Hutchinson
Environmental Sciences Ltd.

Lakeshore Capacity Assessment for Eagle Lake, Township of Machar

Prepared for: The Township of Machar
Job #: J130001

May 6, 2013

3-1 Taylor Road, Bracebridge, ON P1L 1S6 | 705-645-0021

Hutchinson
Environmental Sciences Ltd.

3-1 Taylor Road, Bracebridge, ON P1L 1S6 | 705-645-0021

May 6, 2013 HESL Job #: J130001

Brenda Paul, Clerk-Administrator
The Township of Machar
PO Box 70
73 Municipal Road North
South River, ON P0A 1X0

Dear Ms. Paul:

Re: Lakeshore Capacity Assessment for Eagle Lake, Township of Machar

We are pleased to submit this report that assesses the capacity of Eagle Lake for additional shoreline development based on the Ontario Ministry of the Environment's (MOE's) Lakeshore Capacity Assessment. Our analysis concludes that both basins of Eagle Lake are presently over capacity with respect to total phosphorus concentration and the MOE would recommend against further development within 300 m of the lake's shoreline.

Please do not hesitate to contact me if you have any questions concerning the development of such planning policies or the results of the study.

Sincerely,

Hutchinson Environmental Sciences Ltd.

Brent Parsons, M.Sc.
brent.parsons@environmentalsciences.ca

Signatures

Report prepared by:

Brent Parsons, M.Sc.
Aquatic Scientist

Report reviewed by:

Neil J. Hutchinson, Ph.D.
Principal Scientist

Report reviewed by:

Tammy Karst-Riddoch, Ph.D.
Senior Aquatic Scientist

Executive Summary

The Province's Lakeshore Capacity Model was used to assess the capacity of Eagle Lake for shoreline development. Using the assumptions and coefficients recommended in the Province's guidance, the model predicts existing spring total phosphorus (TP) concentration to within 10% of the long-term measured concentrations of 8.1 μg/L and 6.6 μg/L for the north and south basins of the lake, respectively, and the model is therefore considered to provide reasonable TP estimates to assess shoreline capacity and develop site-specific water quality objectives. Background TP concentration without human development in the watershed is modeled to be 3.5 μg/L and 2.5 μg/L for the north and south basins, respectively. The revised Provincial Water Quality Objective ([PWQO] background plus 50%) is therefore 5.3 μg/L for the north basin and 4.2 μg/L for the south basin. The modeled and measured TP concentrations for existing conditions exceed the PWQO for both basins of Eagle Lake and as such, they would be considered over capacity for additional lot development. Both basins are also considered to be highly sensitive to phosphorus loading based on an assessment following methods of the District Municipality of Muskoka. The Province would not recommend approval of new lot creation unless specific criteria are met, as defined by the Province, to ensure that there is no potential for a net increase in TP loading to either basin of the lake.

Table of Contents

List of Figures

List of Tables

Appendices

1. Introduction

The Township of Machar, in partnership with the Eagle Lake Conservation Association (ELCA), retained Hutchinson Environmental Sciences Limited (HESL) to assess the capacity of Eagle Lake for shoreline development following the Province's recommended approach in the Shoreline Capacity Assessment Handbook (MOE et al. 2010). This approach uses a mass balance model, "the Lakeshore Capacity Model", to estimate total phosphorus concentrations in lakes on the Precambrian Shield. The model can be used to predict 'background', or 'undeveloped' total phosphorus (TP) concentrations and how much shoreline development can occur while maintaining concentrations below the Provincial Water Quality Objective (PWQO). The revised PWQO for total phosphorus in lakes on the Precambrian Shield is modeled 'background' plus 50%.

The Lakeshore Capacity Model is a variant of the original Ministry of the Environment's (MOE) Lakeshore Capacity Study Trophic Status Model (Dillon et al. 1986), which has been substantially reworked and updated over the years to reflect improved scientific understanding of phosphorus loads to lakes and lake responses to those loads (Hutchinson 2002; Paterson et al. 2006). The model is a steady-state mass balance model that estimates hydrologic and phosphorus loading from natural (watershed runoff and atmospheric deposition) and human (septic systems and land disturbance) sources for all lakes within a watershed and links them together considering lake dynamics to predict TP concentrations in lakes.

A lake sensitivity analysis was also completed on Eagle Lake to see how it responds to phosphorus inputs and to provide an additional layer of information with which to make management decisions. In order to complete the sensitivity analysis we applied a standard areal load of TP and assessed lake "responsiveness" based on the basis of percentage change in modeled TP concentration. This approach has been utilized by the District of Muskoka since 2005 and has proven to be an important component of their Lake System Health Program.

The following capacity assessment for Eagle Lake uses the assumptions and recommended coefficients and constants provided by the Province of Ontario (MOE et al. 2010), development data from the Township of Machar, and site-specific input data for lake and watershed characteristics from Arc Hydro and the Provincial Digital Elevation Model.

2. Background Data

2.1 Water Quality Reports

A number of water quality studies have been completed on Eagle Lake, including *Microbiological Water Quality of Eagle Lake* (Ministry of Environment, 1979) and *Water Quality and Fish Habitat Status* (Knight Piesold Consulting, 2000). These reports were reviewed and provided excellent context within which to consider and discuss the results of the Lakeshore Capacity Model.

2.2 Input data

Input data required for the model were obtained from a variety of sources as listed in Table 1.

Table 1. Information on the data used in the Lakeshore Capacity Assessment

Type of Data	Inputs	Reference	Source
Physical	Area for: lakes, catchments, wetland, forest, bare soil	Arc Hydro and Provincial Digital Elevation Model	ESRI, Ministry of Natural Resources
Development	Lots and occupancies	Assessment Records	Township of Machar
Water chemistry	Total phosphorus	Lake Partner Program	Ministry of the Environment
Hydrological	Annual runoff	Runoff Lookup Database	Ministry of Environment

3. Site Description

Eagle Lake is a headwater lake of the Magnetawan River (Georgian Bay) watershed located on the Precambrian Shield in the Township of Machar, west of the Village of South River (Figure 1). The lake comprises two distinct basins separated by a narrow channel which was created following a bridge replacement. Water flows from the north basin to the south basin, which outlets to Distress Creek and the Magnetewan River further downstream.

The north and south basins of Eagle Lake have different surface areas, watershed areas and land cover characteristics (Figure 2; Table 2). Land cover in the watershed is predominantly forest in both watersheds, (north = 69%, south = 58%), with cleared land representing only 12% of the land area in both catchments. Wetland comprises 2% of the land cover in the northern watershed and only 0.64% of the southern watershed.

