 - 0.94 * P_L + 0.0002 * P_L$



Source: Winter, J.

While the goal is to reduce phosphorus loading from 100 tonnes per year to 75 tonnes per year, the dissolved oxygen concentration will increase from 3.3 mg/L to 5 mg/L. It is estimated that in year 1800, natural deposition of phosphorus was 30 tonnes per year with dissolved oxygen of 8 mg/L. The goal of reaching 5 mg/L is not ideal and will only sustain 50% of the natural coldwater fishery [LSEMS 2005]. Dissolved oxygen levels of 7mg/L or higher is necessary for the "minimal impairment of activity" [LSEMS 2005]. By referring to the relationship between dissolved oxygen and phosphorus loading, the total phosphorus loading must be reduced to 45 tonnes per year. Therefore, in order to meet the strategy for *Restoring a self-sustaining coldwater fishery*, atmospheric phosphorus deposition must be addressed and, on-going support of the natural coldwater fishery will need to continue in the form of fish stocking and/or hypolimnion aeration.

Ontario Water Resources Act, Proposed Regulation 010-2246

1. Proposed Regulation

"The Ontario Ministry of Environment is proposing a regulation under the Ontario Water Resources Act (OWRA). The proposed regulation will govern point source discharges in the Lake Simcoe Basin for the purpose of controlling total phosphorus loadings into the Lake from those facilities. Although this proposed regulation focuses on point sources of phosphorus that are currently regulated, it is recognized that the long-term strategy for Lake Simcoe will need to address all sources of phosphorus, both those that are currently regulated and those that are not. The regulation loading limits will be in place from the time the regulation takes effect until March 31, 2009 during which time the Government intends to develop a comprehensive framework to provide for the long-term management of both point sources and non-point sources within the Basin."[Ontario Water Resources Act]

The proposed regulation states that the existing 15 sewage treatment plants within the Lake Simcoe watershed basin have combined certificates of approval for the maximum annual discharge of 12.5 tonnes of phosphorus each year. It is proposed that the maximum allowable permitted phosphorus loading be no greater than 7.5 tonnes per year. The permitted loading is therefore reduced by 5 tonnes per year on aggregate.

The proposed regulation places a prohibition any new sewage treatment plants that will result in additional phosphorus discharge to the Lake Simcoe basin which would be in effect until March 31, 2009.

The proposed regulation places a restriction on the establishment of any new stormwater management facilities that do not meet the "enhanced protection level" in Chapter 3 of the Ministry's Stormwater Management Planning and Design Manual 2003. This regulation would not apply to new stormwater facilities in existing or small infill developments and would be in effect until March 31, 2009.

2. Problem Definition

The Canadian Council of Ministers of the Environment has released a notice of consultation on the draft Canada-wide strategy for the management of municipal wastewater effluent (CCME). The response regarding site-specific treatment costs is as follows:

"Source control is the preferred method to address the majority of substances. This could involve imposition of sewer use controls through a municipal sewer use bylaw and/or targeted best management practices which could be used by industrial, commercial and industrial users who discharge to the sewer system."

Since 52% of sewer system phosphorus can be attributed to dishwasher detergents and cleaning agents [LSRCA], the preferred method is to remove these sources and not treat the phosphorus through the municipal wastewater treatment facilities. The proposed reduction of phosphorus discharge from sewage treatment plants without source control is contrary to the Canada-wide strategy and is not recommended.

3. Problem Analysis

If sewage treatment plant phosphorus limits are set below those required for future growth requirements, then development charges will include marginal treatment capacity and improvements. The cost of improving the entire base facility will be born by all existing customers under Bill 175, *The Sustainable Water and Sewage Systems Act*, who may be unwilling to pay for plant improvements for the benefit of growth. The problem definition here does not clearly and precisely define the cost and effectiveness and any unintended negative consequences. With land developers and homeowners being cost adverse, the following three outcomes are possible:

1. Developers could redirect their focus on urban areas outside of the Lake Simcoe watershed area and subsequently push the phosphorus problem to other demographic jurisdictions.

2. Developers could redirect their focus onto rural settlement areas within the Lake Simcoe watershed area with the use of septic systems. This would require larger lots and would subsequently be contrary to the intensification guideline as identified in the *Places to Grow Act*.

3. The Ministry of Municipal Affairs and Housing could regionalize water and wastewater servicing within the County of Simcoe. Water and wastewater transmission pipes could be built from South Simcoe to Georgian Bay or to York Region's 'big pipe' from Newmarket to Lake Ontario and divert the phosphorus problem to the Great Lakes. The Watertight Report 2005, made to Hon. David Caplan, Minister of Public Infrastructure Renewal promotes the possibility of regionalized water and wasterwater services with Recommendation 4.9:

   The Municipal Act should be amended to give all Regional Municipalities exclusive jurisdiction over all elements of the water and wastewater sector. [Watertight]

   The Intergovernmental Action Plan 2006 recommends a "Consolidated Public Works: Water and Wastewater services and Assimilative Capacity Study Model through a Two Tier delivery", which again quantifies the possibility of regionalized water and wastewater services [IGAP].

The cost for retrofitting existing sewer treatment plants will be born by existing users who may not approve such expenditures for the main benefit of facilitating urban growth. As noted in the three outcomes, by decreasing sewage treatment phosphorus limits, the phosphorus problem is not solved, only redirected.

4. Policy Execution

The population of the watershed was estimated to be 382,887 in 2001 and is expected to grow to over 500k by 2021, [LSEMS 2003]. Assuming that both the populations from 2001 and 2021 were within serviced settlements (worst case), then the impact means a 30% increase in phosphorus loading from sewage treatment plants. Annual sewage treatment plant loading of 5.7 tonnes [LSEMS 2003] x 1.3 is 7.4 tonnes, which basically meets the 7.5 tonne limit proposed. The proposed regulation would therefore not have any effect for at least 13 years.

