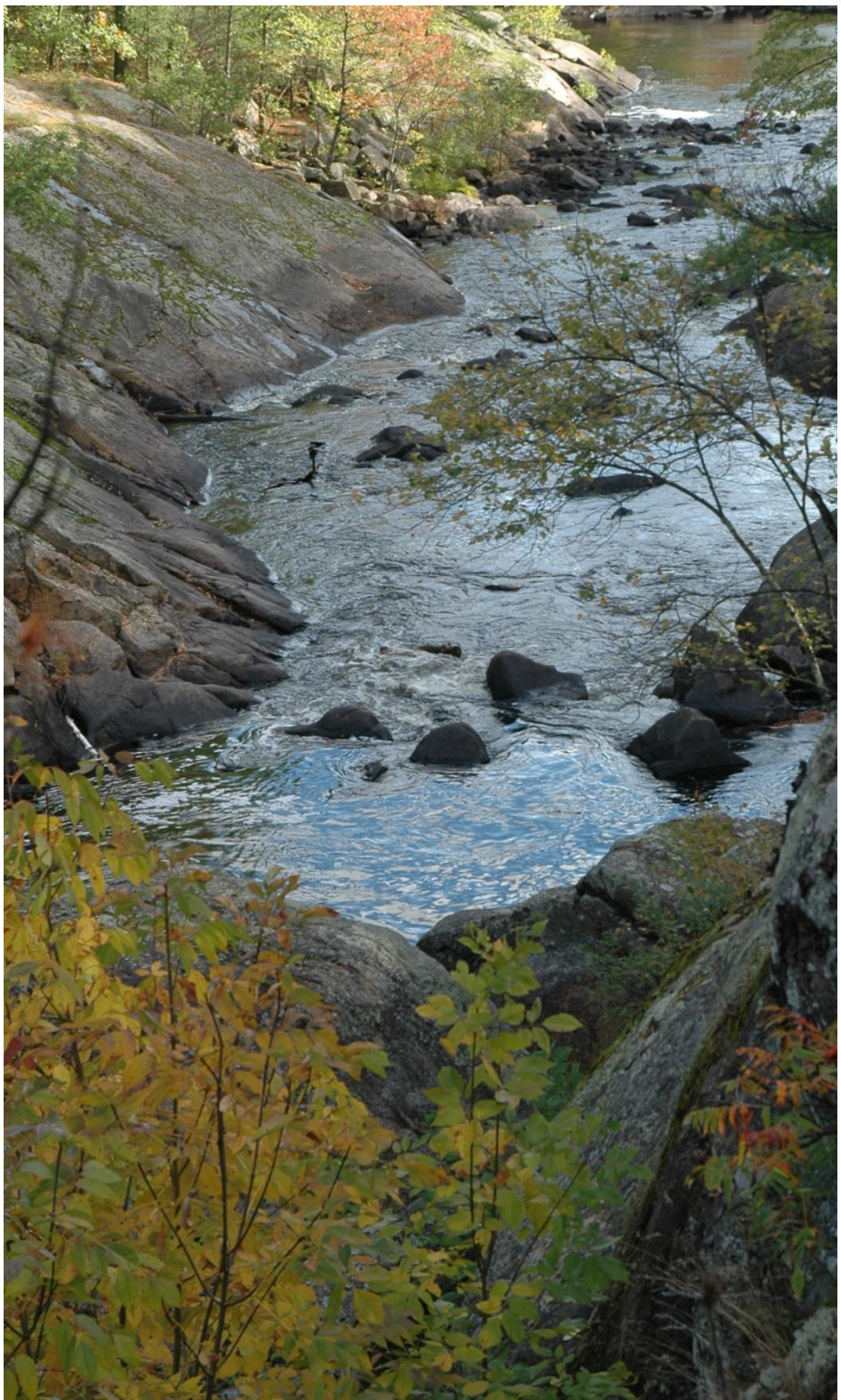
The Muskoka Watershed REPORT CARD 2010



Background Report

Muskoka
WATERSHED COUNCIL

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ACKNOWLEDGEMENTS

The background report for the 2010 Muskoka Watershed Report Card is a combined effort of many people and organizations across the watersheds. Without their expertise and volunteer efforts this report could not have been produced.

Muskoka Watershed Council has relied heavily on the technical expertise of several local scientists. Dr. Neil Hutchinson of Hutchinson Environmental Services and Dr. Andrew Paterson of the Dorset Environmental Science Centre provided input on the water quality section of the report. Al Shaw of RiverStone Environmental accessed the data from the *Guide to Eating Ontario Sport Fish* and, with the help of Dr. Greg Mierle, prepared the section on mercury and fish contamination. Without the support of the Bracebridge Office of the Ontario Ministry of Natural Resources (MNR) many sections of the report would not have been completed and we thank both Jan McDonnell and Steve Scholten for their input and support. The Climate Change section is a collaborative effort of Ken Black, Dr. Isobel Heathcote, Dr. Neil Hutchinson, Dr. Ken Riley, and Tom Clark. Without their expertise in various sectors our understanding of the potential impacts of climate change in Muskoka would be incomplete.

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Every major project needs that one volunteer that you can go to and ask to search out some key information, write a difficult section, connect with a key participant or provide direction and guidance. Ken Black is that person. Without his ongoing support and guidance this report card would not have come together. In the end, however, the 2010 Muskoka Watershed Report Card is a product of the entire Muskoka Watershed Council. The grading, evaluation, recommendations and comments are those of the Council and not individual contributors. The Council also takes responsibility for any errors, although we sincerely hope that we have caught most of them.

All major projects take money to complete. Although the content of the report card was produced for the most part by volunteers, printing, distribution and some of the web design were contracted out. We would like to thank the many sponsors that have help bring the third Muskoka Watershed Report Card to fruition.

Our Supporters:

- The District Municipality of Muskoka
- Parry Sound-Muskoka Stewardship Network
- Town of Bracebridge
- Township of Georgian Bay
- Town of Huntsville
- Muskoka Heritage Foundation
- Township of Lake of Bays
- Town of Gravenhurst/Gravenhurst Environmental Committee
- Township of Muskoka Lakes
- Township of Seguin

EXECUTIVE SUMMARY

The Muskoka Watershed Report Card presents the results of monitoring the health of the natural features of Muskoka's watersheds. The 2010 Muskoka Watershed Report Card is the third report card for the area and the content, level of detail, and accuracy of these reports has evolved and will continue to evolve as new and better information becomes available.

Muskoka is in excellent natural condition: 94% of the watershed is in natural cover; water quality is much better than provincial guidelines for recreational use; and most wetlands are intact. However, changes in vegetation communities, habitat loss, and water quality are becoming evident. The opportunity exists now to develop and live within the limits of our natural features before many of the values that draw us to Muskoka are lost. The objective of the Watershed Report Card is to report on the ecological health of the watershed in order to provide some understanding of the success of our collective ability to live within the natural limits set by the watershed.

Over the years the report card has addressed such issues as human health, municipal action, stewardship, and drinking water. Although all these issues are important, there are other agencies working within the watershed that are better suited to addressing them. For example, the Simcoe Muskoka District Health Unit prepares a newsletter on air quality and the associated health impacts.

The term ***Muskoka watersheds*** refers to all watersheds lying totally or partially within The District Municipality of Muskoka and includes areas in Algonquin Park, the Township of Seguin and the Township of Algonquin Highlands.

The area covered by the Muskoka Watershed Report Card includes all of tertiary watershed 2EB (Muskoka River watershed) and the northern portion of tertiary watershed 2EC (Black River-Lake Simcoe watershed). These tertiary watersheds can then be subdivided into 20 quaternary watersheds (Figure 2). For the most part, the evaluation has been conducted at a landscape level using remote sensing tools such as air photography and satellite imagery. Results are provided on both an aggregated and subwatershed basis. Current data do not facilitate site specific analysis.

As the analysis moves from a landscape level to a subwatershed level, the variation in watershed health becomes more evident. The health of each subwatershed is important not only because people relate more strongly to their local watershed area, but also because each subwatershed requires natural areas to support local processes that serve the needs of local residents for the many ecosystem services and functions they provide.

Benchmarks are necessary if one is to measure progress towards goals, but Provincial or National benchmarks appropriate to the forested environment of Muskoka do not exist. It has been necessary to develop benchmarks that are appropriate to our environment. Where a local standard has been developed and is generally accepted, it has been used. Where no standard has been established, the Muskoka average value has been used as the benchmark.

Indicators of the health of our land include:

1. Percent of each subwatershed in **natural cover**. Natural cover is defined as lakes, wetlands, forests, rock barrens and other natural systems.
2. Percent of each subwatershed in **large natural areas**. Large natural areas are defined as areas of forest, barrens, small lakes, and wetlands with a contiguous area of 200 ha or greater.
3. Percent of each subwatershed in **interior forest**. Interior forest is defined as a forested area with a 100 metre forest buffer surrounding it. A healthy forested landscape should also have a percentage of interior forest with a 200 metre forested buffer.
4. Percent of each subwatershed in **protected and managed areas**. Protected areas are defined as lands within national or provincial parks, Crown conservation reserves, Crown land, and land held by land trusts. Managed areas are defined as lands under the Managed Forest Tax Incentive Program or Conservation Land Tax Incentive Program, or have a conservation easement held by a reputable conservation organization.
5. Percent **natural riparian areas**. Riparian areas are defined as the shoreline of a lake or river plus an area 20 metres inland from the shore.

The overall grade for the health of the land component within the watershed is **B**. This grade indicates that although the overall health is good, improvements can be made and care is required when developing the area to ensure natural values are recognized and protected.

Indicators of the health of our water resources include:

1. **Percent of lake surface area in a watershed that is over threshold for Total Phosphorus**. This is a measure of recreational water quality, as phosphorus is generally the limiting nutrient in algae production.
2. **Percent natural shoreline** is an indication of good fish habitat. Many fish species require overhanging vegetation, rock shoals, and aquatic vegetation found in undisturbed sites.
3. **Mercury level in fish** is an indicator of contaminated aquatic environments. Mercury levels in lakes do not pose a significant human health threat; however, wildlife like loons are less tolerant of mercury and may be impacted.

Like the land component, the overall grade for water within the watershed is **B**. Anecdotal accounts already refer to more or different algae blooms, loss of fish habitat and declining loon populations. In order to preserve the highly valued lakes and rivers across the watershed, increased care for our water resources is required.

Ecologists recommend that 10% of a watershed should remain as wetland in order to provide the ecosystem services and functions necessary for a healthy watershed. However, on the Canadian Shield this number has less meaning. In Muskoka, many subwatersheds are naturally comprised of less than 10% wetlands. Therefore, for the purpose of the report card, it is assumed that the current wetland area in each subwatershed is close to its natural level. A value of no net loss of wetlands from the 2010 level has been used as the benchmark. In future report cards, wetland area will be measured as a deviation from current wetland areas.

Perhaps the biggest challenge facing the watershed is climate change. Between 1948 and 2006 Ontario's average temperature increased by 1.3 ^{o}C. Projections made by the Ministry of the Environment indicate average temperatures over the Great Lakes Basin, which include Muskoka's watersheds, are likely to continue to

rise between 2 and 4 ^{o}C by 2050. The Ministry of the Environment goes on to predict that precipitation may increase by up to 20% by 2050 in all but the summer months, when little or no change is projected. Rising air and water temperatures are already shortening the ice cover season, exposing water to evaporation for more of the year.

Even if carbon emissions ended today, the global temperature would continue to rise through to the end of this century. Adaptation to a modified climate is necessary. Maintaining natural areas and enhancing the health and diversity of ecosystems is essential to the long-term sustainability of watersheds that will be threatened by climate change.

INTRODUCTION

As people live and work, they modify the landscape, impact the plants and animals in their watershed, and alter both ecosystem services[1] and ecosystem functions[2]. The Muskoka Watershed Report Card[3] presents the results of monitoring these changes and evaluating the health of the natural features of Muskoka's watersheds[4]. The 2010 Muskoka Watershed Report Card is the third report card for the area. The content, level of detail, and accuracy of these reports have evolved and will continue to evolve as new and better information becomes available.

The term ***Muskoka watersheds*** refers to all watersheds lying totally or partially within The District Municipality of Muskoka and includes areas in Algonquin Provincial Park, the Township of Seguin and the Township of Algonquin Highlands. Watersheds are the most effective unit for the management of our shared resources; compatible activities and programs should be made available across the watershed, regardless of political boundaries, in order to ensure watershed health.

Unlike some parts of Ontario, Muskoka, in general, is in excellent natural condition: 94% of the watershed is in natural cover; water quality is much better than provincial guidelines for recreational use; and most wetlands are intact. We are in the enviable position of being able to develop our watersheds in a sustainable manner. It should be noted, however, that not all parts of Muskoka enjoy this high level of ecological health. Some areas are already showing some early signs of degradation and local stewardship programs are needed to reverse these trends and restore watershed health. Careful monitoring and local benchmarking will assist in understanding the human impact on natural processes and encourage modified behaviour before significant environmental damage is done.

A variety of indicators[5] will be used to identify present and potential stresses on the watershed and to evaluate the health of the terrestrial and aquatic resources. The intent is to update the report card every four years. Subsequent report cards will document changes over time within our watershed. The report card is based on water quality and shoreline data collected by The District Municipality of Muskoka, fish contaminant data collected by the Ministry of the Environment, and Geographic Information System (GIS) mapping.

Past Indicators

Since the first Muskoka Watershed Report Card in 2004 a lot has been learned about our watershed and what makes it healthy. As experience and knowledge have been gained, the indicators that have been reported on have been changed and modified. The objective of the Watershed Report Card is to report on the ecological

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[1] **Ecosystem Services** are the goods and services which the environment produces, such as clean water, timber, habitat for fisheries, and pollination of native and agricultural plants. From Ecological Society of America, "Ecosystem Services: A Primer," http://www.actionbioscience.org/environment/esa.html

[2] **Ecosystem functions** are the processes by which the environment produces ecosystem services. From Ecological Society of America, "Ecosystem Services: A Primer," http://www.actionbioscience.org/environment/esa.html

[3] **A report card** is a snapshot of the current conditions of our environment.

[4] **A watershed** is an area of land that drains to a river, lake or stream. What happens in one part of a watershed impacts directly on other parts of that watershed regardless of political boundaries.