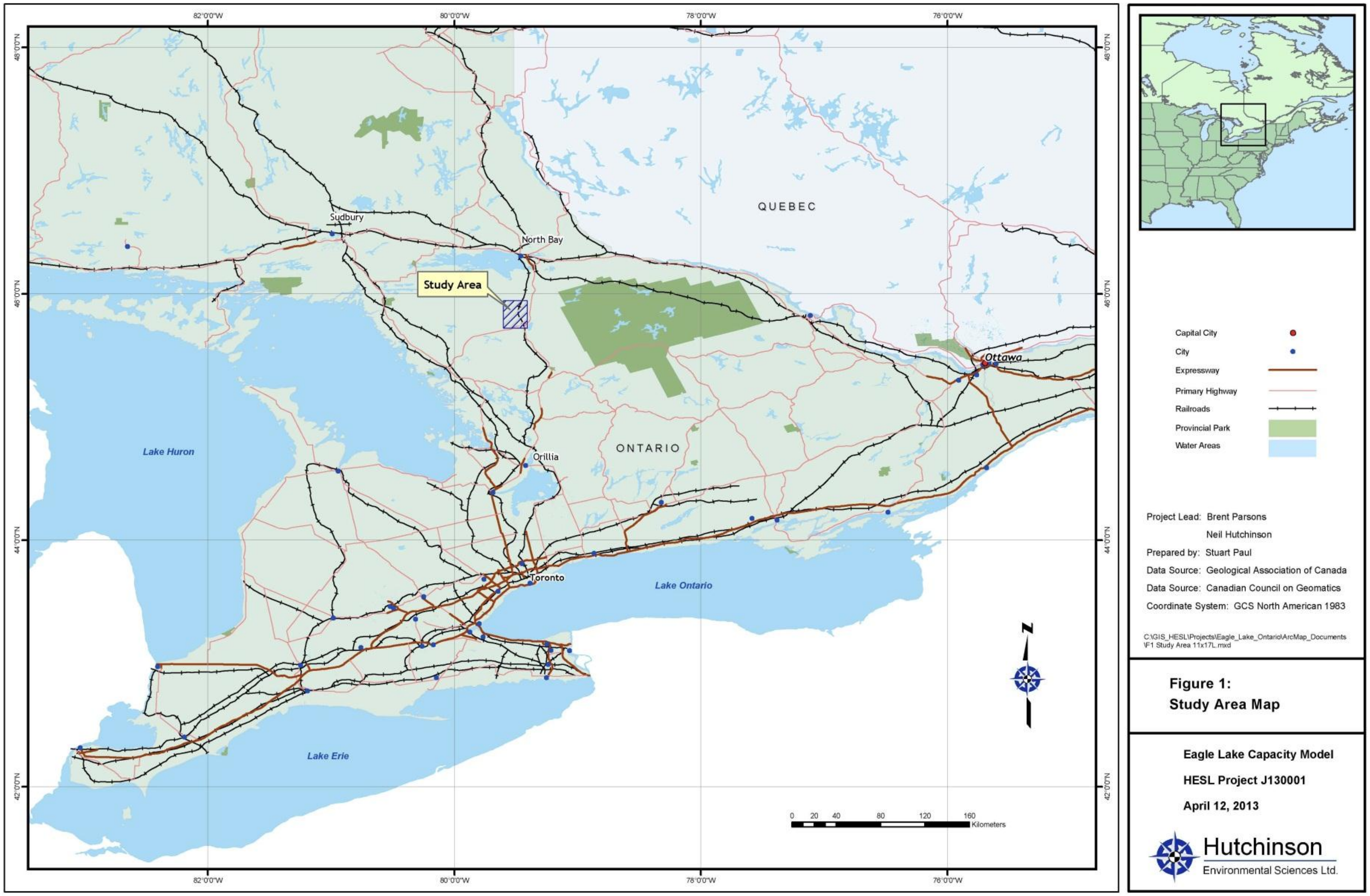


Figure 1. Location of Eagle Lake, Township of Machar.