With the majority of phosphorus disposition coming from the atmosphere, the regulation requiring that proposed stormwater management facilities will meet the "enhanced protection level" as specified in chapter 3 of the Ministry's Stormwater Management Planning and Design Manual 2003 is recommended. It is recommended that the regulation also apply to the construction of new stormwater facilities that are designed to service existing development and new small infill developments within an existing development.

Sources of Phosphorus Loading

Soaps

Historically, soaps have been made from wood ashes and animal fats. Animal fats were boiled to render the oil. Wood ash was dissolved in water making a lye solution. The lye, oil and salt were boiled together then cooled into hard soap. Synthetic petroleum based detergents were introduced in the U.S. in 1946. Phosphorus was added in 1953 when it became known that it dramatically improved the detergent's performance. Phosphorus is still used in dishwater detergent because of its ability to reduce mineral levels in the water and to prevent food particles from sticking on to the dishes. Synthetic detergents have virtually replaced all soap-based products for laundry, dishes and household cleaning.

Monitoring studies from Ontario's Ministry of the Environment has led Canada to be the first country to ban phosphorus in laundry detergents.[1] Nitrilotriacetic acid is now used as a phosphorus substitute, which has been shown to bacterially breakdown in water. The Province of Manitoba has already introduced legislation to ban dishwasher detergents containing phosphates by 2010 [CBC News Nov 29, 2007].

The Canadian Consumer Specialty Products Association (CCSPA), representing companies that produce 86 per cent of the household automatic dish detergent sold in Canada, have worked with the province of Manitoba to prepare for the ban.

"Our members are committed to the July 2010 timeline and will ensure that all Canadians continue to have access to safe and efficacious products," said Shannon Coombs, president of CCSPA, in a release" [CBC News Nov 29, 2007]. The other policy incentives for banning phosphorus in dish detergent and cleaning products is that it is low cost to users, there is perceived public acceptance, it is easily implemented and it has immediate effect.

[1] Fisheries and Oceans Canada

Atmospheric

Atmospheric deposition of phosphorus onto the Lake Simcoe watershed has been monitored since 1995. Bulk precipitation collectors regularly monitored phosphorus deposition and the results were extrapolated over the surface area of the lake. The total phosphorus load calculated in 1998 was 40.1 tonnes [LSEMS 2003]. It was estimated that 62% of the atmospheric phosphorus came from dry deposition (local sources) and the remainder came from wet deposition (not local sources). With the lake occupying 20% of the watershed, it can be extrapolated that 200 tonnes of phosphorus comes from atmospheric deposition. Of that, 76 tonnes would originate from none local sources.

There are five theories for the causes of the dry deposition of phosphorus into lake Simcoe. The impacts of agricultural have been noted in [LSEMS 2003] from conventional tillage where the tiling of the soil leads to soil degradation and erosion. The harrowing of fields does contribute to atmospheric dust, which would be exposed to phosphorus through the fertilisation process. The recommended practice is the no-till system whereby the soil is not disturbed between crops.

Other land use activities contributing to atmospheric phosphorus pollution as noted in [LSEMS 2003] includes logging, urban development, gravel pits, quarries and gravel roads. Particles lifted by wind erosion are transported over relatively short distances and constitute direct input to the Lake Simcoe watershed. There was no supporting data in LSEMS 2003 quantifying the source of the atmospheric phosphorus deposition so other sources were investigated.

Phosphorus is removed from steel and iron during production and then added back in as required to create the desired metallurgical characteristics. Sulphur, carbon, nitrogen and phosphorus is removed during the steel making process. Phosphorus is a deleterious contaminant in steel and iron by virtue of its ability of decreasing ductility and increasing strength and hardness of steel so its concentration is controlled to low levels.

There is 87 million tons of iron ore produced in Canada and the U.S. annually (U.S. Geological Survey 2006). Although concentrations of iron and phosphorus differs within different ore deposits, the following concentrations are used for analysis purposes, [Iron Ore], [Steel Making] & [Springerlink]:

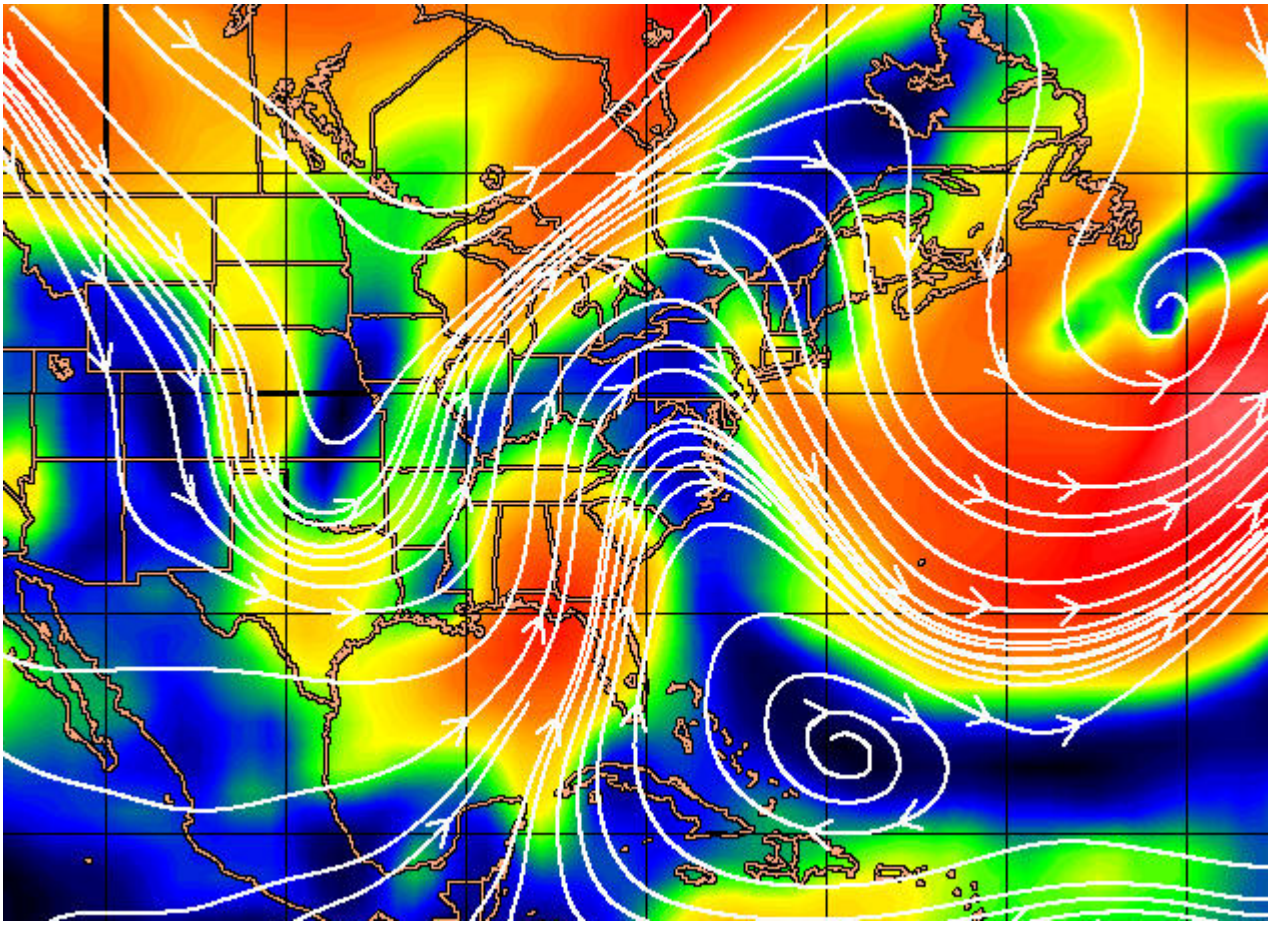
- Iron ore contains 66% iron.
- Iron ore contains 1.12% phosphorus
- Acid and alkali iron ore leaching removes 91.6% of the phosphorus down to .25%
- Levels of phosphorus in iron above .12% can sacrifice the shock resistance of the metal.
- The minimum amount of phosphorus removed during the smelting process is .13%.

Annual Iron ore produced in Canada/U.S.	87,000,000 tons
Phosphorus removal (.13%)	113,000 tons
Conversion to metric tonnes (.907)	102,000 tonnes

The recycling of steel uses only 75% of the energy required to make steel from iron ore. The recycling one ton of steel saves 55 kilograms of limestone, 1,100 kilograms of iron ore and 630 kilograms of coal. During the smelting process for iron ore, iron oxide is used to oxidise the phosphorus in the ore. The melting of recycled steel includes iron oxide so natural phosphorus oxidation will occur. If only the removal of .05% of phosphorus is removed during the recycling process, then the following amounts of phosphorus will be removed:

Annual steel recycled in Canada/U.S.	93,000,000 tons
[Steel making] & [CSPA]	
Estimated phosphorous removal (.05%)	46,000 tons
Conversion to metric tonnes (.907)	42,000 tonnes

Sample Prevailing Wind Map of North America



Source: http://cimss.ssec.wisc.edu/tropic/real-

It is estimated that the North American steel industry produces somewhere in the magnitude of ~ 140,000 tonnes of phosphorus into the atmosphere. The amount of atmospheric phosphorus depositing on the Lake Simcoe Watershed area is estimated to be 200 tonnes. The sample prevailing wind map above indicates that it is likely that the deposition of atmospheric phosphorus into Lake Simcoe could come from the industrial intensive zones of Ohio, Indiana, Illinois, Michigan and Ontario. Cross country and cross border cooperation needs to occur if border limits are self imposed for phosphor source reductions which may involve emission scrubbers at facility stacks.

Recreational Effects

Although one of the stated reasons for phosphorus reductions is for the enhancement of lake related recreational activities, it is the following recreational activities that add to the environmental stress:

- Shoreline erosion caused by boat wakes.
- Grey and black water discharge from the 6,000 transient boaters passing through the Trent-Severn waterway system. [LSEMS 2003].
- Dumping of garbage in and around the lake, and
- The discharge of antifreeze from boat engines into the waterways.

All pollution attributes listed above are difficult to deter by enforcement. Federal law prohibits boats from exceeding 10km/h within 30m of shore to help reduce shoreline erosion caused by boat wakes. As policy initiatives, fines for polluting could be increased along with the increase in public education.


Source: http://www.cigaretteracing.com/

The un-mufflered engines of 'cigarette boats' generate another form of pollution on Lake Simcoe. One boat screaming down the lake can affect the recreational enjoyment of thousands of people due to the sound attenuation capabilities of the lake water surface. Although there are no speed restrictions on the lake away from the shoreline, the speed is not the problem; it's the noise. As a policy initiative, vessel exhaust sound levels should be restricted to 90 decibels at 50 feet as has been accomplished in Chapter 327.65 of Florida Statutes. With verification from adequate stakeholder consultation, this initiative could be considered for the quiet enjoyment by all lakeside recreational users, especially the 12,000 cottages surrounding Lake Simcoe.

Sewage Treatment Plants

The 15 sewage treatment plants within the Lake Simcoe watershed have an average annual phosphorus loading of 5.7 tonnes [LSEMS 2003]. The Ontario Ministry of the Environment has tabled a proposed a phosphorus limit of 7.5 tonnes. Adjusting for anticipated growth within the Lake Simcoe watershed, the phosphorus loading is expected to grow to 7.4 tonnes.