[5] **An indicator** is data that provide information about or predict the overall health of a portion of the natural environment. Examples include total phosphorus as an indicator of recreational water quality or mercury levels in fish as an indicator of toxin levels.

health of the watershed. Over the years, the report card has addressed such issues as human health, municipal action, stewardship, and drinking water. Although all these issues are important, there are other agencies working within the watershed that are better suited to addressing them. For example, the Simcoe Muskoka District Health Unit prepares a newsletter on air quality and the associated health impacts.[6]

The 2010 Muskoka Watershed Report Card uses the best information available and focuses on a limited number of indicators that will provide an overview of the ecological health of the watershed. Past indicators that will not be reported on include:

1. *E. coli* – *E. coli* is a bacterium that is commonly found in the lower intestine of warm-blooded organisms. Most *E. coli* strains are harmless, but some can cause serious health effects in humans. When *E. coli* is found in recreational waterbodies, it is an indicator of contamination from feces. In some cases, the contamination can be a result of a poorly functioning septic system or other waste treatment facility; however, often times it is a natural occurrence from the ducks, geese and other wildlife in the area.

   E. coli contamination is a serious human health matter and should not be taken lightly. Both the Ministry of Environment and the Simcoe Muskoka District Health Unit strongly recommend that all drinking water taken from surface water be treated before ingesting. All drinking water should also be tested on a regular basis to ensure treatment systems are functioning properly.

   The Simcoe Muskoka District Health Unit and several lake associations test swimming areas and other recreational areas for *E. coli* levels on a regular basis. Health Unit data confirm that local beaches have very good swimming water quality, and closures of Muskoka beaches for health reasons are rare. Lake association data are collected using several different protocols. They monitor *E. coli* for human health concerns, and also use *E. coli* levels as an easily measured proxy for other environmental problems that can be caused by faulty septic systems (chiefly nutrification). Generally the data show that *E. coli* levels are very low in cottage areas and although levels may be a little higher in more-developed areas such as marinas, average *E. coli* readings are well below the provincial guideline of 100 cfu (colony forming units) for safe recreational use.

   The Muskoka Watershed Report Card will not continue to report on *E. coli* levels because:

   a. At the subwatershed scale, *E. coli* levels are a very weak, indirect indicator of ecosystem health although they may reveal localized instances of excess nutrients entering the water; and
   b. All data collected to date have shown our waterways to consistently hold quite low levels.

   Other criteria are more useful for subwatershed or larger-scale assessments of ecosystem health. Specific information on *E. coli* levels can be obtained from the Simcoe Muskoka District Health Unit or individual lake associations that have a monitoring program in place.

2. Drinking Water – Municipal drinking water is the responsibility of The District Municipality of Muskoka. Complete water quality analysis and a comparison to provincial guidelines is available on The District Municipality of Muskoka website at http://muskokadistrict.iwebez.com/siteengine/activepage.asp?PageID=317. As drinking water is not an

[6] Simcoe Muskoka District Health Unit http://www.simcoemuskokahealth.org/Topics/Environment/outdoorair.aspx

indicator of ecological health it will not be included in the 2010 Muskoka Watershed Report Card.

3. Stewardship Activities – Stewardship activities and what people can do to address a poor grade is an important component of a report card; however, it is not easy to grade. The 2010 Muskoka Watershed Report Card will identify a series of stewardship activities but it will not provide a grade as it has in past report cards.

4. Air Quality – Air quality is a human health issue and is reported on by the Simcoe Muskoka District Health Unit in its Air Aware newsletter published three times a year.[7] Air quality is not an indicator of ecological watershed health and so will not be included in the 2010 Muskoka Watershed Report Card. The impacts of poor air quality, or atmospheric deposition, do impact watershed health and have been included in the background documentation as it impacts both water quality and terrestrial health.

Muskoka's Watersheds

The area covered by the Muskoka Watershed Report Card includes all of tertiary watershed 2EB (Muskoka River watershed) and the northern portion of tertiary watershed 2EC (Black River-Lake Simcoe watershed). These tertiary watersheds can then be subdivided into 20 quaternary watersheds (Figure 1, Table 1).

The Muskoka River watershed (2EB) is located in central Ontario's lake country, whose main population centres are Huntsville, Bracebridge and Gravenhurst. Both Highway 69/400 extension and Highway 11 bisects the watershed in a north/south direction. From its headwaters in Algonquin Provincial Park, the Muskoka River flows 210 km through a series of connecting lakes to two outlets in Georgian Bay. The watershed is 62 km at its widest point, encompasses an area of approximately 5,100 $km^{2,}$ and includes about 78,000 ha of lakes. The watershed is divided into three distinct areas: the north and south branches of the Muskoka River, and the lower Muskoka River (Figure 2). The north and south branches of the Muskoka River comprise approximately the eastern two-thirds of the watershed, originating in the highlands of Algonquin Provincial Park. They flow south-westerly until converging in Bracebridge and then flow into Lake Muskoka. The lower portion of the watershed covers approximately the western one-third of the watershed and receives the inflow from the north and south branches of the Muskoka River as well as Lakes Joseph and Rosseau, and Gravenhurst Bay. This combined flow passes through the Moon and Musquash Rivers and discharges into Georgian Bay.

[7] http://www.simcoemuskokahealth.org/Topics/Environment/outdoorair.aspx

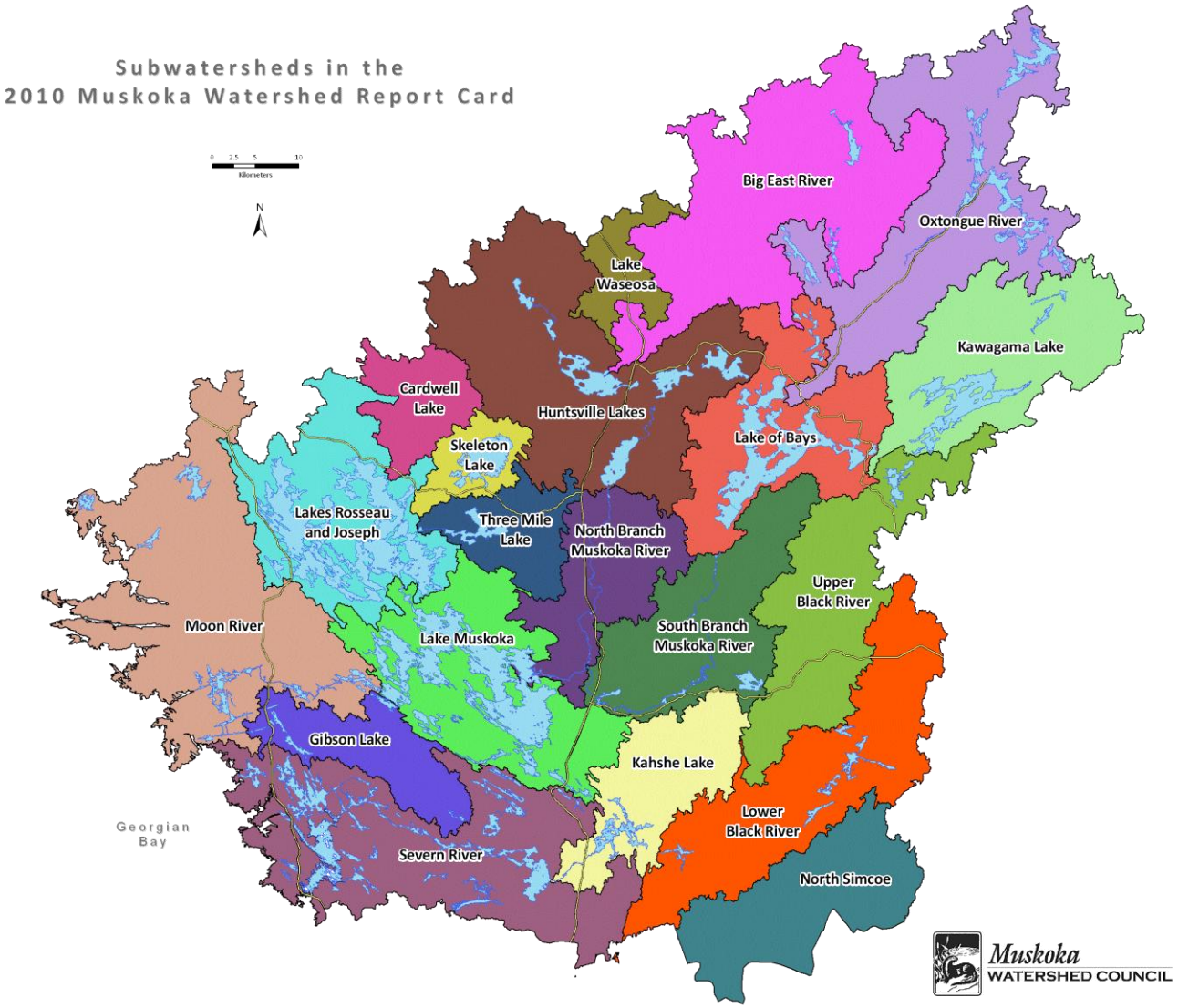

Figure 1: The Subwatersheds (Quaternary Watersheds) Included in the 2010 Muskoka Watershed Report Card

The Black River-Lake Simcoe watershed (2EC) is comprised of the northern portions of the Black and Severn River watersheds, which encompass an additional 2,538 km^2.

The headwaters of the Black River are in the Township of Algonquin Highlands. From there, the river flows in a south-westerly direction through the southern portion of The District Municipality of Muskoka and northern portions of the Township of Minden Hills, City of Kawartha Lakes, and Ramara Township to Lake Couchiching. From Lake Couchiching it enters the Severn River waterway and flows to Georgian Bay. Most of the land area in the Black River watershed is Crown land, with the upper reaches being part of the old Leslie M. Frost Centre.

The portion of the Severn River watershed that flows through the southern portion of Muskoka is the very bottom section of the Trent/Severn Waterway. The water flows from Lake Couchiching into the lower Severn

River and out to Georgian Bay at lock 45 at Port Severn. Both the Kahshe and Morrison Lake subwatersheds flow into the Severn River.

All the Muskoka watersheds support a wide range of aquatic and wildlife ecosystems, and numerous human uses, including waterpower generation, swimming, canoeing, boating, angling, hunting and trapping, and tourism operations. There are 42 water control structures (dams and/or dam/powerhouse combinations) on the Muskoka River system and three navigation locks (Figure 2).

All the water in the Muskoka watersheds eventually flows into Georgian Bay through the Moon, Musquash or Severn Rivers.

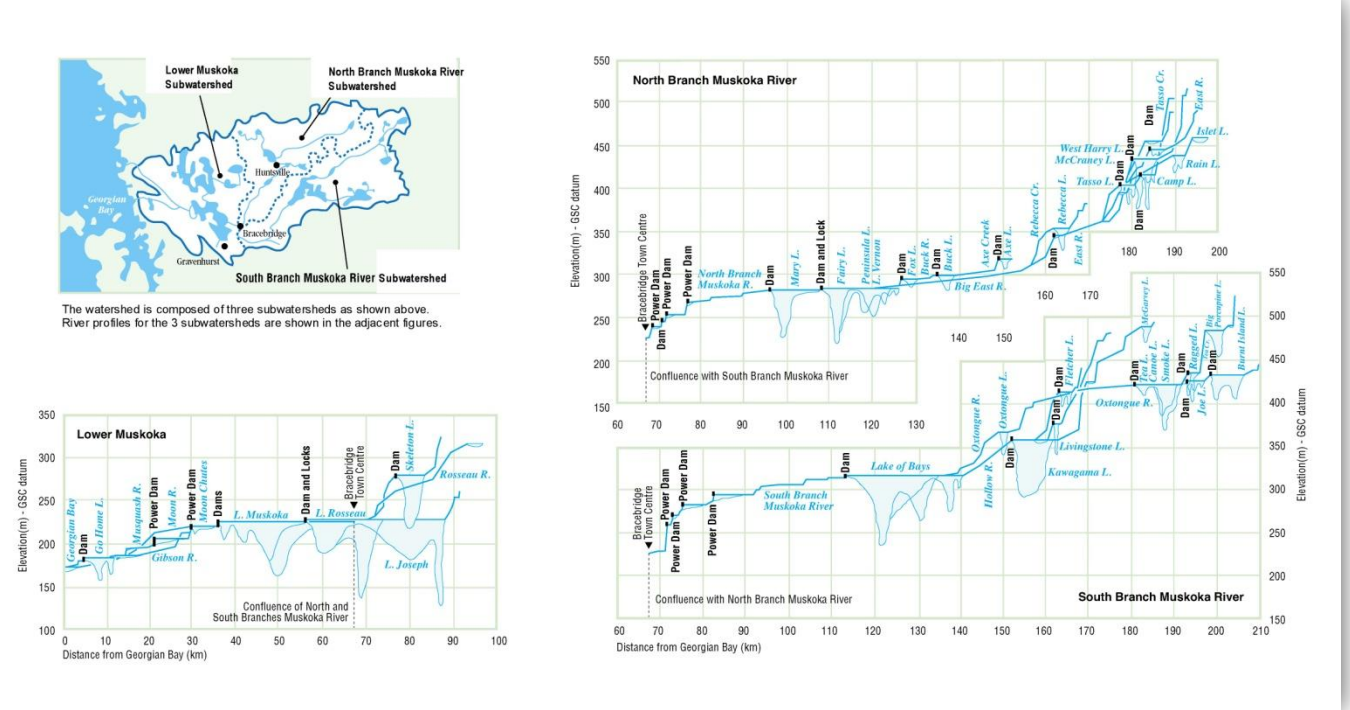

Figure 2: Muskoka River Watershed Elevations (From the Muskoka River Water Management Plan)

The report card evaluation has been completed on a quaternary or subwatershed basis as defined by the Ministry of Natural Resources (Table 1). The Ministry has labelled each subwatershed with an alpha-numeric identification tag (e.g. 2EB-07). For easier reference, the report card has labelled these subwatersheds using the primary waterbody. For example, the Moon River subwatershed includes the full length of the river plus any lakes that flow directly into the river.

For the most part, the evaluation has been conducted at a landscape level using remote sensing tools such as air photography and satellite imagery. Results are provided on both an aggregated and subwatershed basis. Current data do not facilitate site-specific analysis.