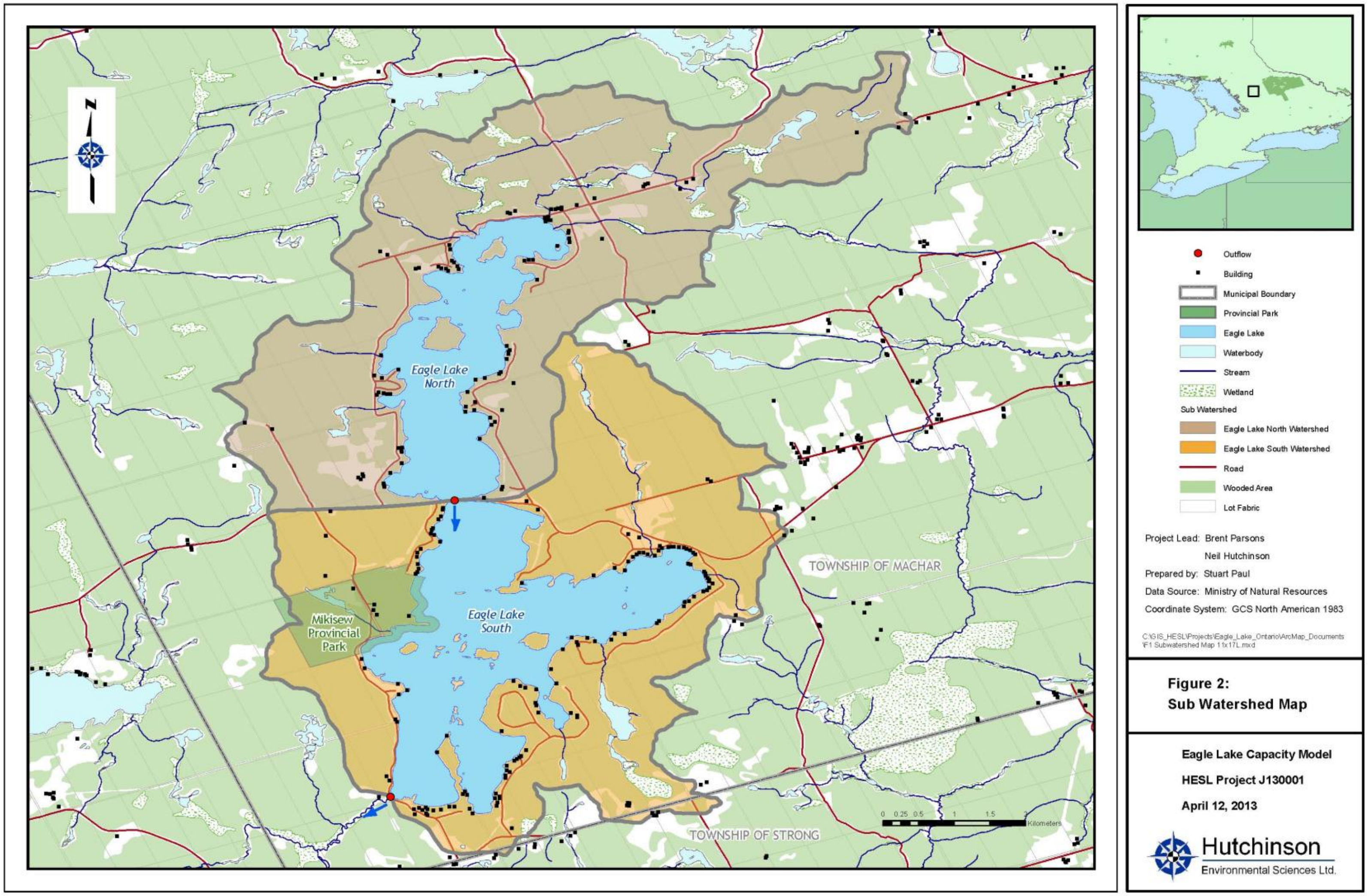


Figure 2. Watershed mapping for the north and south basins of Eagle Lake.

Table 2. Lake and watershed land cover areas

Area (ha)		North Basin	South Basin	Total
Watershed	Forest	1,334 (69%)	1,240 (58%)	2,574
	Wetland	41 (2%)	14 (0.64%)	55
	Cleared Land	232 (12%)	258 (12%)	490
	Mikisew Provincial Park	0 (0%)	130 (6.1%)	130
	Total	1,607	1,642	3,249
Lake Surface		335	608	943

The northern basin is smaller (335 ha) and shallower (maximum depth ~10 m) than the southern basin (608 ha and ~30m). There are a total of 534 lots on the lake's shoreline including 244 on the northern basin and 290 on the southern basin (Township of Machar, 2005). Development information was categorized as recreation, residential, mixed residential and other, tourist commercial, other, vacant, Mikisew Provincial Park and Township by the Township of Machar. These categories were broken into the following occupancy categories: extended seasonal, permanent, vacant, Rainbow Resort and Mikisew Provincial Park (Table 3). Residential, Mixed residential and other, other and Township categories were all treated as permanent residences as part of a conservative approach because permanent residences have the highest usage rate (2.56 capita years/year). A few vacant lots (10%) were subtracted from the dataset to reflect unbuildable vacant lots as per lot requirements in By-Law 13-86.

Table 3. Occupancy of lots on Eagle Lake

Occupancy	No. of Lots		
	North Basin	South Basin	Total
Seasonal	128	164	292
Permanent	63	63	126
Vacant	48	53	111
Rainbow Resort	0	6	6
Mikisew Provincial Park	0	265	265
Total	244	550	794

Phosphorus data is available for both basins and at various times of year in Eagle Lake from 1978 to 2012 as part of MOE's Lake Partner Program. We focused on spring TP measurements and modeling results because for many lakes the long-term trend is described better by spring turnover TP than by ice-free volume because it is easier to standardize sampling at spring overturn (Clark et al. 2010). Spring overturn TP data was available from 1984 to 1990 and 2002 to 2012. Data from 2002 onwards is considered more accurate because of improvements in collection methodologies such as field filtering and sampling directly into glass tubes that are later used during laboratory analysis. The MOE still considers TP data collected pre-2002 to be appropriate to calculate a long term mean so we have used that data for comparison with modeled TP results but we have not used it for trend analysis as the differences in collection methodology could outweigh water quality trends.

The average mean spring TP concentration is higher in the northern basin than the southern basin from 1984 to 1990 and from 2002 to 2012 (Table 4). Phosphorus concentrations in the northern basin were significantly lower in the 2002 to 2012 period than from 1984 to 1990 (T-Test, p = 0.006), while those in the south basin were lower but the difference was not statistically significant (T-Test, p = 0.453). Declining trends in TP concentrations have been observed over that period in many Precambrian Shield lakes, including undeveloped lakes, and are thought to reflect changes in climate and drought, and responses to acidic deposition (Clark et al. 2010, Palmer et. al. 2011).

Table 4. Spring TP concentrations in Eagle Lake 1984-2012 (Lake Partner Program Data)

Date	North Basin	South Basin
29-Apr-84	11	7
05-May-85	7	2.5*
05-May-86	9	7
10-May-87	10	5
03-May-88	10	8
16-May-89	10	11
15-May-90	10	9
Average (1984-1990)	9.57	7.07
20-May-02	10	7
19-May-03	6	5
23-May-05	7	6
22-May-06	8	-
21-May-07	8	6
19-May-08	7	10
18-May-09	5	5
17-May-10	6	7
21-May-11	7	5
21-May-12	9	5
Average (2002-2012)	7.01	6.29
Average (All Years)	8.06	6.63

Notes:

- * Value was less than the laboratory's reportable detection limit and therefore a value of 1/2 of the reportable detection limit was used.
- - Data not available

4. Lakeshore Capacity Assessment

4.1 Approach

Eagle Lake was modeled using the Lakeshore Capacity Model following the Province's guidance in the Lakeshore Capacity Handbook (MOE et al. 2010). The two basins of the lake (north basin and south basin) were modeled separately because they are distinct basins separated by a narrow channel that was created when the original bridge was replaced (ELCA 2007). This prevents complete mixing between the basins and as such, they would be expected to respond differently to TP loads due to basin-specific lake and watershed characteristics.

Input parameters and calculation results used to model TP concentrations in the basins of Eagle Lake are provided in Appendix A. Detailed methods and assumptions of the model are provided in MOE et al. (2010). The following provides a description and brief rationale for the selection of various coefficients and assumptions used in the model for the north and south basins of Eagle Lake:

- TP loading from land area in the watershed was determined using an overland coefficient of 5.5 mg TP/m^2/yr because % wetland was less than 3.5% and % cleared land was less than 15% in each watershed.
- A TP loading rate of 0.167 kg/ha/yr was used to calculate TP loads to the surface of the basins from atmospheric deposition.
- Mean annual runoff of 0.528 m/yr was determined from the runoff look up table provided by the MOE and used to calculate water loads to each basin.
- TP loads from septic systems located within 300 m of the shoreline of each basin were calculated assuming a loading rate of 0.66 kg/capita/year for each septic system and no potential for TP retention by soils. For existing conditions, a septic usage rate of 2.56 capita yrs/yr was used for permanent residences and the 'extended seasonal' usage of 1.27 capita yrs/yr was used for seasonal residences as there is reliable year-round access to the lake. For full build-out of presently vacant lots, TP loads were calculated assuming the same ratio of seasonal:permanent residences and corresponding usage rates (i.e., 1.27 capita yrs/yr and 2.56 capita yrs/yr) that currently exists on each basin.
- TP measurements taken from near the lake bottom do not reflect significant internal phosphorus loading due to anoxia and both basins are sufficiently deep(>5 m deep) to stratify during the open water season. Phosphorus retention in the basins was therefore calculated using the settling velocity of 12.4 m/yr which was developed for stratified lakes that do not have an anoxic hypolimnion (Dillon et al. 1986).