Private Septic Systems

Of the 12,000 dwellings around the Lake Simcoe shoreline, a 5% failure rate of the private septic systems has been estimated with an annual phosphorus loading of 2.2 tonnes [LSEMS 2001]. As a policy initiative, local municipalities could initiate mandatory septic system inspections and certifications with the costs being born by the respective dwelling owners. The Town of Georgina (2001-2006) had placed 2,200 lakeside residences onto municipal services and decommissioned the private septic systems. The total cost was $54 million for a reduction of 1.2 tonnes of phosphorus at a cost reduction of $45 million per tonne.

Household Sources

The following chart was sourced from the Lake Simcoe Region Conservation Authority.

Put Your Household on a "Low-P" Diet

Compare How Much Phosphorus Used, in these two households, in just 90 days			
Phosphorus Source Grams Used	**Recomended Changes =**	**Fewer Grams Into Lake Simcoe!**	
Human waste	535 g	Human waste	535 g
One Load of Dishes, in the Dishwater, per day... using powdered detergent	650 g	Switching to phosphate-free detergent	0 g
Fertilizing a 30mx30m lawn, once per year, with a fertilizer containing 10 percent of each of the following: nitrogen, phosphorus and potassium	1,960 g	No Fertilizer	0 g
Lot cleared of trees increases runoff	30 g	Leave trees standing	20 g
Using commercial household cleaners	180 g	Using Phosphate-free household products	20 g
Total Phosphorus Load	3,355 g	Total Phosphorus Load	575 g

Source: LSRCA

The three sources of household phosphorus includes human waste, dishwater detergent and household cleaners. A ban of phosphate free dish detergents would provide the following immediate reduction in point source sewage treatment plant phosphorus:

Source	Phosphorus
Human Waste	535 grams
Dishwater detergent	650 grams
Household Cleaners	180 grams
Total	1,365 grams
Reduction of dishwater detergent	650 grams
Reduction of household cleaners	160 grams
Total	**710 grams**

A phosphorus influent reduction of 52% is possible through the ban of phosphorus in dish detergents and other household cleaners.

Phosphorus in Sediments

Suspended phosphorus released from locked in lake-bottom sediments has been estimated at 1.3 tonne [LSEMS 2005]. As other external sources of phosphorus are reduced, the relative importance of phosphorus released from sediments increases.

Phosphorus Reductions

Zebra Mussels

With the introduction of zebra mussels into Lake Simcoe in 1995, the levels of phytoplankton biovolume has declined significantly over the following 20-year period:

Year	Phytoplankton Biovolume
1980-1982	334 - 1387 mm^3/m^3
2000-2002	179 – 390 mm^3/m^3

In almost every year between 1983 and 2003, records indicate that minimum deepwater dissolved oxygen levels have increased which could be as a consequence of decreased phytoplankton biovolume [LSEMS 2005].

Zebra mussel effects recorded for Lake Erie (1997 as compared to the late 1980's), show total summer phosphorus declines of 30-50% [LSEMS 1998]. The same impact was less dramatic in Lake Simcoe due to the delayed arrival of that particular invasive species. As a policy initiative, the effects of zebra mussels on phosphorus should be investigated since dense populations of zebra mussels have developed over the past decade. The investigation could identify if there is a phosphorus sequestering effect by the volume of water filtered by the zebra mussels and therefore could re-align LSEMS strategy.

Phosphorus reduction in Laundry Detergents

Awareness of lake eutrophication in the 1960's has driven the Canadian federal government in limiting the phosphorus content in laundry detergents to 20% in 1970 and 5% in 1973 [LSEMS 2001]. Current phosphorus limits have been set at 2.2% in laundry detergents. Phosphate alternatives that are used include such compounds as, sodium carbonate, sodium silicate, zeolite A and citrates [Macintosh H.,]. The Canadian

Automobile Association Quebec (CAA), publishes a list of phosphate free detergents and cleaning agents [CAA Quebec].

Newmarket & Aurora effluent redirect to Lake Ontario

In 1984, the Towns of Newmarket and Aurora had redirected their treated sewage effluent from the Holland River to Lake Ontario. There had been a noticeable improvement in phosphorus discharge into the Holland River but a large reserve of phosphorus was noted in the sediment of the river from decades of phosphorus discharge. The rate of phosphorus decline in the Holland River between 1984 and 1997 was measured at .0005 mg/L/year. At this rate of decline, it would take approximately 35 years to reduce concentrations to Ministry of the Environment recommended levels of .03 mg/L unless measures are introduced to extract the phosphorus from the sediment. [LSEMS 1998].

Duck Weed

It is estimated that the harvesting of duck weed from the Holland River removes ½ tonne of phosphorus from direct application into the watershed [LSEMS 1991 B5]. The duckweed must be harvested otherwise the decomposing material would leach back into the watershed. Duckweed has the following attributes:

- ✓ Has a nutritional value close to soya beans;
- ✓ High profit potential if sold/used in secondary processes; ;
- ✓ Effective at removing metals;
- ✓ Can be used for animal fodder and green fertiliser;
- ✓ N and P are sequestered and removed by harvesting the plants;
- ✓ Algae growth is suppressed since the rhizomes produce algae killing secretions and compete for sunlight;
- ✓ Effectively remove COD, BOD and TSS. A longer retention time is required, but it can remove nitrogen and phosphorous.
- ✓ Metals can be removed as well as fecal coliforms.
- ✓ Plants can be harvested in large enough amounts to make the operation cost effective, i.e., biomass can be sold for animal forage or fish feed.
- ✓ Suppresses mosquitoes.

Source: http://en.wikipedia.org/wiki/Duck_weed

Duckweed could also be used for soil amendment to provide conditioning and organic matter to mineral soils. Possible commercial value could be realised with duck weed through public private partnership. As a policy recommendation, the use of duckweed should be studied with regard to tributary abatement and storm water retention ponds.