Table 1: Subwatersheds (Quaternary Watersheds) Included in the 2010 Muskoka Watershed Report Card

	Watershed	Subwatershed Name		Watershed	Subwatershed Name
1	2EB-02	Moon River	11	2EB-12	Kawagama Lake
2	2EB-03	Gibson Lake	12	2EB-13	Huntsville Lakes
3	2EB-04	Lake Muskoka	13	2EB-14	North Branch Muskoka River
4	2EB-05	Lakes Rosseau and Joseph	14	2EB-15	Big East River
5	2EB-06	Cardwell Lake	15	2EB-16	Lake Waseosa
6	2EB-07	Skeleton Lake	16	2EC-13	North Simcoe
7	2EB-08	Three Mile Lake	17	2EC-14	Lower Black River
8	2EB-09	South Branch Muskoka River	18	2EC-15	Upper Black River
9	2EB-10	Lake of Bays	19	2EC-16	Kahshe Lake
10	2EB-11	Oxtongue River	20	2EC-17	Severn River

Table 2: Watershed Characteristics

Characteristic	Value
Watershed Area	7,638 km^2
Approximate Permanent Population	59,000
Approximate Seasonal Population	100,000
Towns	3 (Bracebridge, Gravenhurst, Huntsville)
Villages and hamlets	11
Number of Subwatersheds	20
Number of Lakes	Over 500
Number of Municipal Waste Water Systems	9
Number of Control Structures	43
Number of Navigation Locks	3
Number of Generating Stations	10

Subwatershed Evaluation

As the analysis moves from a landscape level to a subwatershed level, the variation in watershed health becomes more evident. The health of each subwatershed is important not only because people relate more strongly to their local watershed area, but also because each subwatershed requires natural areas to support local processes that serve the needs of local residents for the many ecosystem services and functions they provide.

In order to evaluate the health of a watershed or to document change over time, benchmarks[8] can be developed and used. In forested environments such as Muskoka, the province has not established any such benchmarks against which watershed health can be evaluated. Most research addresses more-developed environments, such as southern Ontario, where ecological benchmarks have been established. These benchmarks often do not

[8] **A benchmark** is an established guideline against which change in environmental condition can be measured.

make sense in Muskoka. For example, the provincial guideline for total phosphorus concentration in rivers and streams is to maintain an average of less than 30 micrograms per litre (ug/l) total phosphorus. The provincial guideline for lakes is to maintain an average concentration of less than 20 ug/l of phosphorus. Most lakes, river and streams in Muskoka have a natural level of phosphorus substantially below these standards. The Muskoka-specific benchmarks may be more suitable for the forested environment found in central and northern Ontario.

In order to better understand the subtle changes in the subwatersheds of Muskoka as development occurs, the Muskoka Watershed Council has developed local benchmarks that are more suitable to the area. In general, the existing average condition has been used as the benchmark against which change can be measured.

Using these local benchmarks, it is possible to see smaller changes in the health of our subwatersheds and the functioning of our ecosystems and act accordingly before they become more serious ecological problems. Grades have been given based on deviations from these ”made-in-Muskoka” benchmarks in order to provide a better understanding of the health of our local subwatersheds.

The mission of the Muskoka Watershed Council is to”Champion Watershed Health”. A minimum ecological standard is required in order to maintain healthy ecological systems, good water quality, and a strong economic base. A conservative approach has been taken in grading the subwatersheds in order to highlight potential issues and raise awareness of the need to be good stewards of our watersheds. These Muskoka benchmarks will ensure that natural form continues to dominate over built form as development occurs.

The Muskoka Watershed Council supports the Strategic Vision of The District Municipality of Muskoka as stated in its Official Plan:

> The guiding vision is one of predominantly forested landscape that supports diverse and functioning ecosystems including lakes, wetlands, forests, barrens and open fields. Interspersed in the natural setting is small to mid-sized communities and rural and waterfront development that provide a wide range of economic opportunities and lifestyle options. Policies in the Official Plan strike a balance between growth and development and the preservation of the natural Muskoka environment.[9]

District Council restated this position in its Strategic Priorities document, whose first goal is:

1. Manage development and growth within the carrying capacity of the ecosystem and strive to minimize the net ecological footprint of Muskoka. Build on the cultural heritage of Muskoka and be recognized as a municipal leader in environmentally sustainable policies and programs.[10]

Four of the six Muskoka Area Municipalities expressly state that protection of the natural environment is paramount as development occurs. Of the two remaining municipalities, one does not express an overall objective but does have policies that reflect the value of the natural environment to the overall health of the municipality. The other municipality is currently developing their first comprehensive official plan.

[9] District Municipality of Muskoka, “The Official Plan of the District Muskoka District Area, 1991’” as consolidated to November 12, 2007

[10] District Municipality of Muskoka, “Strategic Priorities,” April 7, 2008.

The Township of Seguin also reflects a desire to protect the natural values of the watershed. The first goal in their Official Plan states that "it is the goal of this Plan to protect and enhance significant natural heritage features and ecological functions in the Township through the adoption of an 'Environment-First' principle."[11]

The Township of Algonquin Highlands Official Plan states that "it [the official plan] is intended to provide for the conservation of the natural environment, including wetlands, woodlands, areas of Provincial significance, fish and wildlife habitat, lakes, rivers and streams, on an ecosystem management basis."

The Muskoka Watershed Report Card uses this shared vision as a base against which benchmarks have been established and grades have been assigned. The Report Card is an important management tool because it provides an evaluation of whether the vision of maintaining a predominantly forest landscape with functioning natural ecosystems is being achieved. It also helps improve the understanding of local degraded areas, focuses management actions where they are most needed and tracks progress over time. The Report Card also defines the forested environment and identifies healthy and ecologically important areas that will allow appropriate management practices to be undertaken and significant areas to be protected for future generations.

Benchmarks

Benchmarks are necessary in order to measure progress towards goals, but Provincial or National benchmarks appropriate to the forested environment of Muskoka do not exist. It has been necessary to develop benchmarks that are appropriate to our environment; these benchmarks may also be useful in other rural portions of the province.

In developing benchmarks, where a local standard has been developed and is generally accepted, it has been used. Where no standard has been established, the Muskoka average value has been used as the benchmark (Table 3). More specifically:

1. A standard of leaving 75% of a shoreline natural has been established by The District Municipality of Muskoka and incorporated into several local planning documents. It has been used as the benchmark for both the riparian areas and natural shoreline indicators.
2. The benchmarks for Natural Cover, Large Natural Areas, and Interior Forest reflect the naturally higher percentage of forested land in Muskoka compared to southern Ontario. If Muskoka was to adopt the southern Ontario benchmark for interior forest of 30% there would be considerable loss of natural habitat and significant loss of ecological function across the watershed. Alternatively, adopting the Muskoka average of 80% of each subwatershed being left in natural blocks of 200 ha or larger will ensure the long term health of local ecosystems.
3. In some cases the southern Ontario benchmark is too narrowly defined to reflect the reality on the Canadian Shield. For example, the World Wildlife Fund recommends 12% of the landscape be protected through parks and protected areas. In Muskoka, much of the land stewardship is carried out by private landowners through the Managed Forest Tax Incentive Program (MFTIP) or the Conservation Land Tax Incentive Program (CLTIP). These are important private land initiatives that are recognized through the Protected and Managed Areas benchmark of 50% of the landscape.

[11] Meridian, The Township of Seguin Official Plan, October 22, 2007.

Table 3: Benchmarks Used in the 2010 Muskoka Watershed Report Card.

Indicator	Muskoka Benchmark
Land	
1. Natural Cover	90%
2. Large Natural Areas	80%
3. Interior Forest	60%
4. Protected & Managed Areas	50%
5. Riparian Areas (Unaltered)	75%
Water	
1. Total Phosphorus	0% surface area Over Threshold
2. Natural Shoreline (Unaltered)	75%
3. Mercury Levels in Fish	0.033 ppm
Wetlands	
1. Wetland Cover	No net loss from 2010 levels

Value of Ecosystems

Intact ecosystems are important for a variety of reasons and provide many services such as air and water purification, and wild plants and fish for food. The Credit Valley Conservation Authority in southern Ontario recently hired the Pembina Institute to complete an analysis of the value of natural areas to the Credit River Watershed. Their analysis determined that the Credit River Watershed provides at least $371 million per year in ecological services.[12]

Natural ecosystems and the plants and animals within them provide people with services that would be very difficult to duplicate. While it is hard to place an accurate monetary amount on all ecosystem services, some financial values can be calculated. Many of these services are performed seemingly "free" yet are worth many trillions of dollars. For example, it is estimated that Canada's boreal forest contributes $14.9 billion in forest products and an additional $5.4 billion in pest control by birds and $1.85 billion in net carbon sequestering annually.[13] In Muskoka, recent studies have valued the tourism sector at $220 million a year.[14] In addition, it is estimated that the second-home population contributes approximately $581 million annually to the economy.[15] Both these latter sectors rely heavily on a healthy natural environment.

Although ecological services are how people interpret and value ecosystems and natural areas, maintaining ecological function is critical if we are to continue to benefit from these natural areas. Ecological function can only be maintained where there are large natural areas and natural processes can continue. Ecosystems are intricate and complicated and often a minor change in one part of the system can have a significant impact on

[12] Credit Valley Conservation Authority and Pembina Institute, "Establishing the Value of Natural Capital in the Credit River Watershed – Fact Sheet," 2009.

[13] Pembina Institute: "Counting Canada's Natural Capital – Assessing the Real Value of Canada's Boreal Ecosystems." http://www.borealcanada.ca/pdf/Boreal_Wealth_Report_Nov_2005.pdf.

[14] The District Municipality of Muskoka, "Economic Profile," October, 2004. http://www.muskoka.on.ca/planningeconomic/Economic%20Profile.pdf

[15] The District Municipality of Muskoka, "Second Home Study," September 2005. http://www.muskoka.on.ca/planningeconomic/2004%20Second%20Home%20Study.pdf

another part. The long-term implications of change are not well understood. As climate change is starting to be experienced and studied, these interconnections are becoming even more evident.

As noted above, the best and most efficient way to maintain ecological function is to maintain large undisturbed natural areas. Table 4 highlights the size of natural areas required to maintain key indicator species. Animal species are a good indicator of ecosystem condition and its ability to function because they rely on the broad range of ecosystem functions to live and thrive. They integrate the values of natural cover, access to clean water and clean air in their everyday survival and are often more sensitive to ecosystem deterioration than people.

Table 4: Natural Area Requirements [16]

Area	Forest/Treed Swamp	Area	Forest/Treed Swamp
1 ha	• Edge-tolerant mammals (Squirrels) • Common edge-tolerant birds (Blue Jay, American Crow) • A few birds may be associated with mature trees (Black-Capped Chickadee, Eastern Wood-Pewee)	50 to 75 ha	• A variety of area-sensitive species may be present; some will be absent if there is no nearby suitable habitat • Still predominantly edge influenced, but will support small populations of most forest bird species (Scarlet Tanager)
4 ha	• A very few common edge-tolerant birds (Downy Woodpecker, Great Crested Flycatcher) • Eastern Chipmunk may be present	100 to 400 ha	• Forest-dependent bird species will still be in low numbers and may be absent if there is no nearby suitable habitat
10 ha	• Still dominated by edge-tolerant species; may have very small areas of interior habitat supporting low numbers of moderately area-sensitive species (Hairy Woodpecker, White-Breasted Nuthatch)	1,000 ha	• Suitable for almost all forest birds • Some forest-dependent mammals present, but most still absent
30 ha	• May be large enough to support some species of salamander • Small populations of edge-intolerant species (Winter Wren, Brown Creeper, Black-and-White Warbler)	10,000 ha	• Almost fully functional ecosystem, but may be inadequate for a few mammals such as Gray Wolf and Bobcat (100,000 ha has been suggested as a minimum)

Using the species identified in Table 4 as indicators of ecological function, areas of 100 to 400 hectares are required throughout the watershed to support a wide range of animal species and to ensure that many of the provisioning and regulating ecological services are supported. In addition, some areas that are 10,000 hectares or greater are required to support larger mammals and the ecosystem services and functions they require.

[16] Environment Canada. "How Much Habitat is Enough?" Second edition. Minister of Public Works and Government Services Canada. 2004.

Where the area of study is located on an undeveloped landscape, such as far northern Ontario, one study identified 50,000 hectares as the minimum to

> … be capable of maintaining most natural values and functions of the remaining self-sustaining forest landscape, including natural disturbance processes at different scales (wildfires, storm damages, insect outbreaks, etc.); natural spatial patterns of ecosystems and habitats; viable populations of plants and animals, including wide-ranging predators and prey; and resistance to influences from adjoining disturbed or fragmented areas.[17]

This study assumes an undeveloped landscape and is not a reasonable expectation in Muskoka where there are fire suppression protocols and insect control; however, it is important to understand that local watersheds are vulnerable where these practices are not undertaken.

Cultural services can also be impacted by a reduction in natural areas. Studies over the last ten years have demonstrated that some visitors or tourists avoid visiting resorts because they have experienced or anticipate overcrowding, leading to their reduced enjoyment of natural areas.[18] Large natural areas also support other economic and cultural activities such as forestry, hunting and fishing and are an important foundation to the Muskoka economy and quality of life.

Natural areas can be managed and protected through provincial and national parks, Crown land and Crown nature reserves, and land trust holdings and conservation easements. Areas can also be managed through provincial and municipal land use policy and private stewardship, but these tools do not guarantee the same level of long-term protection as the federal and provincial controls. Although these two levels of management can work together to create a mosaic of well-managed ecosystems, it is recommended that at a minimum, the land area required to maintain a natural areas strategy be incorporated into a parks and land trust strategy. The World Wildlife Fund (WWF) recommends that at least 12% of the landscape be included in this level of land management.

[17] Potapov, P., A. Yaroshenko, S. Turubanova, M. Dubinin, L. Laestadius, C. Thies, D. Aksenov, A. Egorov, Y. Yesipova, I. Glushkov, M. Karpachevskiy, A. Kostikova, A. Manisha, E. Tsybikova, and I. Zhuravleva. 2008. "Mapping the world's intact forest landscapes by remote sensing." *Ecology and Society* 13(2): 51. [online] URL: http://www.ecologyandsociety.org/vol13/iss2/art51.