The resulting modeled spring TP concentration under existing conditions is 7.7 μg/L for the north basin and 6.0 μg/L for the south basin. These modeled values are within 4% and 10% of the long-term measured concentrations of 8.1 μg/L and 6.6 μg/L for the north and south basins, respectively, and the model is therefore considered to provide good TP estimates to assess shoreline capacity.

4.2 Capacity Assessment

The modeled background TP concentrations for Eagle Lake were 3.5 and 2.8 μg/L for the north and south basins, respectively. The PWQO (background plus 50%) is therefore 5.3 μg/L for the north basin and 4.2 μg/L for the south basin. Both the modeled and measured TP concentrations exceed the PWQO under existing conditions (Table 5). Full build-out conditions of existing lots of record to extended seasonal and permanent occupancy in the same ratio as currently exists would increase TP concentrations to 10.1 μg/L (189% over background) in the north basin and to 7.7 μg/L (173% over background) in the south basin.

Table 5. Modeled and measured spring TP concentrations for Eagle Lake

Scenario	North Basin	South Basin
Background Total Phosphorus (μg/L)	3.5	2.8
PWQO (Background plus 50%) (μg/L)	5.3	4.2
Existing Modeled Total Phosphorus (μg/L)	7.7	6.0
Existing Measured Total Phosphorus (μg/L)	8.1	6.6
% difference between modeled and measured:	*-3.98*	*-9.17*
With Full Build-out of Existing Lots Total Phosphorus (μg/L)	10.1	7.7
% Increase over Background (existing):	*120*	*113*
% Increase over Background (full build-out):	*189*	*173*

Both basins of Eagle Lake exceed the PWQO with existing and full build-out of existing vacant shoreline lots based on both measured and modeled TP and would therefore be considered as over capacity for additional lot creation within 300 m of the lake's shoreline.

Existing phosphorus loads are calculated to be greater than 50% over the background loads (**Table 6**) further supporting the conclusion that Eagle Lake is over capacity for shoreline development.

Table 6. Summary of TP loads to Eagle Lake

Scenario	North Basin	South Basin
Background Total Phosphorus Load (kg/yr)	18.57	21.23
Existing Total Phosphorus Load (kg/yr)	67.93	68.72
With Full Build-out of Existing Lots Total Phosphorus Load (kg/L)	73.17	78.52
% Increase over Background (existing):	*144*	*141*

% Increase over Background (full build-out):	*225*	*217*

For lakes that are over capacity, the Province (MOE et al. 2010) recommends that no new lot creation be approved within 300 m of the lake except in the following circumstances:

- *"To separate existing habitable dwellings, each of which is on a lot that is capable of supporting a Class 4 sewage system provided that the land use would not change and there would be no net increase in phosphorus loading to the lake;*
- *Where all new tile fields would be located such that they would drain into a drainage basin which is not at capacity, or*
- *Where all new tile fields would be set back at least 300 m from the shoreline of lakes, or such that drainage from the tile fields would flow at least 300 m to the lake"* and,

Where municipal planning tools and agreements are in place such as a Development Permit System under the Planning Act, and/or site plan control under the Planning Act, and site alteration and tree-cutting by-laws under the Municipal Act, the following additional criteria can be applied as exceptions to allow new lot creation on over capacity lakes:

- *"Where a site-specific soils investigation prepared by a qualified professional has been completed showing the following site conditions:*
  - *The site where the septic tile-bed is to be located, and the region below and 15 m down-gradient of this site, toward the lakeshore or a permanently-flowing tributary, across the full width of the tile bed, consist of deep (more than three meters), native and undisturbed, non-calcareous (<1% $CaCO_3$ equivalent by weight) overburden with acid-extractable concentrations of iron and aluminium of >1% equivalent by weight (following Robertson 2005, 2006, Appendix B). Soil depth shall be assessed with test pits and/or boreholes at several sites. Samples for soils chemistry should be taken at a depth adjacent to, or below, the proposed tile bed; and*
  - *An unsaturated zone of at least 1.5 m depth exists between the tile bed and the shallowest depth (maximum) extent of the water table. The position of the water table shall be assessed with test pits during the periods of maximum soils saturation (e.g., in the spring, following snowmelt, or late fall)"*

We note, however, that these Provincial criteria for allowable development have been successfully challenged at the Ontario Municipal Board on the basis of documentation of effective phosphorus abatement techniques. Nevertheless, the degree of exceedance of the PWQO seen in Eagle Lake, and the close correspondence between measured and modeled estimates of TP concentrations provide confidence that the modeling conclusions and recommendations presented herein are robust and defensible.

4.3 Lake Sensitivity

Lake sensitivity is the degree to which a lake will respond to the addition of phosphorus and is a function of such attributes as the lake size, shape, surface area and flow of water. Use of a standard loading of phosphorus for a lake allows lake sensitivities to be classified and compared between lakes.

Lake sensitivity was assessed by modeling each lake basin with a standard density of development - a standard load of phosphorus to the surface area of each lake. A development density of 1 lot/1.62 ha of lake surface area (and associated phosphorus load) was modeled. This density was chosen as the “filter” used by several Ontario municipalities as a “crowding” or social density filter to reflect recreational use of lake surface areas. The absolute and percent increase in TP concentration resulting from addition of a standard areal load for each lake was determined. No phosphorus load from the upstream basin was applied to the southern basin, as the intent was to determine lake response independent of the source of phosphorus.

The Lake System Health Program of the District Municipality of Muskoka, classifies lakes as having high, medium or low sensitivity to phosphorus loading based on the following scale:

< 40% change - Low Responsiveness
40 to 80% change - Moderate Responsiveness
> 80% change - High Responsiveness

Background +50% TP concentrations and loads calculated for each basin using the Lake Capacity Model were compared to the TP concentrations and loads presented in Table 7. Both basins proved to be highly responsive to TP as the TP concentrations were >80% than the background +50% concentrations. This indicates that Eagle Lake is sensitive to increased phosphorus loadings, will respond to them and should be managed accordingly.