Hypolimnion Aeration

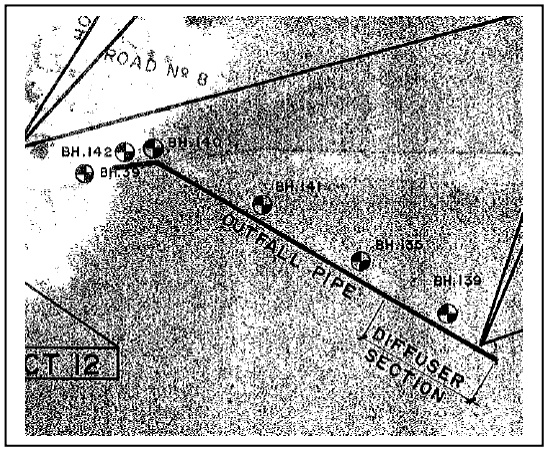
J. Neil from Limnos Limited had prepared a report for the LSEMS Technical Committee in August 1990 [LSEMS 1991]. Two systems were evaluated as having the potential to add and distribute the required oxygen to the cold waters of Lake Simcoe by means of hypolimnion aeration. One was the Locher "Mountain Creek" system which was designed by the Swiss and effectively used in Europe in a number of smaller lakes. Oxygen enriched water was supplied to the lake bottom where needed to enrich the depleted waters. This system would operate year round. The technology is known and the efficacy of the system has been demonstrated.

The second system investigated is similar to the "Thames Bubbler" which is used in the Thames River in London England. A dual pump mechanism would inject oxygen enriched water from a vessel to

depths several meters above the lake bottom. This system would not operate during the winter months
and would therefore require extended aeration during summer months.

The *Thames Bubbler* is 50m long and 10m wide and was launched in 1989. It was built at a cost of £3.5m ($7m Can) and costs £0.25m ($0.5m Can) to operate annually. A second similar sized vessel named the *Thames Vitality* was launched in 1997. "[The Thames] is actually an environmental success story but it's not well known in this country," said Steve Colclough, a fisheries specialist at the Environment Agency [Griffiths, E.]

J. Neil estimates that 1,200 tonnes of oxygen would be required in Kempenfelt Bay and a further 3,600 tonnes of oxygen in the open water basin in order to achieve the Ministry objective of 5mg/l during the summer. The annual costs over a 20-year lifecycle for each system was estimated by Neil to be $350k in 1990 dollars. Utilising a 3% annual inflation rate, it translates into $540k in 2008 dollars. The report recommends the aeration treatment of Kempenfelt bay first and then further study the efficacy of oxygenating the larger lake basin.

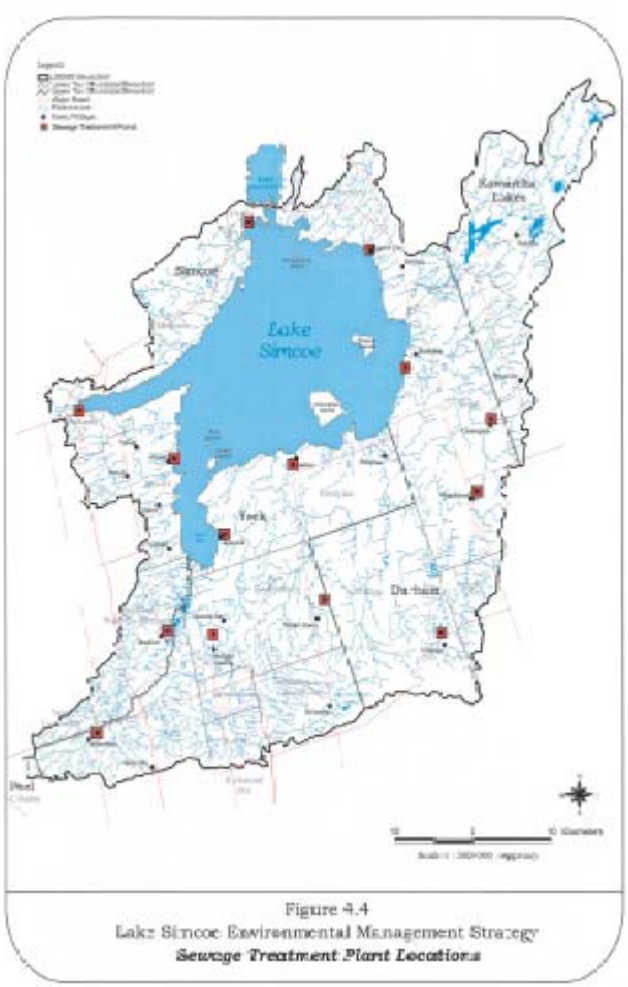


Sport fish such as whitefish and lake trout require a temperature ranging between 7-12ºC. This temperature range is evident in the lake at depths below 18m. The most cost effective approach could be achieved by the utilisation of the existing infrastructure at the Barrie wastewater treatment plant for the initial hypolimnion aeration phase of Kempenfelt Bay. Wastewater effluent is being discharged into Kempenfelt Bay at a rate of 52,000 cubic meters per day and at depths below 18m. An estimated 12T/day of oxygen are required to bring the dissolved oxygen level to 5mg/L. The cost estimate in 1990 dollars for oxygen, electricity and maintenance was $140k. Utilizing a 3% annual

inflation rate, it translates into $215k in 2008 dollars. A typical out-fall pipe is shown with the diffuser section out in deeper water.