[18] Eugenio-Martin Juan Luis, "Monitoring the Congestion Level of Competitive Destinations with Mixed Logit Models," Chritel Dehaan Tourism and Travel Research Institute, University of Nottingham, 2004.

LAND

Indicators of the health of our land include:

1. Percent of each subwatershed in **natural cover**. Natural cover is defined as lakes, wetlands, forests, rock barrens and other natural systems.
2. Percent of each subwatershed in **large natural areas**. Large natural areas are defined as areas of forest, barrens, small lakes, and wetlands with a contiguous area of 200 ha or greater.
3. Percent of each subwatershed in **interior forest**. Interior forest is defined as a forested area with a 100-metre forest buffer surrounding it. A healthy forested landscape should also have a percentage of interior forest with a 200-metre forested buffer.
4. Percent of each subwatershed in **protected and managed areas**. Protected areas are defined as lands within national or provincial parks, Crown conservation reserves, Crown land, and land held by land trusts. Managed areas are defined as lands under the Managed Forest Tax Incentive Program or Conservation Land Tax Incentive Program, or have a conservation easement held by a reputable conservation organization.
5. Percent **natural riparian areas**. Riparian areas are defined as the shoreline of a lake or river plus an area 20 metres inland from the shore.

Percent Natural Cover

Regardless of ownership or level of protection, large areas of all watersheds should remain in natural cover in order to support the provisioning, regulating, cultural and supporting ecosystem functions described earlier. The percent natural cover analysis has been completed at a fairly high level and does not consider the fragmentation created by roads, railways and other forms of linear development. This landscape level indicator provides a good understanding of the overall health and function of the watershed.

Studies in the Severn Sound area directly to the southwest of our watersheds indicate that total forest cover is the primary factor determining the number of interior birds expected to occur.[19] Birds are often used as an indicator of forest health, as they integrate biological, physical and chemical conditions required to support healthy populations.

Additional research is required on the optimum level of natural area required to sustain the ecosystems of a forested area. These areas support larger mammals and provide significant ecosystem services. A conservative approach to evaluating natural cover has been taken in order to provide more options in the future as research provides better information.

In order to maintain natural cover as development occurs, municipalities need to focus development in urban areas, while at the same time developing an urban green strategy. Rural and waterfront development will also have to occur within a sustainable framework that supports the maintenance of healthy natural ecosystems. This

[19] Environment Canada. "How Much Habitat is Enough?" Second edition. Minister of Public Works and Government Services Canada. 2004.

may be accomplished through municipal land use policy, private land-stewardship initiatives, or land acquisition by local land trusts.

Using the Muskoka Watershed Inventory tool[20], the percent natural cover was determined for each subwatershed (Table 5). The grade was determined by using the 2010 average Muskoka natural cover as the benchmark. Subwatershed grades were scaled from that standard. The 2010 benchmark will be used in future report cards.

Table 5: Subwatershed Grades for Percent Natural Cover

Subwatershed Name	Natural Area		Subwatershed Name	Natural Area	
	Grade	%		Grade	%
Moon River	A	96	**Kawagama Lake**	A	98
Gibson Lake	A	97	**Huntsville Lakes**	A	91
Lake Muskoka	A	90	**North Branch Muskoka River**	B	85
Lakes Rosseau and Joseph	A	94	**Big East River**	A	98
Cardwell Lake	A	98	**Lake Waseosa**	A	92
Skeleton Lake	A	96	**North Simcoe**	A	93
Three Mile Lake	B	84	**Lower Black River**	A	98
South Branch Muskoka River	A	95	**Upper Black River**	A	99
Lake of Bays	A	97	**Kahshe Lake**	A	95
Oxtongue River	A	98	**Severn River**	A	94
				Watershed:	**94**

Grades

A >90% **B** 75 – 89.9% **C** 60 – 74.9% **D** 50 – 59.9% **F** < 50%

Benchmark - 90% in natural cover

Percentage of Large Patch Size

Despite increasing evidence in the literature indicating the significant contribution of forest or natural cover, it is clear that patch size, or size of unfragmented natural areas, is likely more important to many wildlife species. Although there is limited research on the amount and optimum patch size that should be maintained within a forested environment, work undertaken in eastern and southern Ontario recommends that in areas where conifer and deciduous forests are both naturally occurring, forest tracts of 200 hectares for each forest type be maintained to support all or most native interior bird species (used as an indicator of forest health).[21] No research could be found that provides guidance on the amount of natural areas required to maintain a healthy

[20] Tran, Phung . "The Muskoka River Watershed Inventory Project," funded by the Ontario Trillium Foundation, 2007.

[21] Environment Canada. "How Much Habitat is Enough?" Second Edition. Minister of Public Works and Government Services Canada. 2004.

watershed where the natural cover is not forest but may be rock barren or large wetland areas. Research in this area is fairly new and until studies have been completed that provide some explicit direction, the Report Card will continue to report on the natural area patch sizes over 200 hectares. In order to track changes in patch size over time, the Report Card will also report on patch sizes of 200 to 500 ha, 500 to 10,000 ha, and patch sizes over 10,000 ha.

Birds are not the only consideration when determining appropriate natural area patch sizes. Other values of large natural areas have been identified by a number of researchers and summarized by Popatov et al.[22]

- Large natural forest areas are important for the preservation of all strata of biological diversity and are important for maintaining ecological processes and services like water and air purification, nutrient cycling, carbon sequestration, erosion, and flood control.
- Large unpopulated areas are often comparatively cheap to conserve, as their remoteness and low current economic value protect them from human disturbance.
- The ability of ecological systems to support the natural diversity of species and communities, and their ability to absorb disturbance (resistance) and recover from disturbance (resilience), is enhanced if they have little or no human interference and the area is large enough to support core ecological processes.
- Forest biomes, including tropical, temperate, and boreal forests, play a crucial role in mitigating climate change by serving as carbon sinks…containing up to 80% of all above ground and approximately 40% of all below ground terrestrial carbon.
- As the most biologically diverse terrestrial ecosystem, forests provide critical habitats to more than half of all known plant and animal species on Earth.
- The basic provisional (timber, food, and forage) and supporting (water purification, climate regulation) ecosystem services provided by forests are essential for human well-being.

Using the Muskoka Watershed Inventory tool, the percent of large patch sizes was determined for each subwatershed (Table 6). As noted above, the patch size analysis has three components:

1. the percent of each subwatershed in patch sizes of 200 to 499 ha;
2. the percent of each subwatershed in patch sizes of 500 to 9,999 ha; and
3. the percent of each subwatershed in patch sizes of 10,000 hectares or greater.

This continuum of patch sizes will provide a better understanding of change over time and the impact on forest health. Together these indicators provide an understanding of the watershed's ability to both sustain existing wildlife and natural biodiversity (the natural variance in the biological community) and to withstand catastrophic events such as fire or disease.

The grade was determined by using only the percent of area in parcels over 200 hectares and using the 2010 average Muskoka value as the benchmark. Subwatershed grades were scaled from that standard. The 2010 benchmark will be used in future report cards.

[22] Potapov, P., A. Yaroshenko, S. Turubanova, M. Dubinin, L. Laestadius, C. Thies, D. Aksenov, A. Egorov, Y. Yesipova, I. Glushkov, M. Karpachevskiy, A. Kostikova, A. Manisha, E. Tsybikova, and I. Zhuravleva. 2008. "Mapping the world's intact forest landscapes by remote sensing." *Ecology and Society* 13(2): 51. [online] URL: http://www.ecologyandsociety.org/vol13/iss2/art51.

Table 6: Subwatershed Grades for Percent Large Patch Size

Subwatershed Name	Grade	Total % over 200 ha		% 200-500 ha	% 500-10,000 ha	% over 10,000 ha
Moon River	**A**	87		8	57	23
Gibson Lake	**A**	93		7	82	3
Lake Muskoka	**F**	43		9	34	0
Lakes Rosseau and Joseph	**F**	45		6	39	1
Cardwell Lake	**A**	96		3	33	59
Skeleton Lake	**C**	64		1	53	10
Three Mile Lake	**B**	72		10	62	0
South Branch Muskoka River	**A**	87		8	76	3
Lake of Bays	**B**	79		7	70	2
Oxtongue River	**A**	93		6	68	18
Kawagama Lake	**A**	93		3	27	64
Huntsville Lakes	**B**	71		13	52	6
North Branch Muskoka River	**C**	66		16	50	0
Big East River	**C**	69		4	41	24
Lake Waseosa	**B**	72		3	69	0
North Simcoe	**A**	92		2	46	44
Lower Black River	**A**	96		2	47	46
Upper Black River	**A**	98		1	31	66
Kahshe Lake	**A**	83		8	60	15
Severn River	**A**	82		12	68	2
Watershed		**79**		**7**	**52**	**20**

Grades

A >80% **B** 70 – 79% **C** 60 – 69% **D** 50 – 59% **F** < 50%

Benchmark - 80% in large natural areas

Percent Interior Forest

As a more detailed analysis of each subwatershed is undertaken it is evident that roads, development and utility corridors fragment much of the forested landscape. These smaller, often disconnected, parcels cannot always provide the same quality of habitat and level of ecological services and functions provided by larger, connected natural features. In particular, these areas often lack forest interior habitat. Interior forest is defined as a forested area with a 100-metre forested buffer surrounding it.

A healthy forested landscape should also have a percentage of interior forest with a 200-metre buffer. In order to maintain biodiversity, moisture regimes, microclimates, and reduce impacts such as flooding, it is important to maintain a diversity of habitats. Interior forests are one habitat type that is threatened as development occurs. Because much of Muskoka is not forested but is in natural cover (lake, rock barren) the interior forest

calculation was the percent interior forest of the forested area only. In addition, the southern and western subwatersheds that are comprised of a high percentage of rock barren and small lakes were not evaluated for interior forest because it is not a significant habitat in those areas.

Ecological benefits of forest interior habitat are similar to that of all forests but these areas are naturally more protected from outside intrusion and form the base of the watershed's natural ability to function. Benefits include filtering and absorption of water into the system; absorption of large amounts of carbon dioxide that would otherwise be released into the atmosphere; and photosynthesis (plants use the energy from sunlight and nutrients from the soil and air to yield the oxygen that is essential to the survival of living things). Forests serve as important education, research and recreation areas, and forests are treasured places for spiritual and psychological well-being. Ecosystems are dynamic, adapting and resilient living systems, but they cannot withstand the rapid change that results from development or road construction. If the benefits that forests provide are to be maintained, they need to be kept intact.

The importance of interior forests is often equated to the health of interior forest birds. Species diversity typically increases with increasing forest cover, although the size and composition of woodlands determine what species live there. Birds are a particularly effective barometer of forest size and shape, since many of our native species need large expanses of interior habitat. Many forest-nesting birds shun edges because of the increased risk of predation or nest parasitism, as well as inhospitable temperature and moisture conditions, or insufficient food. Edges are also more susceptible to human disturbance. Studies undertaken in southern Ontario indicate that at least 10% of a watershed should have forest cover with a forested buffer of 100 metres and that an additional 5% of the watershed should have forest cover with a forested buffer of 200 metres. These values are considered to be minimum areas within a highly developed landscape and provide only minimal benefits with little ability to sustain any type of natural or man-induced stress. Unfortunately, there is insufficient research to establish interior forest standards in a forested environment.

The grade for the 2010 Watershed Report Card was determined by using the 2008 average Muskoka interior forest value as the benchmark. The average Muskoka interior forest value was calculated as the percent of the forested area for each subwatershed. Where there is an "N/A" it reflects that the majority of that subwatershed is barrens and scrubland and does not naturally support extensive amounts of interior forest. Subwatershed grades were scaled from that standard. The 2008 benchmark will be used in future report cards.

Using the Muskoka Watershed Inventory tool, the percent interior forest of the forested area was determined for each subwatershed (Table 7). As noted above, interior forests have two components:

1. The percent of each subwatershed with forest that has a 100 m forested buffer
2. The percent of each subwatershed with forest that has a 200 m forested buffer

Table 7: Subwatershed Grades for Percent Interior Forest (100 m Buffer)

Subwatershed Name	Interior Forest		Subwatershed Name	Interior Forest	
	Grade	%		Grade	%
Moon River	**N/A***	-	**Kawagama Lake**	**B**	53
Gibson Lake	**N/A***	-	**Huntsville Lakes**	**C**	46
Lake Muskoka	**D**	35	**North Branch Muskoka River**	**C**	40
Lakes Rosseau and Joseph	**C**	43	**Big East River**	**A**	62
Cardwell Lake	**A**	66	**Lake Waseosa**	**B**	49
Skeleton Lake	**C**	47	**North Simcoe**	**A**	78
Three Mile Lake	**C**	43	**Lower Black River**	**A**	79
South Branch Muskoka River	**B**	50	**Upper Black River**	**A**	61
Lake of Bays	**B**	48	**Kahshe Lake**	**B**	54
Oxtongue River	**A**	72	**Severn River**	**C**	44
				Watershed:	**60**

* Mostly barren topography with many small lakes, very little forested area

Grades

A > 60 **B** 48 - 59 **C** 40 – 47 **D** 30 - 39 **F** < 30

Benchmark - 60% interior forest (100-metre forested buffer)

Percent Protected and Managed Areas

There is no natural areas strategy within the watersheds that recognizes and connects actively managed areas; however, the area is blessed with land that is well managed both by the province and by good private land stewards. Eventually a natural areas strategy is required to ensure natural areas remain connected, key areas remain in a natural state, and significant habitat is protected. Managed areas are lands managed by either the Crown or a private landowner for the natural values they possess. In particular there are:

1. large areas of Crown land managed under the Public Lands Acts,
2. Crown nature reserves managed and administrated under the Provincial Parks and Crown Reserve Act,
3. eleven (11) provincial parks and one national park managed and administered under specific parks acts,
4. an increasing number of nature reserves owned and managed by local land trusts, and
5. private lands managed by individual landowners and associations under such programs as the Managed Forest Tax Incentive Program (MFTIP) and the Conservation Lands Tax Incentive Program (CLTIP).

These areas will serve as a base for a natural areas system in the future but effort to develop connecting corridors and address natural areas protection in the central corridor of Muskoka is necessary to ensure long-term watershed health. It is expected that pressure for development in Muskoka will continue to increase in the

next few decades and a natural areas strategy will be important to protect some of the natural values of the watershed.