Table 7. Input data and results of the lake responsiveness exercise

Data	**North Basin**	**South Basin**
# Lots/1.62 ha	209	380
TP Load (kg/yr)	175	318
TP (µg/L)	10.3	7.8
Responsiveness (%)	254	246
Responsiveness Class	High	High

5. Conclusions

The modeled and measured TP values in Eagle Lake exceed background + 50% and the lake is highly sensitive to TP inputs. Following the provincial guidance, both basins of Eagle Lake are considered to be over capacity for shoreline development with respect to TP concentration under existing conditions. The Province would not recommend approval of new lot creation unless specific criteria are met, as defined by the Province, to ensure that there is no potential for a net increase in TP loading to either basin of the lake. Development of vacant lots should be done with close attention paid to minimize the potential for water quality degradation. The Township of Machar's Official Plan (2012) includes provisions for the preservation of shoreline vegetation and increased setbacks for sewage systems but other best management practices can be found in Protect your Waterfront Investment and Caring for your Septic System (Muskoka Watershed Council (Appendix B and C)).

Knight Piesold (2000) noted that TP had not increased over time. These findings were confirmed with more up to date data as spring TP concentrations exhibited declining trends in both the north ($y = -0.1911x + 8.062$ $R^2 = 0.12$) and south basins ($y = -0.0813 + 6.6979$, $R^2 = 0.02$) from 2002 to 2012 (Figure 3). Secchi disk depth collected as part of the Lake Partner Program also declined in both basins from 2002 to 2012 (Figure 3 (north basin: $y=-0.0821 + 4.6145$ $R^2 = 0.38$; south basin: $y=-0.0658x + 5.4382$ $R^2 = 0.191$)). The decline in Secchi disk depth is more likely related to increased concentrations of Dissolved Organic Carbon (Palmer et al. 2011), which reduces water clarity than changes in TP.

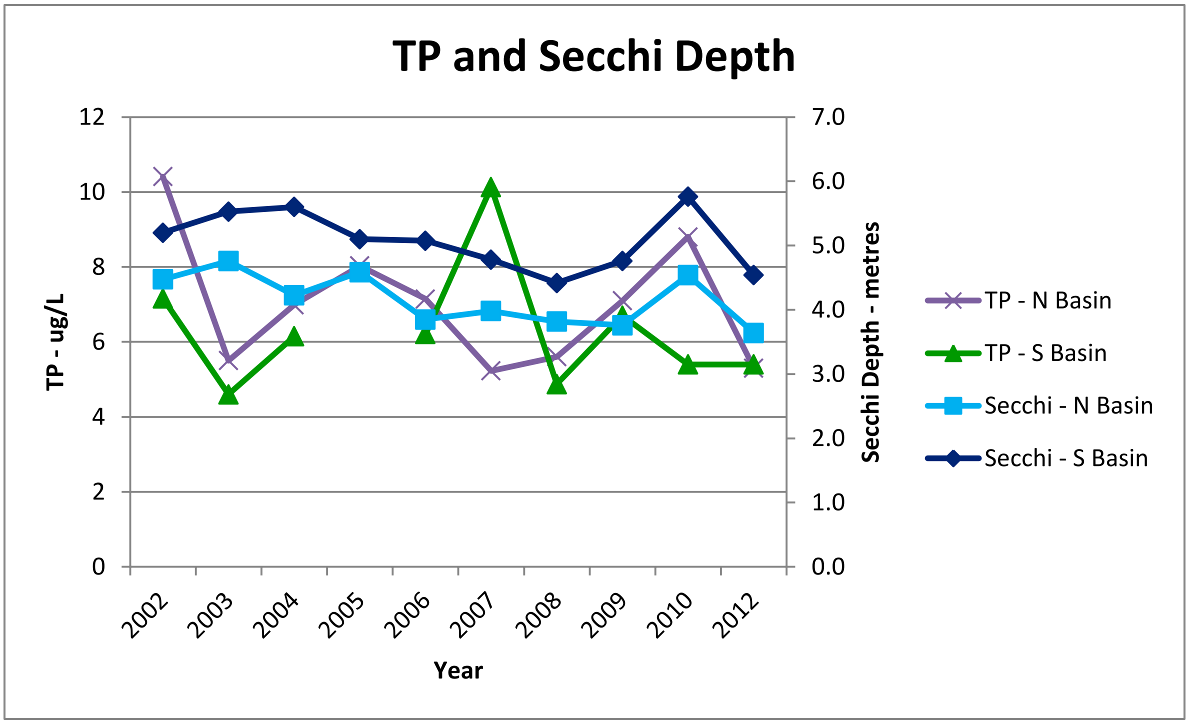


Figure 3. TP and Secchi Disk depth data in both basins in Eagle Lake from 2002 to 2012 (MOE Lake Partner Program).

Phosphorus trends indicate improving water quality conditions in Eagle Lake which could in part, reflect the various stewardship activities undertaken by residents and the ELCA. Phosphorus concentrations however remain appreciably elevated over background + 50% values and therefore stewardship activities aimed at reducing nutrient inputs such as the promotion of natural shorelines, upgrading of sewage treatment systems, and discouraging the use of fertilizers should continue to be promoted in addition to the development of appropriate development policies. Lastly, the water quality samples collected by ELCA, especially spring overturn TP concentrations have proven vital to the modeling exercise completed herein. The current monitoring program is suitable for the continued management of Eagle Lake but we recommend that Dissolved Organic Carbon is also sampled each year when the spring phosphorus samples are taken because it provides important information during the assessment of nutrient enrichment and water clarity.

6. References

Province of Ontario 2010. Lakeshore Capacity Assessment Handbook. Protecting Water Quality in Inland Lakes on Ontario's Precambrian Shield. Queen's Printer for Ontario. PIBS 7642e

Clark, B. J., Paterson, A. M., Jeziorski, A., and S. Kelsey, 2010. Assessing variability in total phosphorus measurements in Ontario lakes. Lake and Reservoir Management. 26:53-72.

Dillon, P.J., K.H. Nicholls, W.A. Scheider, N.D. Yan and D.S. Jeffries, 1986: Lakeshore Capacity Study, Trophic Status. Research and Special Projects Branch, Ontario Ministry of Municipal Affairs and Housing. Queen's Printer for Ontario. 89p.

Eagle Lake Conservation Association. 2007. Eaglke Lake Community Plan – Summary and Action Guide 2008.

Hutchinson, N.J., 2002: Limnology, plumbing and planning: Evaluation of nutrient-based limits to shoreline development in Precambrian Shield watersheds. In: R.L. France (ed). Handbook of Water Sensitive Planning and Design, CRC Press, London. Pp. 647-680.