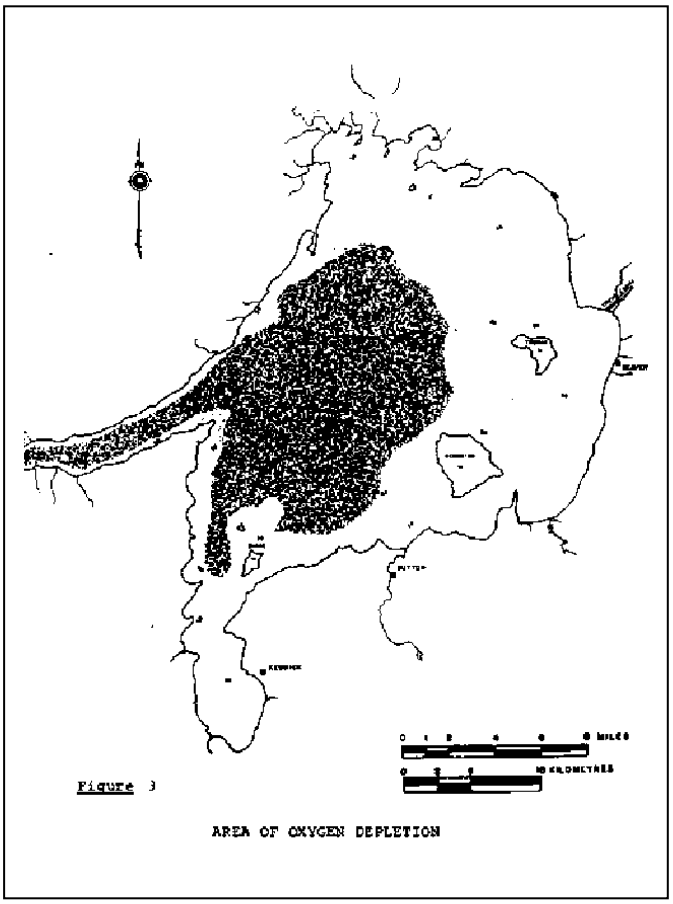
LSEMS is working towards a goal of reducing the phosphorus loading into Lake Simcoe from 100 annual tonnes to 75 annual tonnes. This reduction would theoretically increase the cold water dissolved oxygen level to 5mg/l, which would facilitate a 50% survival rate for natural cold water fish reproduction. It is evident that what the lake really needs is more dissolved oxygen at 18m depths where cold water fish habituate. A solution for low dissolved oxygen levels in artificial fish habitats has been successfully implemented by the means of mechanical hypolimnion aeration.

It is recommended that the Ministry of the Environment and the Department of Fisheries and Oceans fund research into the development and deployment of oxygenating sewage treatment plant effluent that could provide immediate relief for the hypolimnion aeration of the lake. The cost and effectiveness of hypolimnion aeration can be used to evaluate the cost benefit of future policy initiatives directed at reducing phosphorus at the source.
The following two maps indicate the area of oxygen depletion and the locations of the area sewage treatment plants. For hypolimnion aeration of the open water basin, the wastewater plants of Innisfil and Sutton could be utilized.



Source: LSEMS 2003

Lake Simcoe Wastewater Treatment Plants



Source: LSEMS 1991

Lake Simcoe Area of Oxygen Depletion

Recommended Policy Summary

The following public policy recommendations have been provided for consideration:

Regulation Proposal Notice: EBR Registry Number: 010-2246

- The reduction of permitted loading for sewage treatment plants from 12.5 tonnes to 7.5 tonnes is not recommended as a permanent solution because the problem will not be abated, only relocated.
- It is recommended that the Ontario Ministry of the Environment work with Environment Canada to ban the use of phosphorus in dishwater detergents and household cleaning agents for a possible 52% reduction in sewage treatment plant phosphorus influent.
- It is recommended that the Ministry of the Environment research into the sources of atmospheric phosphorus and should focus the research on the North American steel industry that emits ~ 140,000 tonnes of phosphorus into the atmosphere. A bilateral phosphorus reduction agreement would benefit the Great Lakes.
- With the majority of phosphorus disposition coming from the atmosphere, it is recommended that new stormwater management facilities will meet the "enhanced protection level" as specified in chapter 3 of the Ministry's Stormwater Management Planning and Design Manual 2003.
- It is recommended that the regulation also apply to the construction of new stormwater facilities that are designed to service existing development and new small infill developments within an existing development.

LSEMS

- LSEMS should include as one of their resources, the U.S. Environmental Protection Agency (EPA), to establish a National Emission Standards for phosphorus pollutants from iron and steel foundries.

- LSEMS should include as one of their resources, Environment Canada for the banning of phosphorus in detergents and cleaning products which has the ability of reducing sewer treatment plant phosphorus influent by 52%.
- It is recommended to research into the effective use of duck weed for the abatement of phosphorus from stormwater runoff.

Other Agencies

- It is recommended that the DFO consider public consultation to restrict vessel exhaust sound levels to 90 decibels at 50 feet as has been accomplished in Chapter 327.65 of Florida Statutes as a means to "promote recreational activities and the health of the lake".
- It is recommended that the DFO investigate the effects of zebra mussels on phosphorus concentrations in the lake.
- It is recommended that fines for polluting lakes should be investigated and possibly increased along with an increase in public education.
- It is recommended that local Municipalities or a Provincial By-law initiate mandatory lake side septic system inspections and certifications with the costs being born by the respective dwelling owners.
- It is recommended that the aeration treatment of Kempenfelt bay through Barrie's sewer treatment plant effluent discharge be investigated along with a further study of the efficacy of oxygenating the larger lake basin.

Conclusion

It is evident that the desired Lake Simcoe Phosphorus loading reduction from 100 tonnes per year to 75 tonnes per year will not completely facilitate the natural coldwater fish reproduction cycle. Until the source of atmospheric phosphorus is determined and abated, supplemental support to maintain the coldwater fish population will still be required. The most cost effective means is to continue the fish stocking program which could be supplemented by hypolimnion aeration through existing sewer system plant effluent discharge.