Muskoka still enjoys many areas that are in good condition and have very high ecological significance. These areas should form the base, or core, of a protected areas strategy. Muskoka is a mosaic of Crown and private land and individuals and land managers responsible for both classifications of land must work together to develop a comprehensive approach to the management of the area.

Using the Muskoka Watershed Inventory tool, the percent of protected and managed area was determined for each subwatershed (Table 8). The 2008 average Muskoka protected and managed area value was used as the benchmark for the 2010 Muskoka Watershed Report Card, and this benchmark will be used in future report cards.

Table 8: Subwatershed Grades for Percent Actively Managed Areas.

Subwatershed Name	% Total		% Crown Land	% Private Stewardship	% Parks & Protected Areas
Moon River	69		49	3	17
Gibson Lake	70		32	0	38
Lake Muskoka	16		6	4	6
Lakes Rosseau and Joseph	16		12	2	2
Cardwell Lake	45		29	9	7
Skeleton Lake	33		16	17	0
Three Mile Lake	14		3	11	0
South Branch Muskoka River	27		15	10	2
Lake of Bays	36		24	11	1
Oxtongue River	99		28	2	69
Kawagama Lake	75		61	0	14
Huntsville Lakes	16		5	10	1
North Branch Muskoka River	17		8	9	0
Big East River	80		39	7	34
Lake Waseosa	18		9	2	7
North Simcoe	63		0	0	63
Lower Black River	91		41	1	49
Upper Black River	90		76	3	11
Kahshe Lake	28		6	6	16
Severn River	72		56	2	14
Watershed	**48**		**26**	**5**	**17**

Benchmark - 50% combined managed areas

Riparian Areas[23]

The interrelationship between a lake and its shoreline is important. The shoreline zone is the last line of defence against the forces that may otherwise destroy a healthy lake. A naturally vegetated shoreline filters runoff generated by surrounding land uses, removing harmful chemicals and nutrients.

[23] Riparian areas are an area of land directly influenced by water. An ecosystem that is transitional between land and water ecosystems. Riparian areas usually have visible vegetative or physical characteristics reflecting the influence of water. From Biology Online http://www.biology-online.org/dictionary/Riparian_area.

Table 9 provides an overview of shoreline development and alteration across the watershed. Although the shoreline (where the water meets the land) is often left fairly natural, the shoreline buffer area between the shoreline and the house or cottage is often more disturbed with an average of 67% altered; with a variance of a low of 5% to a high of 79% altered.

The combined disturbance of the natural vegetation along the shoreline and in the yard area between the residential structure and the water's edge is an important indicator of the impact shoreline development may have on a waterbody. A weighted average for each lake was calculated combining the findings of the shoreline and yard area data. The overall weighted average is 37.93% altered or 62.07% left naturally vegetated.

Across the watersheds, municipalities, lake associations and heritage foundations have done significant work to encourage landowners to maintain or renaturalize shorelines. The Towns of Bracebridge, Gravenhurst and Huntsville and the Township of Muskoka Lakes, in conjunction with the Muskoka Heritage Foundation, have undertaken local projects to renaturalize the shoreline in public parks. Recent policy of many watershed municipalities requires the maintenance of shoreline vegetation through the development approval process or through a tree-cutting and site alteration bylaw. The Township of Lake of Bays has also implemented a development permit system that requires a permit to remove shoreline vegetation.

Table 9: Shoreline Alteration Data for Specific Lakes

Lake	Subwatershed	Yard Area		Shoreline		Weighted Average (Altered)
		Natural	Altered	Natural	Altered	
Moon River – Bala Reach	Moon River	34.79	65.21	84.8	15.2	61.46
Lake Joseph	Lakes Rosseau and Joseph	58.34	41.66	90.86	9.14	39.22
Mary Lake	Huntsville Lakes	47.29	52.71	76.57	23.43	50.51
Bird Lake	S. Branch Muskoka River	49.93	50.07	82.15	17.85	47.65
Clearwater Lake GR	Severn River	68.24	31.76	91.94	8.06	29.98
Clearwater Lake HTE	N. Branch Muskoka River	48.06	51.94	89.32	10.68	48.85
Dark Lake	Lake Muskoka	23.25	76.75	65.51	32.49	73.43
Go Home Lake	Gibson Lake	92	8	94.39	5.61	7.82
Longline Lake	Lake of Bays	73.24	26.76	88.58	11.42	25.61
Lake Muskoka - Muskoka Bay	Lake Muskoka	48.82	51.18	79.29	20.71	48.89
Lake Rosseau - Brackenrig Bay	Lakes Rosseau and Joseph	38.66	61.34	81.7	18.3	58.11
Baxter Lake	Severn River	51.78	48.22	87.42	12.57	45.55
Gull Lake	Lake Muskoka	45.02	54.98	90.29	9.71	51.58
Long Lake (Bala – ML)	Lake Muskoka	51.76	48.24	89.9	10.1	45.38
Long's Lake	Lakes Rosseau and Joseph	44.08	55.92	78.32	21.68	53.35
McKay Lake	S. Branch Muskoka River	57.77	42.23	81.42	18.58	40.46
Nutt Lake	Lakes Rosseau and Joseph	72.76	27.24	94.91	5.09	25.58

Lake	Subwatershed	Yard Area		Shoreline		Weighted Average (Altered)
		Natural	Altered	Natural	Altered	
Pell Lake	Lake of Bays	94.98	5.02	100	0	4.64
Silver Lake ML	Lake Muskoka	44.97	55.03	93.06	6.94	51.42
Spring Lake	S. Branch Muskoka River	31.16	68.84	89.94	10.06	64.43
Tooke Lake	Lake of Bays	45.7	54.3	89.26	10.74	51.03
Walker Lake	Huntsville Lakes	34.46	65.54	89.57	10.43	61.41
Wood Lake	S. Branch Muskoka River	45.96	54.04	86.77	13.23	50.98
Bruce Lake	Lakes Rosseau and Joseph	66.75	33.25	94.7	5.3	31.15
Paint Lake	Lake of Bays	51.35	48.65	87.27	12.73	45.96
Pine Lake BB	S. Branch Muskoka River	53.76	46.24	93.64	6.36	43.25
Six Mile Lake	Severn River	77.8	22.2	92.33	7.67	21.11
Loon Lake	Severn River	58.72	36.76	96.5	3.5	34.27
Ril Lake	S. Branch Muskoka River	53.48	46.52	89.04	10.96	43.85
Three Mile Lake ML	Lakes Rosseau and Joseph	59.02	40.98	94.53	5.47	38.32
Turtle Lake	Severn River	65.68	34.32	96.27	3.73	32.03
Twelve Mile Bay	Moon River	82.5	17.5	97.57	2.43	16.37
Fox Lake	Huntsville Lakes	74.7	25.3	96.59	3.41	23.66
Muldrew Lake	Severn River	93	7	97.26	2.74	6.68
Muskoka River - Confluence to Mouth	Lake Muskoka	56.41	43.59	66.14	33.86	42.86
South Bay	Severn River	74.59	25.41	91.99	8.01	24.11
Bella Lake	Big East River	83.33	16.67	93.24	6.76	15.93
Brandy Lake	Lake Muskoka	81.15	18.85	96.04	4.64	17.78
Rebecca Lake	Huntsville Lakes	83.38	16.62	96.29	3.71	15.65
Lake Vernon Excl Hunters Bay	Huntsville Lakes	80.02	19.98	89.87	10.13	19.24
Lake Vernon - Hunters Bay	Huntsville Lakes	36.39	63.04	60.28	39.72	61.29
Lake Waseosa	Huntsville Lakes	74.6	25.4	93.56	6.44	23.98
Watershed		**59.80**	**40.08**	**88.53**	**11.44**	**37.93**

Source: District Municipality of Muskoka

The percentage of altered shoreline in various subwatersheds (Table 10) was determined using the shoreline survey data collected by The District Municipality of Muskoka. There is insufficient data in many subwatersheds to report on and that is noted in the table below. A value of 75% unaltered riparian area was used as the benchmark. Subwatershed grades were scaled from that standard.

Table 10: Subwatershed Grades for Percent Unaltered Riparian Area

Subwatershed Name	Riparian Area		Subwatershed Name	Riparian Area	
	Grade	%		Grade	%
Moon River	A	88	**Kawagama Lake**	insuf. data	
Gibson Lake	insuf. data		**Huntsville Lakes**	D	44
Lake Muskoka	D	43	**North Branch Muskoka River**	C	51
Lakes Rosseau and Joseph	B	62	**Big East River**	insuf. data	
Cardwell Lake	insuf. data		**Lake Waseosa**	insuf. data	
Skeleton Lake	insuf. data		**North Simcoe**	B	70
Three Mile Lake	B	54	**Lower Black River**	insuf. data	
South Branch Muskoka River	C	48	**Upper Black River**	insuf. data	
Lake of Bays	B	59	**Kahshe Lake**	insuf. data	
Oxtongue River	A	95	**Severn River**	B	60
				Watershed:	**61**

Grades

A > 75% B 52 – 74% C 45 – 51% D 37 – 44% F <37%

Benchmark - 75% Muskoka standard as established by municipalities

Summary

The terrestrial component of each subwatershed can be analyzed based on the five (5) components outlined above (natural cover, patch size, interior forest, managed and protected area, and riparian area). Together these components provide an indication of the health of the terrestrial component of the watershed.

Table 11: Overall Subwatershed Grades for the Land Component of the 2010 Report Card

Subwatershed Name	Overall Grade		Subwatershed Name	Overall Grade
Moon River	**A**		Kawagama Lake	**A**
Gibson Lake	**A**		Huntsville Lakes	**C**
Lake Muskoka	**D**		North Branch Muskoka River	**C**
Lakes Rosseau and Joseph	**C**		Big East River	**A**
Cardwell Lake	**A**		Lake Waseosa	**C**
Skeleton Lake	**B**		North Simcoe	**A**
Three Mile Lake	**C**		Lower Black River	**A**
South Branch Muskoka River	**B**		Upper Black River	**A**
Lake of Bays	**B**		Kahshe Lake	**B**
Oxtongue River	**A**		Severn River	**B**
			Watershed	**B**

WATER

Water quality is one of the fundamental components of a healthy watershed. As people live and work around lakes, they impact and change the lake ecosystem. Some of these changes may be beneficial and others may degrade the natural systems upon which both humans and other species rely. The Muskoka Watershed Report Card grades the health of our lakes using the following indicators:

1. **Percent of lake surface area in a watershed that is Over Threshold for Total Phosphorus**. This is a measure of recreational water quality, as phosphorus is generally the limiting nutrient in algae production.
2. **Percent natural shoreline** is an indication of good fish habitat. Many fish species require overhanging vegetation, rock shoals, and aquatic vegetation found in undisturbed sites.
3. **Mercury levels in fish** are an indicator of a contaminated aquatic environment. Mercury levels in lakes do not pose a significant human health threat; however, wildlife like loons are less tolerant of mercury and may be impacted in some cases.

Background

Lake Size

There are over 500 lakes in the Muskoka watersheds that range in size from very large and deep to very small and shallow. Figure 3 illustrates the range in lake size across the watersheds. Each lake has its own characteristics and natural healthy equilibrium; therefore, in evaluating the health of a lake it can only be compared to itself as it changes over time and should not be compared to other lakes.

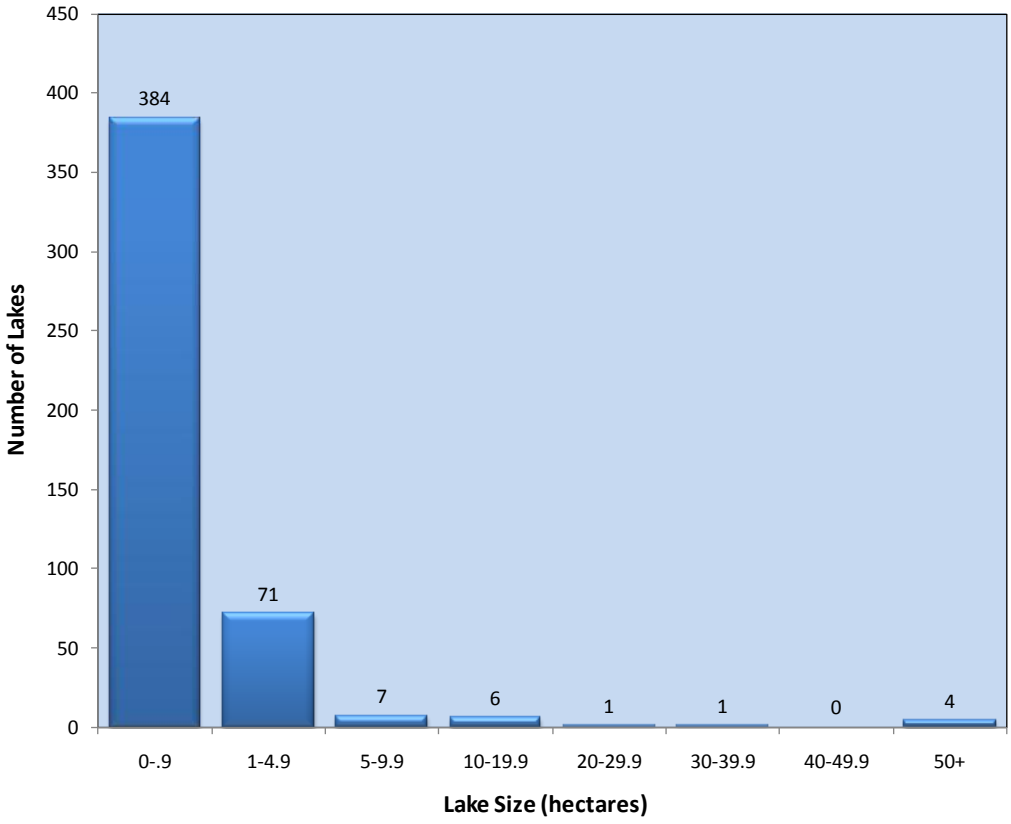

Figure 3: Distribution of Lakes by Size in Muskoka's Watersheds

Recreational Water Quality

Recreational water quality is the quality of the water in lakes and rivers used by people for

recreational pursuits such as swimming, boating, fishing and aesthetic enjoyment. Change in phosphorus concentration is a standard indicator of recreational water quality. This indicator is used across Ontario and has been adopted as an indicator for the Muskoka Watershed Report Card.