Knight Piesold Consulting. 2000. Water Quality and Fish Habitat Status (Ref. No. D2388/1). North Bay, Ontario.

Paterson, A. M., P. J. Dillon, N. J. Hutchinson, M. N. Futter, B.J. Clark, R. B. Mills R. A. Reid and W. A. Scheider 2006: A review of the components, coefficients, and technical assumptions of Ontario's Lakeshore Capacity Model. Lake Reserv. Manage. 22: 7-18.

Palmer, M.E., N.D. Yan, A.M. Paterson and R.E. Girard. 2011. Water quality changes in south-central Ontario lakes and the role of local factors in regulating lake responses to regional stressors. Can. J. Fish. Aquat. Sci. 68: 1038-1050.

Township of Machar. 2005. Assessment Records. South River, Ontario.

Appendix A. Lakeshore Capacity Model Results for Eagle Lake

Lakeshore Capacity Model

Eagle Lake

input data	
constant/coefficient	
calculation	

		North Basin		South Basin	
Catchment					
Lake Area	ha	334.89		608.39	
Catchment Area (exluding lake)	ha	1,607.01		1381.84	
Wetland	%	2.12		0.64	
Forest (includes natural cleared area)	%	68.70		58.49	
Watershed Load					
Existing	kg/yr	88.39		76.00	
Background	kg/yr	88.39		76.00	
Atmospheric Deposition	kg/ha/yr	0.167		0.167	
Atmospheric Load	kg/yr	55.93		101.60	
Flow					
Mean Annual Runoff	m/yr	0.528		0.528	
Lake outflow (Q)	m3*yr-1	10,253,232		20,761,646	
Areal water load (qs)	m*yr-1	3.06		3.41	
Septics					
Septic Load Rate	kg/cap/yr	0.66		0.66	
Occupancy	Usage (cap yrs/yr)	Units	Load (kg/yr)	Units	Load (kg/yr)
Permanent	2.56	55	92.93	55	92.93
Extended Seasonal	1.27	128	107.29	164	137.46
Vacant	0	48	0.00	53	0.00
Rainbow Resort	1.18	0	0.00	6	4.67
Mikisew	0.37	0	0.00	265	64.71
Mixed residential/other	2.56	2	3.38	0	0.00
Other	2.56	5	8.45	6	10.14
Township	2.56	1	1.69	2	3.38
Total Existing		191	200.22	498	230.39
Total Full Buildout		239	315.26	551	360.81
Lots		Existing	Full Buildout	Existing	Full Buildout
Number of Developed		191	239	498	551
Load	kg/lot/yr	0.04	0.04	0.04	0.04

Lot Load	kg/yr	7.64	9.56		19.92	22.04	

Losses

Is the lake anoxic/shallow?	z_{mean} is 2.5 m	n			n
Settling Velocity	m/yr	12.4			12.4
In lake retention	prop.	0.802			0.784

Loading Summary

Source		Existing	Full Buildout	Background	Existing	Full Buildout	Background
Atmosphere	kg/yr	55.93	55.93	55.93	101.60	101.60	101.60
Runoff	kg/yr	88.39	88.39	88.39	76.00	76.00	76.00
Septic	kg/yr	200.22	315.26		230.39	360.81	
Lot Runoff	kg/yr	7.64	9.56		19.92	22.04	
Upstream Load	kg/yr	0.00	0.00	0.00	69.74	92.90	28.58
Total Load	kg/yr	352.17	469.13	144.31	497.65	653.35	206.18
Total Areal Loading rate	$mg/m^2/yr$	105.16	140.08	43.09	81.80	107.39	33.89
Total Export from Land	kg/ha/yr	0.18	0.26	0.06	0.29	0.40	0.08
Export Load to Downstream Lake	kg/yr	69.74	92.90	28.58	107.40	141.00	44.50

Modelled TP

		Existing	Full Buildout	Background	Existing	Full Buildout	Background
TPout	µg/L	6.8	9.1	2.8	5.2	6.8	2.1
TPlake	µg/L	7.1	9.5	2.9	5.4	7.1	2.2
TPso	µg/L	7.7	10.1	3.5	6.0	7.7	2.8

PWQO (background plus 50%)	µg/L			5.3			4.2

Mean Measured TPso	µg/L	8.1		6.6	
% Difference from measured	%	-3.98		-9.17	
% increase over background	%	120.72	188.65	112.99	173.35

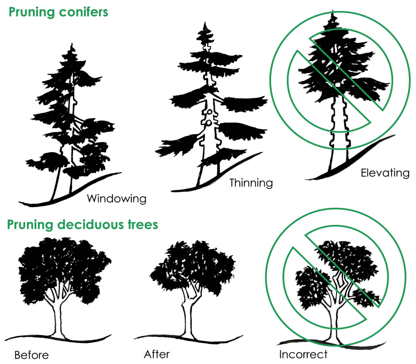
Appendix B. Protect your Waterfront Investment

Your shoreline insurance policy

Before you cut down trees or remove understory vegetation, think about how it will affect your investment.

1) *PLAN FOR NATURAL SUCCESSION* - young plants tend to be more resilient and will grow into your future trees so leave a healthy mix of young and old trees.

2) *PLAN YOUR VIEWS* - with proper pruning, you can obtain good views of the water while maintaining your shoreline buffer and your privacy. Improper pruning can weaken trees. If you are in any doubt, hire a tree specialist to prune and protect your investment.



3) *PROTECT YOUR SOIL* - native grasses and groundcover can be established in less shaded or more active areas to further enhance your buffer zone, reduce runoff and immobilize pollutants.

4) *INVEST IN YOUR PROPERTY* - manures, compost and fertilizers, should only be applied carefully or by qualified individuals and used only as a last resort to maintain optimum plant health.

Without a buffer zone, nutrients and toxic chemicals can be carried into your lake and contribute to water quality issues such as algae blooms. This decrease in water quality can reduce the value of your property by as much as 8.5%!