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Appendix 1

Regulation Proposal Notice: EBR Registry Number: 010-2246
Title: Regulation under the Ontario Water Resources Act for the Protection of Lake Simcoe

Ministry: Ministry of the Environment

Date Proposal loaded to the Registry: December 06, 2007 Keyword(s): Water
Related Act(s): Ontario Water Resources Act, R.S.O. 1990
Comment Period: 60 days: submissions may be made between December 06, 2007 and February 04, 2008.
Description of Regulation:

The Ontario Ministry of Environment is proposing a regulation under the Ontario Water Resources Act (OWRA). The proposed regulation will govern point source discharges in the Lake Simcoe Basin for the purpose of controlling total phosphorus loadings into the Lake from those facilities. Although this proposed regulation focuses on point sources of phosphorus that are currently regulated, it is recognized that the long-term strategy for Lake Simcoe will need to address all sources of phosphorus, both those that are currently regulated and those that are not. The regulation loading limits will be in place from the time the regulation takes effect until March 31, 2009 during which time the Government intends to develop a comprehensive framework to provide for the long-term management of both point sources and non-point sources within the Basin.

The proposed regulation will define the Lake Simcoe Basin as including Lake Simcoe and the lands and waters of Ontario which drain into Lake Simcoe. A copy of a map of the Lake Simcoe Drainage Basin is attached. However, it is proposed that the definition in the regulation would be used to determine the extent of the regulation, not the map.

Phosphorus Loading Limits for Existing Sewage Treatment Plants

The proposed regulation would impose a rolling 12-month phosphorus loading limit on each of the 14 existing municipal sewage treatment plants and the one industrial sewage treatment plant located in the Lake Simcoe Basin that contributes phosphorus to the Lake. The proposed regulation would apply from the date it comes into effect until March 31st, 2009. Each of these plants is governed by a sewage works approval issued under section 53 of the Act. The approval for each plant contains detailed requirements for monitoring and reporting, and discharge limits, including phosphorus loading limits. The proposed new phosphorus loading limit for each plant would be listed in the regulation. The proposed loading limits for phosphorus imposed by the regulation would be in addition to any requirements in the plant's approval; meaning all other provisions of a plant's approval would continue to apply.

The phosphorus loading limit that would be imposed on each plant is to be based on the following two parameters. The first parameter is the projected flow of sewage that is anticipated at the sewage treatment plant for any 12-month period from the time the regulation takes effect until March 31, 2009. A small margin would be added to this value to accommodate any planned development requiring sewage capacity shortly after this period (i.e. development proposals that already have appropriate approvals). The projected flow amount for each sewage treatment plant will be based on a historical analysis of the actual flow data for that plant as reported to the Ministry and information relating to short-term capacity requirements. The intent of this approach is to set strict limits and at the same time ensure that adequate capacity is available only to service approved and existing development while a long-term Lake Simcoe strategy is developed.

The second parameter is the plant's engineering design concentration for phosphorus. This concentration is the level of performance that the sewage treatment plant is designed to achieve. A phosphorus loading limit that is based on the plant's engineering design concentration will ensure that the plant is operated in a manner that, on average, removes the amount of phosphorus that the treatment technology has the capacity to reliably achieve.

The two parameters, flow and phosphorus concentration, will then be multiplied together to derive the 12-month phosphorus loading limit for each of the 15 sewage treatment plants. For many of the 15 sewage treatment plants, the new phosphorus loading limits will be significantly lower than the enforceable limits currently specified in approvals.

Taken collectively, the 15 existing sewage treatment plants within the Basin are legally permitted under their current respective OWRA sewage works approvals to discharge up to 12.5 tonnes of phosphorus each year. As an interim cap, it is proposed that the new basin-wide permitted aggregate phosphorus loading for these existing sewage treatment plants be no greater than 7.5 tonnes/year for the period of the regulation, a reduction in permitted loading of approximately 5.0 tonnes/year for that period.

The proposed regulation will require the operator of each of the existing sewage treatment plants to record the total amount of phosphorus discharged from the plant during each month the regulation is in effect. The proposed regulation will require that such information be kept at the plant and be provided to a provincial officer upon request. The proposed regulation will require the operator of each of the existing sewage treatment plants to prepare and submit a report to the Director (i.e. Ministry of the Environment District Manager) by June 30, 2009 that sets out each monthly phosphorus loading amount for the period of the regulation and the total phosphorus loading amount from the plant during each 12-month period encompassed by the effective period of the regulation (i.e. rolling 12-month total loadings). This report would have to be prepared in a form and manner approved by the Director.

Prohibition on New Sewage Treatment Plants

The proposed regulation will prohibit the Director from issuing an approval under section 53 of the Act for the establishment of a new sewage treatment plant within the Lake Simcoe Basin that discharges sewage to the surface waters of the Basin, if the discharge from the plant will result in the addition of phosphorus loadings to the waters of the Basin. This prohibition will cover applications for an approval to establish a new sewage treatment plant by any person, including the Crown and a municipality. This provision would be in effect until March 31, 2009.

New Stormwater Management Facilities That Serve New Development

The proposed regulation will place a restriction on the Director's authority to issue an approval under section 53 for the establishment of a new sewage works designed to manage stormwater from a new development within the Lake Simcoe Basin. The regulation would restrict the Director from issuing an approval for such proposed stormwater management facilities unless the Director is satisfied that the proposed facilities will meet the "enhanced protection level" specified in chapter 3 of the Ministry's Stormwater Management Planning and Design Manual 2003. The "enhanced protection level" is the highest protection level that is mandated by the Manual for a stormwater management facility. This provision of the proposed regulation would not apply to the construction of new stormwater facilities that are designed to service existing development or a new small infill development within an existing development. This provision would be in effect until March 31, 2009.

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Purpose of Regulation:

The proposed regulation will govern point source discharges in the Lake Simcoe Basin for the purpose of controlling total phosphorus loadings into the Lake from those facilities. The regulation will govern point source discharges in the Lake Simcoe Basin in three ways. First, it will limit the phosphorus loadings from existing municipal and industrial sewage treatment plants within the Basin. Second, it will prohibit the Director from approving the establishment of a new municipal or industrial sewage treatment plant in the Basin. Third, it will impose stringent performance standards on new stormwater facilities that service new developments located in the Basin.