Lakes in Muskoka are generally in good to very good condition for recreational use as defined by the limited number of algae blooms and low total phosphorus levels. It is important to note, however, that lakes are changing and that scientists do not completely understand the processes that are currently occurring. In general, data are becoming more chaotic and long-term trends are not as predictable as previously observed. As noted below, some indices suggest signs of improvement while others indicate deterioration. It is generally agreed that climate change is affecting natural processes; therefore, intact natural systems, as we enjoy in Muskoka, will be critical in adapting to the projected changes in climate for this area.

Total Phosphorus

Phosphorus is the nutrient that generally controls the growth of algae in most Ontario lakes. For this reason, a change in phosphorus concentration in a lake impacts the types of algae that live in the lake and the potential for algae blooms. Algae blooms detract from recreational water quality and in some cases affect the habitat of coldwater fish species such as lake trout.

The District Municipality of Muskoka has monitored over 160 lakes across the District for over twenty-five (25) years for both Secchi depth and phosphorus levels. Even with this long-term data set, it is difficult to understand changes and trends that might be occurring. Phosphorus levels in a lake will naturally vary between years as a result of such factors as precipitation, wind, and levels of sunlight. Scientists are also starting to understand that climate change is affecting phosphorus levels. In order to understand trends in phosphorus concentration, detailed studies that relate all these factors to variables such as development, invasive species and other human impacts would be necessary.

In any watershed, there is also a natural variation in phosphorus concentration from lake to lake as a result of such variables as lake size, amount of wetlands, and flow characteristics. This variation across the watershed should be maintained as development and other changes occur. Figure 4 shows the variance in phosphorus concentration across the watersheds. The long-term objective is to maintain the same number of lakes with <10, 10 to 20, and >20

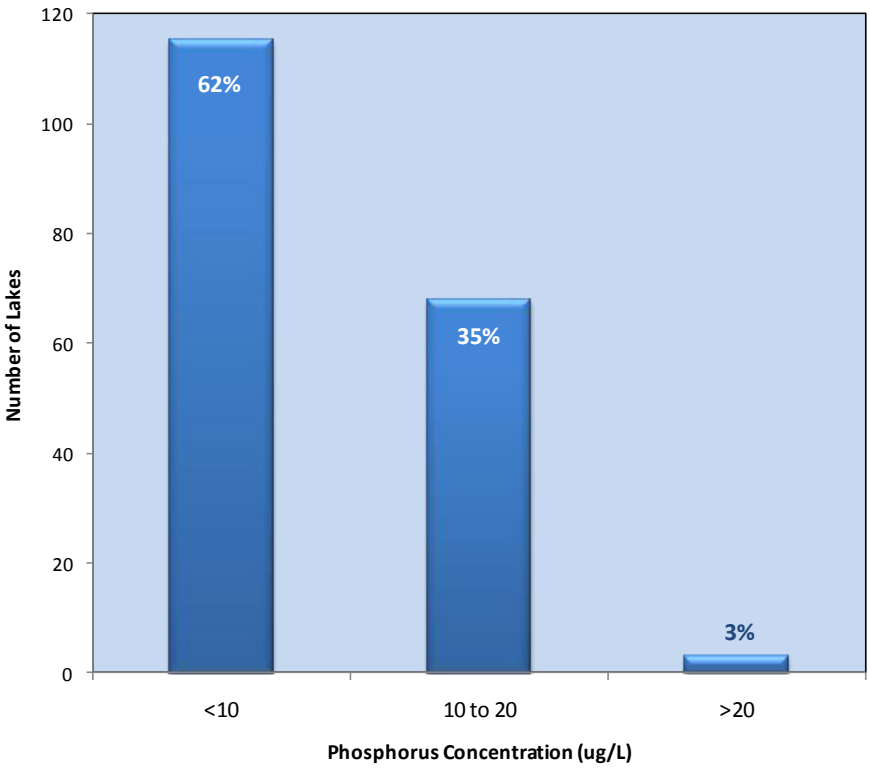

Figure 4: Long-Term Total Phosphorus Concentrations

micrograms/litre (ug/L)[24] of phosphorus, as there would be without development. As the bars on the graph move to the right the lakes are experiencing higher phosphorus concentrations, which might result in more algae blooms. As the bars shift to the left the lakes are experiencing lower phosphorus concentrations, which might result in a loss of lake productivity and lead to stress in aquatic animals. Neither situation is desirable or healthy for the long-term life of the lake.

Figure 5 illustrates that there has been a gradual shift in long-term phosphorus levels to the right over time, which indicates a slight increase in phosphorus concentrations over the undeveloped standard. However, improvement is occurring and over the last twenty years, phosphorus in over 60% of the lakes in Muskoka has remained constant or decreased. As noted in Figure 5, although there is an increase in phosphorus in the 10 to 14.9 ug/L category, it is likely due to lakes having reduced phosphorus from the 15 to 19.9 ug/L and 20+ ug/L categories over the last few years.

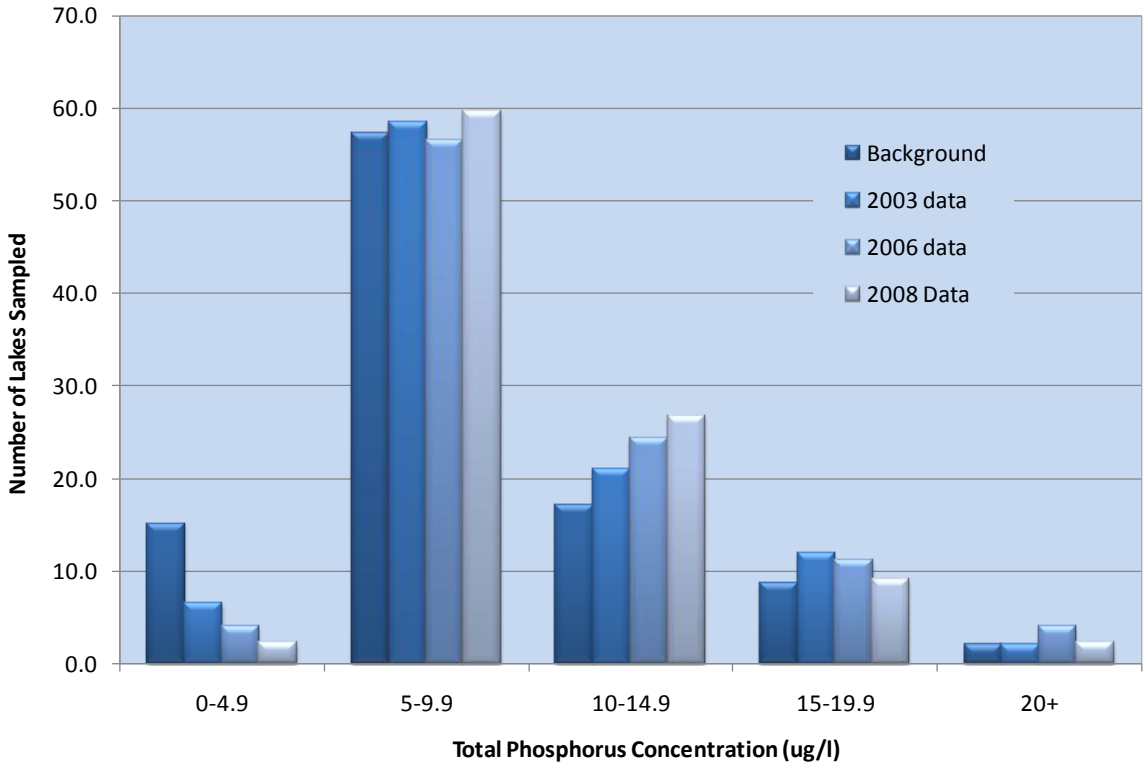

Figure 5: A Comparison of Total Phosphorus Concentrations (Predevelopment Estimates and Monitored Data)

Data collected by the Ministry of Environment over a wide series of lakes across all of Ontario indicate that many lakes are experiencing a decrease in phosphorus. The mechanism for this decrease is not completely understood but the multiple stresses of climate change[25] and acid deposition[26] are considered to be contributing factors. Long-term studies are required to truly understand the complex nature of such trends.

[24] ug/L means micrograms per litre and is equivalent to parts per billion (ppb). This would represent one grain of sand in one billion grains of sand.

[25] Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events around an average (for example, greater or fewer extreme weather events).

[26] Acid deposition is rain, snow, fog and other forms of precipitation with extremely low pH (acidic).

Paleo core samples are sediment core samples used to reconstruct the lake environment throughout geologic time looking especially at changes associated with such events as climatic change, acidification and other human impacts. Paleo core analysis of local waterbodies indicates that in some cases, the present day concentration of phosphorus in lakes in Muskoka is below that experienced before European development on the lake.[27] The data collected by The District Municipality of Muskoka over the last twenty-five years also indicates that some lakes are decreasing in phosphorus concentration. In fact, forty-seven lakes in Muskoka have a long-term phosphorus average of less than the predicted background or undeveloped value for that lake.

This apparent contradiction in data makes it hard for lake managers to develop effective programs and predict the impact of management decisions. Further monitoring of lake system changes is required to fully understand many of these trends.

As illustrated in Figure 4, sixty-two percent (62%) of lakes in the watershed are considered oligotrophic, or nutrient poor, and have phosphorus concentrations of less than 10 ug/L[28]. These lakes are considered excellent recreational lakes and are highly valued for cottage development. Thirty-five percent (35%) of the lakes are considered mesotrophic, or moderately enriched, and have phosphorus concentrations between 10 and 20 ug/L. These lakes tend to be smaller and support warm-water fish species and more diverse shoreline habitat. Three percent (3%) are considered eutrophic, or enriched, and have phosphorus concentrations over 20 ug/L. These lakes have naturally elevated levels of phosphorus based on natural watershed inputs.

In 2005, The District Municipality of Muskoka launched an updated Lake System Health program. Background (or predicted undeveloped) total phosphorus levels were modeled for over 180 lakes or portions of lakes across the District. Threshold or upper limits for total phosphorus that will sustain a healthy lake were also determined for each lake. Using the computer model and monitoring data, lakes with excessive phosphorus were identified and classified as being 'Over Threshold' (OT). Figure 6 is an example of the graphing of phosphorus data. Because many of the lakes in Muskoka are naturally very low in phosphorus, many of the threshold limits are well below any standard established by the province. In fact, many OT lakes have phosphorus levels that are less than 10 ug/L, which is generally considered the level at which one might expect to experience occasional nuisance algae blooms. These stringent controls have been adopted to ensure the wide range of phosphorus levels found in lakes across Muskoka are maintained over time as presented in Figure 4.

The water quality of small and large lakes has different impacts on the overall health of the watershed. A large lake with significant water volume and flow that is OT has a greater impact on the overall watershed water chemistry than a small OT lake. Surface area or amount of water in a watershed that is OT, or high in phosphorus, therefore, is a better indicator of watershed health than a simple count of the number of lakes that are OT.

A value of zero percent (0%) of watershed lake surface area being Over Threshold (OT) was used as the benchmark. Subwatershed grades were scaled from that standard (Table 12).

[27] Cornelisse, K.J. and Evans, D.O. "The Fairy and Peninsula Lakes Study, 1994-1998: Effects of Land Use on the Aquatic Ecosystem."

[28] ug/L means micrograms per litre and is equivalent to parts per billion (ppb).

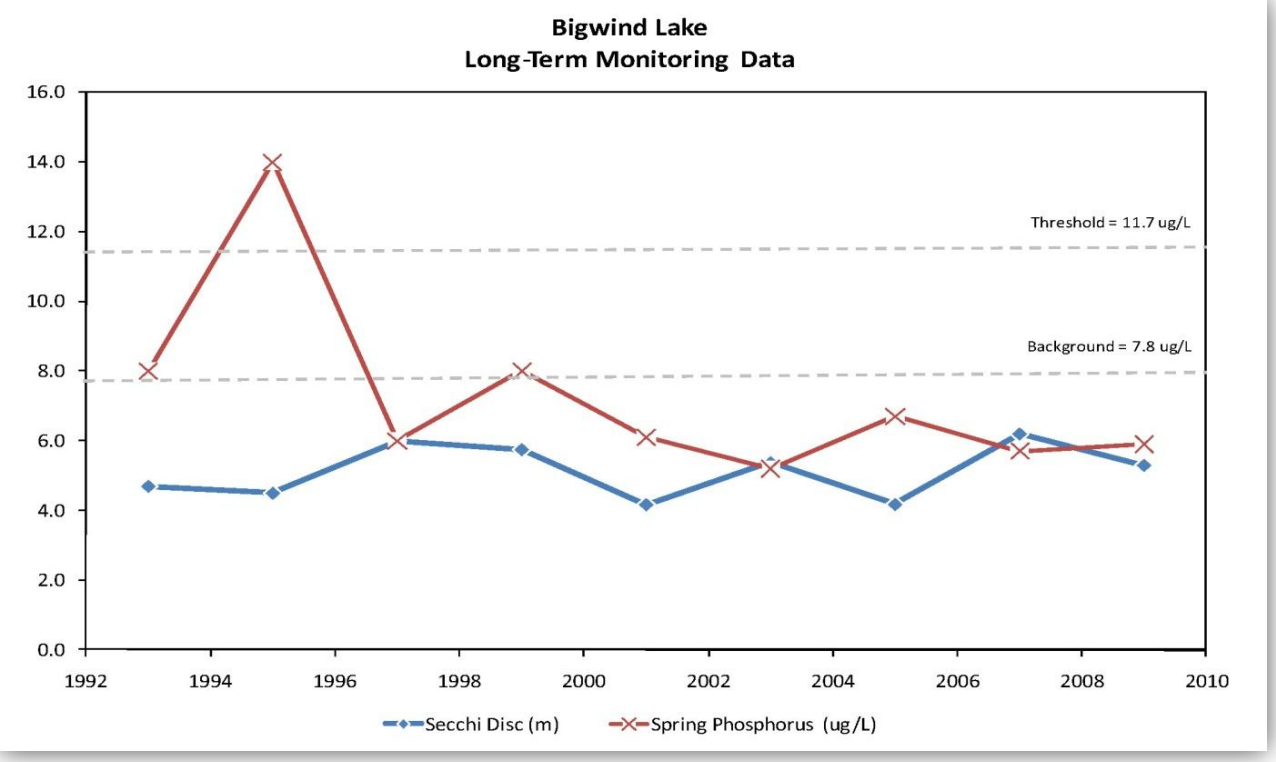

Figure 6: Example of Long-Term Monitoring Data

Table 12: Subwatershed Grades for Percent Surface Area Considered Over Threshold for Phosphorus

Subwatershed Name	% Surface Area OT	Grade		Subwatershed Name	% Surface Area OT	Grade
Moon River	15.5	C		Kawagama Lake	0	A
Gibson Lake	0	A		Huntsville Lakes	1.2	B
Lake Muskoka	7.7	B		North Branch Muskoka River	9.6	B
Lakes Rosseau and Joseph	3.9	B		Big East River	0	A
Cardwell Lake	0	A		Lake Waseosa	0	A
Skeleton Lake	4.1	B		North Simcoe	0	A
Three Mile Lake	4.1	B		Lower Black River	4.9	B
South Branch Muskoka River	39.4	D		Upper Black River	0	A
Lake of Bays	0.9	B		Kahshe Lake	0	A
Oxtongue River	1.2	B		Severn River	7.6	B
					Watershed:	4.9

Grades

A 0% OT B 0.1 - 10% OT C 10.1% – 25% OT D 25.1% – 50% OT F >50% OT

Benchmark - Zero percent of watershed lake surface area Over Threshold

Fish Habitat

The shoreline is defined as that area where the water meets the land. Shorelines are an important habitat for both terrestrial and aquatic animals. Shoreline vegetation protects waterbodies from nutrients and toxic chemicals that can be carried into the lake and contribute to water quality issues. They also protect the lake edges from erosion caused by waves and ice. The shoreline zone provides critical habitat for aquatic insects, microorganisms, fish, and other animals, thereby helping to maintain a balance in sensitive aquatic ecosystems.