Where to find more information

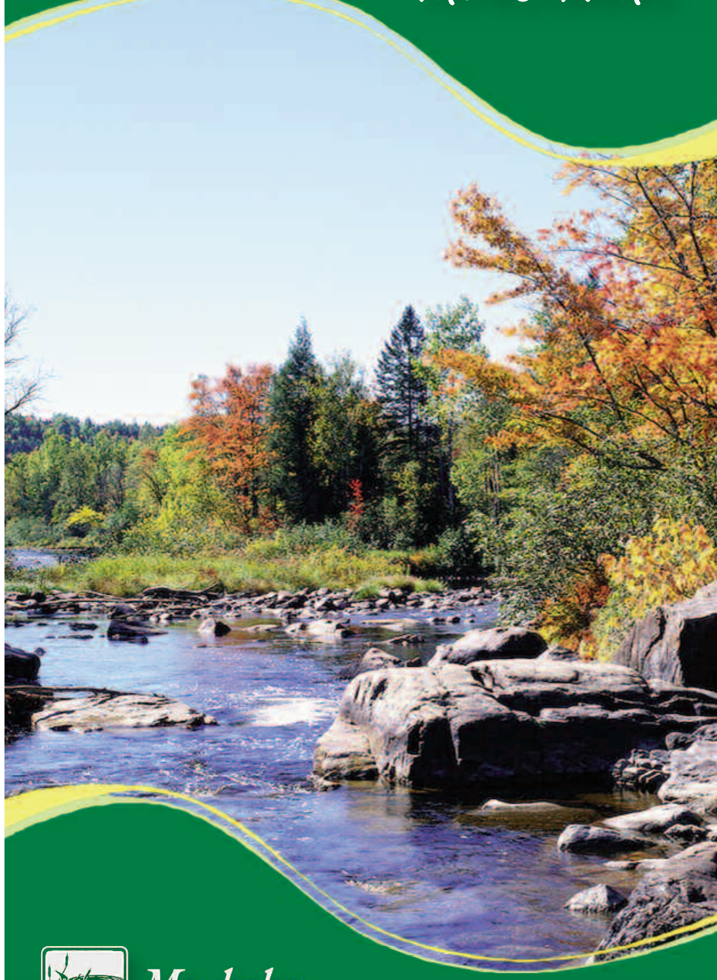
- Muskoka Watershed Council
  www.muskokaheritage.org/mwc
- District Municipality of Muskoka
  www.muskoka.on.ca
- Parry Sound-Muskoka Stewardship Network
  www.ontariostewardship.org/councils/parrysound-muskoka
- Muskoka Water Web
  www.muskokawaterweb.ca
- Ontario Professional Forester's Association
  www.opfa.ca
- Ontario Ministry of Agriculture and Food
  www.omafra.gov.on.ca
- Ontario Ministry of Environment
  www.ene.gov.on.ca/environment
- Ontario Ministry of Natural Resources
  www.mnr.gov.on.ca
- *On the Living Edge*: Your Handbook for Waterfront Living published by the Living By Water Project. Available from the Muskoka Heritage Foundation at (705) 645-7393.

Muskoka Watershed Council
11-B Taylor Road, Box 482
Bracebridge, ON P1L 1T8

Phone: (705) 645-7393 Fax: (705) 645-7888
Email: watershed@muskokaheritage.org

Brought to you by:

Protect your Waterfront Investment



Muskoka WATERSHED COUNCIL

Best Practices Series

Help your investment grow!

Reduced water clarity can result in an 8.5% decrease in your property value!

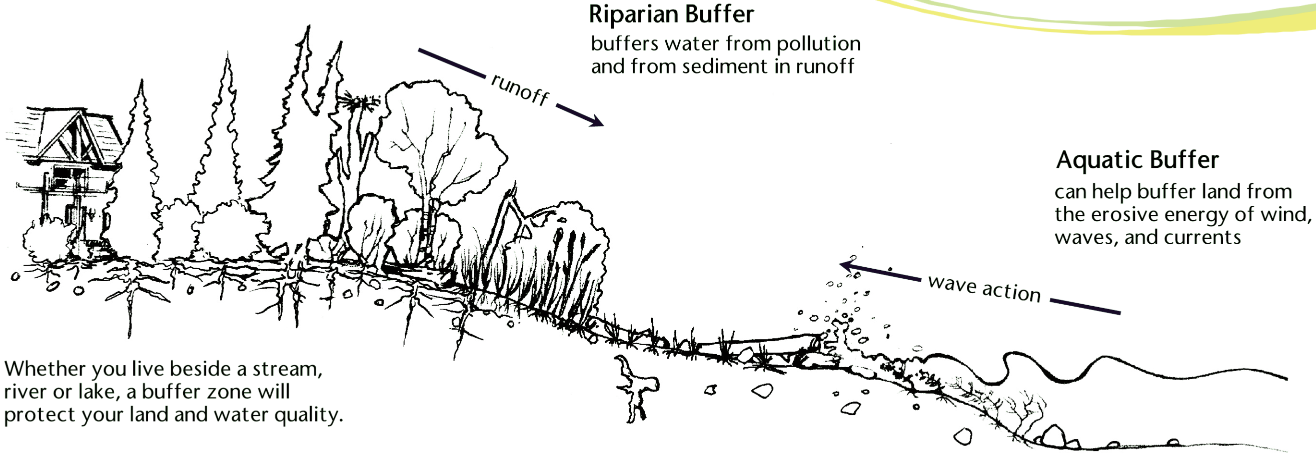
Studies demonstrate that property values decrease as water quality declines. The single most important thing you can do to protect the value of your waterfront investment is to maintain the water quality in your lake.

The natural vegetation on your property, especially that located along your shoreline, is an excellent and low cost way to maintain the quality of your water and protect your land from erosion. Think of the natural vegetation on your property as a free shoreline insurance policy.

Protect your investment

- Maintain or re-establish a shoreline buffer using species native to Muskoka.
- Get to know your property. Look at the vegetation on your property and make note of what species are present and in what numbers.
- Inspect the shoreline buffer area in all four seasons and take notes to compare one season to the next. Certified foresters, horticulturalists, and/or arborists can help you in this process.
- Use this information to gauge the health of your shoreline and plan accordingly.
- Have many different native plant species on your property with varied ages. By doing so, you can account for any unforeseen disturbances, such as wind or ice storms, and/or environmental changes that may occur in the future.

Your buffer zone



Whether you live beside a stream, river or lake, a buffer zone will protect your land and water quality.

From On the Living Edge

Your buffer zone is an area of natural vegetation, including fallen trees, branches and washed up logs, and natural rocks or pebbles, that runs along the length of your shoreline. It includes the areas upland of the high water mark (your riparian buffer) as well as the area below the high water mark, right down into the water (your aquatic buffer).

Ideally, a buffer zone contains vegetation that would normally grow in Muskoka. These native species might include trees, shrubs, wildflowers, grasses and native aquatic plants.

When a shoreline is cleared, the buffer area has the potential to become an erosion zone. Alterations to shorelines can also result in:

- silted up spawning beds
- pollution from runoff
- increased flooding

Your buffer zone is in a constant state of change.

Dead, dying, diseased, and dangerous material can be removed in order to improve the health, safety and aesthetics of your property.