Other Information:

Ontario is committed to taking strong action to protect the health of Lake Simcoe, and in doing so:

- build on the good science and planning work already done by the province, municipalities, the Lake Simcoe Region Conservation Authority, and community groups;

- set strict limits on pollutants such as phosphorus;
- require stringent sewage treatment;
- implement a long-term governance structure that supports comprehensive Lake Simcoe environmental protection; and
- promote recreational opportunities while protecting the health of the lake.

The government will develop and implement this initiative in cooperation with First Nations, municipalities, the conservation authority, local residents, cottagers, farmers, environment groups, developers, and the tourism industry.

Background on Lake Simcoe

Lake Simcoe is located in central, southern Ontario in close proximity to more than half the population of the province. Aside from the Great Lakes, it is the largest lake in southern Ontario. Lake Simcoe is a complex ecosystem that is home to 58 different warm and coldwater fish species, as well as many other species. In addition to being a significant natural heritage feature, Lake Simcoe supports a thriving tourism industry and provides many recreational opportunities. The lake also provides drinking water for municipalities and is used to assimilate treated wastewater.

The drainage basin, or the area of land which drains into the lake, sweeps north from the Oak Ridges Moraine through parts of York and Durham Regions, the Cities of Kawartha Lakes, Orillia, and Barrie, and the County of Simcoe, crossing 23 municipalities. The drainage basin is home to over 350,000 permanent residents and an estimated 50,000 cottagers.

Scientific studies in the 1970s and 80s by the Ministry of the Environment, the Ministry of Natural Resources, the Ministry of Agriculture, Food, and Rural Affairs, and the Lake Simcoe Region Conservation Authority identified phosphorus enrichment of the lake as a key water quality problem. Phosphorus inputs from urban stormwater runoff, sewage treatment plant effluents, agricultural practices and other sources, caused prolific growth of aquatic plants and algae and resulted in levels of dissolved oxygen in the water which were too low to support the successful natural reproduction of cold water fish, such as lake trout, lake whitefish, and lake herring.

In response, in 1990, the Lake Simcoe Environmental Management Strategy (LSEMS) partnership was initiated. The goal of the LSEMS is to improve and protect the health of the Lake Simcoe watershed ecosystem and improve associated recreational opportunities by:

- Restoring self sustaining coldwater fisheries,
- Improving water quality,
- Reducing phosphorus loads to Lake Simcoe, and
- Protecting natural heritage features and functions.

Since its inception, the LSEMS has made steady progress:

- lake water quality targets for phosphorus and dissolved oxygen have been established;
- the amount of phosphorus entering the lake each year has been reduced;
- levels of dissolved oxygen in the lake's deep water zones (critical for cold water fish survival) have increased; and
- there is evidence that a small number of naturally produced wild lake trout are able to survive.

However, the cold water fishery is still not able to sustain itself naturally. Aquatic plants can accumulate at waterfront areas, beaches, and marinas and, in excess, can have negative impacts on recreational activities. Invasive species, such as zebra mussels, have altered the way the lake ecosystem functions.

In order to further improve the health of the Lake, phosphorus levels need to further decrease. Future population growth that is planned within the Lake Simcoe Basin could add additional stress to the lake ecosystem. Recent studies have modeled potential phosphorus increases to the lake and tributaries from planned development and indicate the need for comprehensive basin-wide management of phosphorus. Without such management it is expected that phosphorus levels in Lake Simcoe will increase, eliminating the progress made in recent years.

Developing a Lake Simcoe Strategy

Over the next year, the Ministry will be developing its strategy to protect Lake Simcoe, including considering elements that may be incorporated into Lake Simcoe protection legislation. The province will engage First Nations in this initiative. The province will also consult with municipalities, the Lake Simcoe Region Conservation Authority, local residents, cottagers, farmers, environment groups, developers, and the tourism industry, providing opportunities for all parties to provide ideas and concerns, and to become involved in developing this strategy. The province is establishing a science advisory panel and intends to establish a multi-stakeholder working group to assist in this task. Details about the consultation process and opportunities for involvement will be provided early in 2008.

While this strategy is being developed, the Ministry of the Environment is proposing to take interim actions to prevent deterioration of the Lake. One of these interim actions is to place limits on point sources of phosphorus into Lake Simcoe and its basin tributaries, specifically on municipal and industrial sewage treatment plants. The interim actions would also prohibit the establishment of new industrial or municipal sewage treatment plants in the Basin and impose standards on new stormwater facilities that service new developments located in the Basin. The Ministry is also moving forward on several studies supporting long-term management of non-point sources of phosphorus. Taken together these form an interim approach to managing sources of phosphorus entering Lake Simcoe.

The Lake Simcoe protection strategy being developed over the next year will seek to put in place a framework that protects the quality and quantity of Lake Simcoe waters and supports a healthy lake ecosystem. As part of this framework, phosphorus management will be addressed in a comprehensive manner, not only including municipal and industrial sewage discharges, but also setting out strategies to address urban and rural run-off, septic systems and other sources of phosphorus. Strategies could include regulatory controls, remedial programs, nutrient off-setting or trading programs and other management tools. Interim limits on phosphorus loadings that may be put in place would also be reviewed through development of this strategy.

The Ministry of the Environment is currently seeking comment on the proposal to place in regulation interim limits on point sources of phosphorus within the Lake Simcoe Basin.
Public Consultation:

This proposal has been posted for a 60 day public review and comment period starting December 06, 2007. If you have any questions, or would like to submit your comments, please do so by February 04, 2008 to the individual listed under "Contact". Additionally, you may submit your comments on-line.

All comments received prior to February 04, 2008 will be considered as part of the decision-making process by the Ministry of the Environment if they are submitted in writing or electronically using the form provided in this notice and reference EBR Registry number 010-2246.

Please Note: All comments and submissions received will become part of the public record. You will not receive a formal response to your comment, however, relevant comments received as part of the public participation process for this proposal will be considered by the decision maker for this proposal.