Native vegetation along the shoreline is important to maintain biodiversity and is an important component of a lake system by providing habitat for both aquatic and terrestrial animals, stormwater management, water purification and visual beauty.

There is a belief that key fish populations across Ontario, like lake trout, have been degraded. The extent of the damage, however, cannot be assessed objectively because the required data are not available. Where data are available, it comes from case studies instigated in response to a perceived problem. Such data have enhanced the understanding of the stressors that impact fish populations, but they are not very useful in addressing questions about the overall condition of the fish resource.[29]

Alteration to shorelines has been used in the Report Card as an indicator of the health of fish habitat. Natural shoreline areas include wetlands, deciduous or coniferous forests and natural beaches, amongst others. Altered shoreline areas include man-made beaches, lawns, and hardened shorelines, amongst others.

There is a direct correlation between the quality of fish habitat and disturbance to natural shorelines. The District Municipality of Muskoka undertakes shoreline land use surveys that identify shoreline alteration. Where no shoreline surveys have been conducted the 2008 air photos were used to estimate the shoreline condition. Work in the early 1990s undertaken by The District Municipality of Muskoka, the Township of Muskoka Lakes and local builders established a reasonable shoreline disturbance zone of 25% of a shoreline lot, based on 200-foot lot frontages. This benchmark has been used to establish a standard for grading shoreline alteration in the Report Card. Table 13 provides an evaluation of the health of fish habitat by subwatershed.

[29] Lest, N.P., Dunlop, W.I. "Monitoring the State of the Lake Trout Resource: A Landscape Approach." In *Boreal Shield Watersheds: Lake Trout Ecosytems in a Changing Environment*, ed. By. J.M. Gunn, R.J. Steedman, and R.A. Ryder. Lewis Publishers, 2004.

Table 13: Subwatershed Grades for Fish Habitat

Subwatershed Name	% Natural Shoreline	Grade	Subwatershed Name	% Natural Shoreline	Grade
Moon River	96	A	**Kawagama Lake**	96	A[1]
Gibson Lake	86	C[1]	**Huntsville Lakes**	88	B
Lake Muskoka	86	C	**North Branch Muskoka River**	86	C[1]
Lakes Rosseau and Joseph	86	C	**Big East River**	95	A
Cardwell Lake	98	A[1]	**Lake Waseosa**	94	A
Skeleton Lake	85	C[1]	**North Simcoe**	92	B
Three Mile Lake	86	C	**Lower Black River**	94	A[2]
South Branch Muskoka River	86	C	**Upper Black River**	-	insuf. data
Lake of Bays	88	B	**Kahshe Lake**	90	B[1]
Oxtongue River	100	A	**Severn River**	95	A
				Watershed:	**91**

Grades

A ≥ 94% Natural B 88 - 93% Natural C 83 – 87% Natural D 75 – 82% Natural
F <75% Natural

Benchmark - 75% natural shoreline – Muskoka standard as established by municipalities

Fish Contaminants

In Muskoka there are no notable point sources of industrial contamination in lakes and rivers. Most heavy metal and other industrial contamination is generally a result of airborne pollutants traveling long distances and being deposited in local lakes and rivers. In inland lakes on the Canadian Shield, mercury in fish is the most significant contaminant. Most of the consumption restrictions of inland lakes and river in the *Guide to Eating Ontario Sport Fish* are due to mercury. Hence, it will be used as an indicator of watershed health.

Like water, mercury has a natural cycle of evaporation, atmospheric transport, deposition, and re-emission. This cycle has persisted as trace phenomenon as long as the earth has existed. However, man's use of mercury and of resources containing trace amounts of mercury (e.g., ores, coal and oil) greatly enhanced the emission and subsequent deposition of mercury over the past two centuries. Consequently, large regions of North America, and indeed the globe, have been subject to a prolonged period of elevated deposition of mercury. Although anthropogenic emissions in North America have declined dramatically over the past two decades, the residual pool of previously deposited mercury as well as continuing emissions from fossil fuel combustion, smelting and other industrial activities sustain elevated levels in fish.

Mercury in the environment can be transformed into many different forms, but one form, methylmercury, is of particular concern. Methylmercury is a highly potent neurotoxin[30] and its concentration biomagnifies[31] through the food chain. It accumulates throughout the bodies of animals, but protein-rich tissues such as muscle have the highest affinity. Unlike most organic contaminants, it does not concentrate in body fat. Methylmercury binds tightly to sulphur containing amino acids of protein and cannot be removed, for example, by trimming fat from fish filets.

Methylmercury forms in the environment by several mechanisms, but a particular group of bacteria (sulphate reducers) appear to be responsible for most of its formation. They are found everywhere in a lake environment, but their activity is highest where oxygen levels are low such as in sediments, wetlands and in some types of lakes. Consequently, there may be significant variation in the methylmercury concentrations between lakes, even those in close proximity.

The methylmercury concentration in water is exceedingly low in all lakes and rivers and it is not of concern with regard to drinking water. However, methylmercury in water is easily absorbed and concentrated by microorganisms like phytoplankton (microscopic plant organisms) at the base of the food chain. Their levels of methylmercury are often 100,000 fold higher than the water. Each subsequent step up the food chain further enhances the concentration such that levels in large fish may be well over a million fold higher than the water. Inorganic forms of mercury do not biomagnify through the food chain. Consequently, the mercury at the top of the food chain is almost entirely methylmercury.

The current levels of mercury in fish are the result of both ongoing deposition and the pool of previously deposited mercury in forest soils, wetlands and sediments. Some of that mercury is from the natural background cycle that has always been present. The rest is from ongoing or previous anthropogenic emissions. The relative proportions are difficult to determine, but changes in the sediment record suggest that current levels are two to three times higher than background. Because mercury is an element it persists indefinitely in the environment and its effects are mitigated only when it is sequestered deep in sediments or soils. Thus, elevated levels of methylmercury in fish are likely to persist for decades (perhaps centuries) while previously deposited mercury is gradually removed from active cycling in the environment.

There is no direct evidence of overt, adverse effects of methylmercury on humans or wildlife in Muskoka, but there are suggestions in the scientific literature (Scheuhammer et al., 1994; Mierle et al., 2000) that fish-dependent wildlife such as loons, mergansers and otters are at risk. These and some other species consume so much fish that their intake, and consequently their risk of mercury poisoning, is relatively high. The risk to humans is lower because of their lower consumption of fish. However, it is important to follow the consumption guidelines published in the *Guide to Eating Ontario Sport Fish* to ensure that the risk is kept low.

The risk of mercury poisoning to wildlife varies from species to species. Factors such as size and metabolic rate influence food consumption rate, but combined with toxicological information, maximum safe concentrations of methylmercury in food can be determined. These values have been determined for a number of Canadian wildlife species (Environment Canada, 2001) and the most sensitive species is thought to be Wilson's storm petrel. Its maximum safe concentration (0.033 ppm methylmercury) has been set as the Canadian Tissue Residue Guideline for the protection of wildlife consumers of fish and shellfish. The Muskoka Watershed Report Card uses this value as the benchmark.

[30] Neurotoxin - any toxin that affects neural tissues. wordnetweb.princeton.edu/perl/webwn

[31] Biomagnification - the process whereby concentrations of certain substances increase with each step up the food chain. www.fishonline.org/information/glossary/

Mercury levels in fish in a series of lakes across the watersheds of Muskoka were analyzed. The fish species included were yellow perch, walleye, small mouth bass, northern pike and lake trout. For each fish species the size at which a fish accumulated mercury to the 0.033 ppm benchmark was determined. For example, in the Huntsville Lakes subwatershed yellow perch reach the 0.033 ppm concentration level at about 10.68 centimetres while northern pike do not reach that concentration until 52 centimetres.

The common loon was used as the indicator species in determining the environmental impact of mercury concentrations on wildlife in lakes. Loons normally eat fish that are 4 to 10 centimetres in size. Therefore, if fish in a particular lake do not reach the 0.033 ppm standard until the fish is over 10 centimetres, then loons will not be impacted. Alternatively, where fish that are less than 10 centimetres have mercury concentrations over 0.033 ppm there could be a possible neurological impact on loons.

Table 14: Subwatershed Grades for Mercury Contamination of Fish

Subwatershed Name	Grade		Subwatershed Name	Grade
Moon River	**A**		Kawagama Lake	**ISD**
Gibson Lake	**A***		Huntsville Lakes	**A**
Lake Muskoka	**B**		North Branch Muskoka River	**C***
Lakes Rosseau and Joseph	**ISD**		Big East River	**ISD**
Cardwell Lake	**ISD**		Lake Waseosa	**C***
Skeleton Lake	**C***		North Simcoe	**ISD**
Three Mile Lake	**ISD**		Lower Black River	**ISD**
South Branch Muskoka River	**B**		Upper Black River	**ISD**
Lake of Bays	**A**		Kahshe Lake	**A***
Oxtongue River	**B**		Severn River	**A**
			Watershed	**B**

* No data on one or more fish species

Grades

A All species meet benchmark at 10 centimetres
B Four species meet benchmark at 10 centimetres
C Three species meet benchmark at 10 centimetres
D Two species meet benchmark at 10 centimetres
ISD Too few data sets to evaluate

Benchmark - <0.033 ppm mercury in fish 10 cm in length

Summary

The aquatic component of each subwatershed can be analyzed based on the three indicators outlined above (total phosphorus, fish habitat, and mercury contamination). Together these components provide an indication of the health of the aquatic component of the watershed.

Based on work undertaken within Muskoka, local benchmarks have been developed against which change in the watershed can be measured. The 2009 benchmarks will be used in future report cards to understand change within the watershed.

Table 15: Overall Subwatershed Grades for the Water Component of the 2010 Report Card

Subwatershed Name	Overall Grade	Subwatershed Name	Overall Grade
Moon River	**B**	Kawagama Lake	**A**
Gibson Lake	**B**	Huntsville Lakes	**B**
Lake Muskoka	**B**	North Branch Muskoka River	**C**
Lakes Rosseau and Joseph	**B**	Big East River	**A**
Cardwell Lake	**A**	Lake Waseosa	**B**
Skeleton Lake	**C**	North Simcoe	**A**
Three Mile Lake	**B**	Lower Black River	**A**
South Branch Muskoka River	**C**	Upper Black River	**A**
Lake of Bays	**B**	Kahshe Lake	**A**
Oxtongue River	**B**	Severn River	**A**
		Watershed	**B**

WETLANDS

Wetlands are defined as

> *lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. In either case the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic or water tolerant plants. The four major types of wetlands are swamps, marshes, bogs and fens.* [32]

A **swamp** is a wetland type with woody vegetation such as white cedar, black spruce, red maple, tamarack and white pine. Swamps are the most common wetland type in Muskoka. A **marsh** is a wetland type without woody vegetation and features grasses, rushes, reeds, sedges, and other herbaceous plants. A **bog** is a wetland type that accumulates acidic peat and has no flow of water through it. A **fen** is a wetland type that accumulates peat deposits. Fens are less acidic than bogs and may have some flow through of water.[33]

Wetlands have been recognized by all levels of government as being important components of a healthy environment. The Federal government, through the National Round Table on the Economy and the Environment, considers wetland loss an indicator of declining environmental health. The Provincial government has taken many steps to identify and protect large, provincially significant wetlands, the most notable being the adoption of a protective policy statement under the Planning Act in the mid 1990's. The Province has also developed a system (Ontario Wetland Evaluation System: Northern Manual) to allow the evaluation and classification of wetlands in order to secure their protection through municipal planning documents such as Official Plans and zoning bylaws.

Wetland Values

Most "species at risk" native to Muskoka rely on wetlands for all or a portion of their life cycles. Many also rely on the surrounding land. Therefore, in order to protect these species and to ensure that wetlands continue to function, both the wetland and the surrounding land should be protected as changes are proposed.

Wetlands are both essential individual ecosystems and parts of larger, more complex ecosystems. They do not function in isolation and require the physical and biological interaction with the surrounding land to continue to function and provide benefits. Wetlands and the area that surrounds them provide continuous, sustainable environmental, economic and social benefits that contribute to the high quality of life in Muskoka.