Common shoreline species in Muskoka:
TREES: White cedar, White pine, Hemlock
SHRUBS: Red-osier dogwood, Meadowsweet
WILDFLOWERS: Cardinal flower, Blue flag iris
AQUATIC PLANTS: Pickerelweed, Coontail

Whether you are planning a major construction project or just maintaining what you have, it is important to:

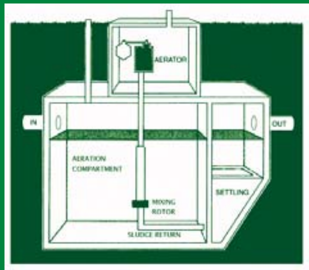
- *MINIMIZE* the types and amount of traffic your buffer area receives. Simple foot traffic can drive oxygen out of the soil and allow for water runoff.
- *MAINTAIN* natural forest floor coverings and keep natural areas as large as possible.
- *INCORPORATE* a woodchip-style mulch approximately 2-4" thick in high traffic areas to condense traffic flow and minimize damage.
- *LEAVE* some dead or dying material on your property, if it isn't a hazard, to enhance wildlife habitat.
- *CHECK* with local authorities before removing vegetation from your property so you don't contravene any laws.

Appendix C. Caring for your Septic System

Other Systems

Treatment Units

There are several new technologies called treatment units that are approved under the Ontario Building Code.



Aerobic Treatment Unit

Treatment units are aerobic devices or filters that provide treatment of sewage either in conjunction with a conventional septic tank or with an aeration chamber. They provide improved effluent quality.

Filter Treatment Unit

These systems require soil bases that may be smaller than those required for conventional systems, making them ideal for use on small or difficult sites.

Leaching Pits

Leaching (grey water) pits are allowed for low water flow conditions in remote areas.

Pit Privies & Composting Toilets

Pit privies (outhouses) or composting toilets may also be used, but must meet current standards.

Composting toilets with drains must be connected to a cesspool (drainage pit), and a permit is required.

Composting Toilet

Holding Tanks

Holding tanks are only permitted under specified circumstances where other alternatives are not feasible.

Where To Find More Information

Your local Area Municipal Building Dept:

Bracebridge 645-5264
Gravenhurst 687-3412
Lake of Bays 635-2272
Georgian Bay 538-2337
Huntsville 789-1751
Muskoka Lakes 765-3156

Muskoka Watershed Council
www.muskokaheritage.org/watershed

Ontario Rural Wastewater Centre
www.orwc.uoguelph.ca

Tarion Warranty Corporation
www.tarion.com

Ministry of Municipal Affairs & Housing
www.obc.mah.gov.on.ca

On the Living Edge: Your Handbook for Waterfront Living published by the Living By Water Project. Available from the Muskoka Heritage Foundation at (705) 645-7393.

Muskoka WATERSHED COUNCIL

9 Taylor Road, Box 482
Bracebridge, ON P1L 1T8

Phone: (705) 645-7393 Fax: (705) 645-7888
Email: watershed@muskokaheritage.org

Brought to you by:

Printed on 50% recycled Fiber content with 20 % post consumer recovered fiber.

Caring for your Septic System in Muskoka

BEST PRACTICES SERIES

Your septic system is Your responsibility!

A septic system built to current-day standards and maintained properly may:

- enhance the value of your property;
- prevent costly replacement or repairs in the future; and
- help protect our environment by reducing the risk of surface water and drinking water contamination.

Your septic system is a sewage treatment facility that requires careful attention to design, construction, operation and maintenance.

With proper knowledge and care of your septic system, you will be contributing to the protection of the ground and surface waters that are so important to all who share the memorable experiences of cottage country.

In Ontario, the specifications for construction and maintenance of sewage systems (with a design daily sewage flow of less than 10,000 litres per day) are regulated under the Ontario Building Code. Municipalities are responsible for the inspection and approval of septic system installations.

In Muskoka, your Area Municipal Building Department is the place to find out about permit, design and maintenance requirements for your septic system.

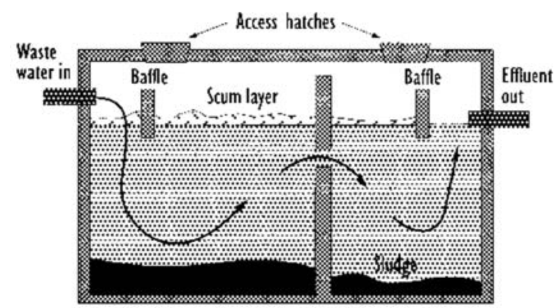
What can you do regarding your septic system?

- Obtain and review the permit for your septic system.
- Keep accurate records of pumping, maintenance and repair.
- Locate and prepare a sketch of components.
- Conserve water flowing to the system (i.e. low flush toilets, low flow showerheads).
- Ensure all fixture drains are connected (as per design).
- Repair any leaking plumbing fixtures.
- Do not put paint, petroleum products, grease or pesticides down the drain.
- Flush only biodegradable products like toilet tissue, not sanitary napkins, diapers, cigarette butts, or paper towels.
- Avoid high water flows that may overload your system.
- Install an effluent filter to the outflow pipe leading from your septic tank to your leaching bed. An effluent filter will prevent suspended solids from entering the leaching bed and must be cleaned as prescribed by the manufacturer.
- Maintain vegetation on top of your leaching bed to aid in evaporation and prevent erosion, but don t allow trees or shrubs to grow too close to the bed or tank as their roots can clog or damage your system.
- Ensure that renters or guests are aware of your septic system and its proper use.

Your Septic System

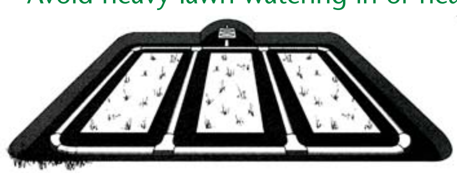
Septic Tank

- Locate lids of tank and install risers to aid access if necessary
- Have scum and sludge layer level checked yearly
- Have baffles checked and replaced if necessary
- Have tank pumped as necessary (usually every 3-5 years)
- Have tank replaced if not sound (ie steel) or if undersized for sewage flows



Leaching Bed

- Divert surface runoff and roof drains away from the bed area
- Avoid compaction of soil over the bed by vehicles, heavy equipment or materials
- Ensure that unsaturated, porous soil is present under the leaching pipes
- Avoid heavy lawn watering in or near the bed area
- Maintain access to sunlight in the bed area to promote evaporation
- Check for wet spots (ponding) or uneven lush growth on areas over runs which may indicate poor distribution of effluent



Other Components

- Locate all pump chambers and ensure that pumps and alarms are working properly
- Service treatment units and effluent filters as prescribed by the manufacturer
- Ensure privies, composting tiolets and greywater pits are constructed and maintained to current standards