For convenience, wetland values are generally grouped into biological, hydrological and socio-economic benefits; however, many of the values contribute to all three broad categories. Wetlands and their surrounding area:

- are important for control and storage of surface water and recharge and discharge of groundwater;
- maintain and improve water quality, aid in flood control, and protect shorelines from erosion;
- trap sediments that would otherwise fill watercourses;

[32] Government of Ontario, Provincial Policy Statement, Queen's Printer, 2005.

[33] Wikipedia, wetland definitions. http://en.wikipedia.org/wiki.

- support and initiate complex food chains that are ultimately essential for a broad spectrum of living organisms, including humans;
- provide important habitat for a wide variety of plants and animal species;
- immobilize some contaminants and nutrients;
- reduce other contaminants to less-damaging compounds;
- assist in maintaining water quality in adjacent lakes and streams that support fish populations;
- provide valuable resource products such as timber, fish and wild rice on a sustainable basis;
- contribute substantial economic and social benefits to the municipality through trapping, hunting, fishing and outfitters; and
- provide active and passive recreational opportunities, including canoeing, bird watching, hunting and fishing.

Although all wetlands have importance, it is broadly recognized that larger wetlands that support regional hydrological systems or are home to rare, threatened and endangered species require an extra level of protection.

Wetland Area

There are over 90,000 ha of wetlands in the Muskoka watersheds which represents 11.81% of the watershed area. Table 16 indicates that only 7.17% (approximately 6,400 ha of the total wetland area in the watersheds) have been evaluated. Of the wetlands that have been evaluated, 5,900 ha (6.6% of the wetland area) are of provincial significance. It is expected that this value will increase as more wetland evaluations are completed.

Protection of these significant systems is important in order to ensure that wetlands continue to function and provide ecosystem services in the long term. Currently 33.67% of known Provincially Significant Wetlands (PSW) are protected either as part of a provincial or national park, a provincial Conservation Reserve, a land trust property, or they are located on Crown land. An additional 3.73% of PSWs located on private land are part of the Conservation Land Tax Incentive Program, a voluntary program that allows property owners to be exempt from paying property taxes on the portion of their property that is PSW. In total 37.4% or 2,200 ha of PSWs are protected by these tools.

As development pressure continues, it is important to identify and evaluate wetlands in those subwatersheds most at risk from development pressure to ensure that appropriate consideration is given to the protection of these areas so that we continue to benefit from the ecosystem services they provide.

Wetland Grades

In southern Ontario, ecologists recommend that 10% of a watershed should remain as wetland in order to provide the ecosystem services and functions necessary for a healthy watershed. However, on the Canadian Shield this figure is less applicable. In Muskoka, many subwatersheds are naturally comprised of less than 10% wetlands. Therefore, for the purpose of the Report Card, it is assumed that the current wetland area in each

subwatershed is close to its natural level. For example, Skeleton Lake subwatershed has only 5.7% wetlands and the Lakes Rosseau and Joseph subwatershed has only 6.46% wetlands. As a result, these lakes are clear, cold water lakes that support healthy lake trout populations.

A value of no net loss of wetlands from the 2010 level will be used as the benchmark. In future report cards, wetland area will be measured as a deviation from current wetland areas as determined by a landscape level evaluation using air photography.

Table 16: Wetland Coverage for Each Subwatershed

Subwatershed Name	Subwatershed Area (ha)	Wetland Area (ha)	% Wetlands	Grade
Moon River	71,434.03	9,331.41	13.06	TBE 2014
Gibson Lake	18,577.59	4,390.35	23.63	TBE 2014
Lake Muskoka	46,545.40	4,847.90	10.42	TBE 2014
Lakes Rosseau and Joseph	42,745.24	2,760.08	6.46	TBE 2014
Cardwell Lake	13,235.75	2,051.10	15.50	TBE 2014
Skeleton Lake	9,206.27	524.57	5.70	TBE 2014
Three Mile Lake	15,023.26	1,816.22	12.09	TBE 2014
South Branch Muskoka River	35,845.57	5,004.46	13.96	TBE 2014
Lake of Bays	38,513.08	3,351.17	8.70	TBE 2014
Oxtongue River	60,786.08	5,765.83	9.49	TBE 2014
Kawagama Lake	40,750.28	4,063.48	9.97	TBE 2014
Huntsville Lakes	66,544.19	9,123.02	13.71	TBE 2014
North Branch Muskoka River	25,123.66	2,838.64	11.30	TBE 2014
Big East River	64,682.73	5,424.58	8.39	TBE 2014
Lake Waseosa	9,527.08	1,060.44	11.13	TBE 2014
North Simcoe	30,840.30	4,433.24	14.37	TBE 2014
Lower Black River	48,084.67	7,541.03	15.68	TBE 2014
Upper Black River	39,311.31	3,369.80	8.57	TBE 2014
Kahshe Lake	24,533.83	4,651.21	18.96	TBE 2014
Severn River	62,500.38	7,832.34	12.53	TBE 2014
Watershed	**763,810.70**	**90,180.86**	**11.81**	**TBE 2014**

TBE – To Be Evaluated

Benchmark – no net loss of wetlands from 2010 level in any subwatershed

SUMMARY

The health of a watershed can be defined both scientifically as the ability of a system to continue to provide ecosystem services and functions, and sociologically as the level of ecosystem function that is acceptable to society. Human settlement and activity are part of the watershed and future development is not only inevitable but also necessary to ensure the vibrant nature of communities. Whereas it may not be appropriate to hold a more developed subwatershed – such as the subwatersheds that encompass the Towns of Bracebridge, Huntsville and Gravenhurst – to the same high standard as an undeveloped subwatershed, more science is required to establish appropriate benchmarks that define a balance between the built and natural environments.

Table 17: Overall Subwatershed Grades for the 2010 Report Card

Subwatershed Name	Land		Water		Wetland		Overall	
	2007	2010	2007	2010	2007	2010	2007	2010
Moon River	NG	A	NG	B	NG	TBE 2014	NG	A
Gibson Lake	NG	A	NG	B	NG	TBE 2014	NG	A
Lake Muskoka	NG	D	NG	B	NG	TBE 2014	NG	C
Lakes Rosseau and Joseph	NG	C	NG	B	NG	TBE 2014	NG	B
Cardwell Lake	NG	A	NG	A	NG	TBE 2014	NG	A
Skeleton Lake	NG	B	NG	C	NG	TBE 2014	NG	B
Three Mile Lake	NG	C	NG	B	NG	TBE 2014	NG	C
South Branch Muskoka River	NG	B	NG	C	NG	TBE 2014	NG	B
Lake of Bays	NG	B	NG	B	NG	TBE 2014	NG	B
Oxtongue River	NG	A	NG	B	NG	TBE 2014	NG	A
Kawagama Lake	NG	A	NG	A	NG	TBE 2014	NG	A
Huntsville Lakes	NG	C	NG	B	NG	TBE 2014	NG	C
North Branch Muskoka River	NG	C	NG	C	NG	TBE 2014	NG	C
Big East River	NG	A	NG	A	NG	TBE 2014	NG	A
Lake Waseosa	NG	C	NG	B	NG	TBE 2014	NG	B
North Simcoe	NG	A	NG	A	NG	TBE 2014	NG	A
Lower Black River	NG	A	NG	A	NG	TBE 2014	NG	A
Upper Black River	NG	A	NG	A	NG	TBE 2014	NG	A
Kahshe Lake	NG	B	NG	A	NG	TBE 2014	NG	B
Severn River	NG	B	NG	A	NG	TBE 2014	NG	B
Watershed	**B-**	**B**	**B**	**B**	**NG**	TBE 2014	**B**	**B**

NG – No Grade
TBE – To Be Evaluated

CLIMATE CHANGE

Climate change will have a significant impact on the Muskoka watersheds over the next 100 years. This section is a synopsis of the Muskoka Watershed Council position paper on *Climate Change Adaptation in Muskoka* that can be found on the MWC website at www.muskokaheritage.org/watershed.

Although mitigation is necessary to reduce future climate change impacts, even if all carbon emissions ceased today, the climate would continue to warm until the end of the current century. Mitigation is required to address the impact of climate change in Muskoka.

Between 1948 and 2006, Ontario's average temperature increased by 1.30C. Projections made by the Ontario Ministry of the Environment indicate average temperatures over the Great Lakes Basin, including Muskoka watersheds, are likely to continue to increase between 2 and 40 C by 2050. The Ministry of Environment goes on to predict that precipitation may increase by up to 20% by 2050 in all but the summer months, when little or no change is projected. Rising air and water temperatures are already shortening the ice cover season, exposing water to evaporation for more of the year.

Warmer water combined with stronger winds and a longer ice-free period is likely to increase the volume of water evaporating from the surface of the lakes. Increased evaporation from the land surrounding the lakes, especially in summer, is likely to reduce the flow in rivers after the spring runoff. In the long-term, the most obvious combined result is likely to be a fall in the average lake levels of the four lower Great Lakes, currently projected to be between 15 and 115 cm over the next 40 years.

More moisture in a warmer atmosphere is expected to cause an increase in extreme weather events – rain, snow, drought, heat waves, wind, and ice storms. There are indications that this trend has already begun. Weather is also likely to be more variable and less predictable.

Both natural areas and socio-economic aspects of the watershed will be impacted by climate change.

Surface Water

Warmer summers will see increased evaporation of water from lake surfaces and increased transpiration of water by wetlands and forests, meaning less runoff, less water and longer periods of drought. As the watershed gets drier, wetlands will dry out and surface water temperatures will become warmer. Ice will form later in the fall and leave earlier in the spring. The longer ice-free season and warmer surface waters will cause the lakes to stratify earlier and be more stable.

Earlier onset and stronger, deeper stratification will means less cold water habitat for lake trout and an increased risk of total loss of oxygen (anoxia) in lakes leading to an internal phosphorus load and the potential for blue green algae (cyanobacteria).

Water quantity may be the most important integrator of response to climate change and should be monitored. Methods to hold back spring freshet and storm waters and release it slowly, sustaining streams during periods of drought, and increasing recharge to groundwater should be explored. Approaches to active lake management should also be explored with the province.

Forests and Wetland

Climate change will have three potential impacts on the forests and wetlands in Muskoka:

- Disease and Insects – as winters are less severe, more invasive species will survive in local forests.
- Extreme weather – The frequency and intensity of extreme weather and climatic events, such as thunderstorms and windstorms, hailstorms, ice storms, intense precipitation events, drought, heat waves, and abnormally warm winters, are likely to increase and this may be apparent by 2030 according to OMNR. More-frequent storm events will have significant financial implications.
- Drought – Drought will likely not have as significant an impact on forest health as other climate change factors. Muskoka may be lucky due to its location in the lee of the Great Lakes.

Climate change will increasingly make both animal species and local populations of tree species less well adapted to the climate where they occur. For some species, this will reduce growth at the centre of their range and increase growth closer to the northern end of their distribution. Northward movement of the climate is predicted to be +/- 3 km/year; a tree species' ability to migrate is typically < 1 km/yr. As a result, habitats will change in unknown ways and reaction to changing climate will be species specific.

Muskoka should be in a position to benefit from production of wood products near to major markets. Ironically, despite the rough time that forest products companies have had recently, future prospects may be much brighter, if climate change-appropriate economic policies are put in place.

Biodiversity

Biodiversity can be defined as the range of plant and animal life in a particular region. These systems in turn depend on a complex and interlinked set of ecological processes, and the physical systems – water, air, soil, and nutrients – on which they depend. It has taken millions of years, through cycles of fluctuating temperatures, precipitation, and atmospheric concentrations of carbon dioxide, for these systems to evolve.

A healthy ecosystem, with high biodiversity, provides important services to human society and a warmer climate will increase the rate of such processes as photosynthesis, plant growth, decomposition, and nutrient cycling. Disturbance regimes, including fire, insect pests, and invasive species, will likely increase in frequency and severity in a warming climate, and will test the ability of existing ecosystems to withstand change. Since much of Muskoka's economy derives from its natural environment, it will be important to build the resilience of those systems as an essential component of adaptation to climate change.

It can be difficult to separate the impact of climate change from other ecosystem stressors such as urban development, alien invasive species, and habitat fragmentation. Careful regional land use planning, creation of buffer zones, and protection of connected wildlife corridors are necessary to ensure that seemingly innocuous changes on the land surface do not have unintended consequences for biodiversity in a changing climate.

Community Infrastructure

Disruptions to critical community infrastructure as a result of climate change – including water treatment and distribution systems, energy generation and transmission, as well as transportation and residential damage – are

likely. Periodic assessment of the risks in the light of climate projections, followed by a review of the design standards for new transmission and distribution systems will be required as trends become clearer, including shifts in the tracking of ice storms.

Human Health

Projections of milder winters suggest that the stresses associated with living in a colder climate will diminish in the years ahead; however, there may be increased risks of illness and premature death as a result of heat waves, smog episodes and ecological changes that support the spread of mosquito and tick-borne diseases such as West Nile Virus, Lyme Disease, and even malaria as the climate changes.

The results will be not only more serious threats to human health, but increased costs and stresses on existing healthcare services and facilities. Clearly, there will be a need for more attention to long-term planning for healthcare in Muskoka.

Tourism

Muskoka's tourism sector is projected to experience some challenges. Winter recreation, like snowmobiling, may suffer some decline. In contrast, the season for warm-weather activities like golf is expected to increase. Muskoka can anticipate a longer season for recreational water activities such as swimming and boating. However, that may have a negative impact on water quality.

While the total value of tourism and its ancillary recreational equipment suppliers is unlikely to decrease and could even increase, there will be a shift in the balance of outdoor recreation from winter to warm-weather activities.

Agriculture

Warmer summer and winter temperatures will increase the duration of the spring and fall growing season, and expand the range of crops that can be grown. However, the frequency and severity of summer dry periods and droughts will increase the risk of growing these crops. Higher levels of carbon dioxide will promote faster growth, but studies show that nutritional quality may be reduced. Increased winter precipitation will result in faster spring runoff, increasing the risk of soil erosion. Rising temperatures are also expected to increase the potential spread of pests and diseases.

Adaptation to climate change includes the small size and isolation of Muskoka farms which can be an advantage in slowing the spread of crop and animal pest and disease epidemics. The higher organic matter soils will reduce runoff and erosion due to higher winter precipitation and extreme weather events. The high landscape diversity found on Muskoka's farmland will facilitate the migration of plant, animal and microorganism species to new habitats, and provide havens for the evolution of new biodiversity.

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