




The Naked Truth

GOING BEHIND THE SCIENCE OF LAKE SIMCOE

Ladies of the Lake
The Naked Truth

Windfall ecology centre

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An investigation by the Windfall Ecology Centre

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Contributing Authors

Jasmine Chabot, Randy French, Brent Kopperson, Gord Rodgers, Annabel Slaight,
Hilary Van Welter, Romila Verma

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Editor: Hilary Van Welter

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Ladies of the Lake
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Windfall Ecology Centre
P.O. Box 1319
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L0E 1R0
Website: www.windfallcentre.ca
E-mail: info@windfallcentre.ca
Tel: 866-280-4431

Design and production by Konstantin Roussetos

Photography:

p.6 Jim McConnell, p.7 Aaron Kohr, p.16 Chauvin Gatineau, p.23 Stephen Finn, p.26 Laura Dominguez, p.31 Nantel Pierrefonds, p.32 Chin Petaling Jaya, p.33 Sparkia Haslett, p.63 Jorge D'Onofrio, p.46 www.umext.maine.edu, p.46 www.owwrc.com, p.48, 51, 52 Jen Atkinson, p.50 Environment Canada, p.51 Shedd Aquarium, p.53, 58 www.lakeplan.com, p.54 www.scenicbarrie.com, p.55, 56 www.lsrca.ca, p.58 A.B. Sheldon, p.76 Jim Panou

Introduction

In 2005, the **Ladies of the Lake**, a grassroots group of women from around Lake Simcoe, brought attention to the issues facing the lake by disrobing for a 'cheeky not cheesy' 2006 Calendar. They put Lake Simcoe on the map!

The 'Ladies' did not wish to stop there so they launched a new initiative – **The Naked Truth Summer of Events** with the **Windfall Ecology Centre**. The purpose: to move awareness into action.

Systematic, sustainable action requires knowledge about the issues, so one of the first events in **The Naked Truth** initiative was to undertake a comprehensive research project. This research, we discovered, would prove to be the very first time that the science behind the changes in Lake Simcoe was presented in a way that would:

- Provide an overview of the signs or indicators of change as identified by the stakeholders around the Lake;
- Put into perspective the science behind the indicators in simple, lay terms, and;
- Offer a set of possible actions to restore the Lake to health for the communities around the Lake and watershed.

This research document was developed during the Winter and Spring of 2006, under the direction of the Windfall Ecology Centre, as the basis for a series of **The Naked Truth** action planning sessions in the Summer of 2006. A series of action planning events will build on the research by validating and adding to the list of indicators or signs about the lake as described by people who love Lake Simcoe, as well as creating a comprehensive set of priorities suggested by Lake Simcoe's key stakeholders.

At the very core of this paper is the understanding that the Lake is more powerful than us and that we need to create ways to stop harming it, start helping it and continue loving it so it can get on with healing itself.

We would like to thank Randy French, Gord Rodgers, and Jasmine Chabot of **French Planning Services** and **Dr. Romila Verma** for contributing to the research. This has been an extensive undertaking. Not only has the research been collected and synthesized, but all of the references have been peer reviewed and verified.

Lake Simcoe needs help. This help must come from scientists and governments, and also the communities of people that Lake Simcoe has taken care of for centuries. Welcome to the Naked Truth --a new and different expedition to restore the health of Lake Simcoe!

Hilary Van Welter
Chair of the Board
Windfall Ecology Centre

Brent Kopperson
Executive Director
Windfall Ecology Centre

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CHAPTER 1 – THE CONTEXT FOR THIS REPORT

"A wise owl by the name of Sam once told me about his connection to the land surrounding his home. As he explained this complex web, he taught me that "We are connected to all living things and to all things that support life." He explained that his "Quality of Life is not dependent on one single factor, such as clean water to drink or to swim in. Instead, the quality of his life is related to the health of the NATURAL, SOCIAL, and PHYSICAL environment that surrounds him."

Ojibway Shawanaga First Nation

The Ladies of the Lake 2006 Calendar raised awareness and the photographs we loved showed the women posed as partners with the landscape - flora, fauna as well as the water itself. This interdependency is also a component of this Report. We are reminded as we go forward to think about:

How all the indicators of the Lake's ailing health are interconnected, and

How human inhabitants need to work with the forces of nature to restore the Lake to health.

If we view the future only through a framework of science we may miss the magic and mystery that Lake Simcoe offers, and we risk being limited in our range of new ideas for action.

The context of this Report is one which attempts to view the science as one of a number of key components that must be considered when determining how to help the Lake return to sustainable health. Bringing the various scientific findings together 'under one roof' is one of the goals of this Report – there is another however. This is a Report about an ecosystem; therefore we wish to present the information using that framework – a number of interdependent issues that together form a picture of the current state of health of the Lake and the watershed. As Lake Simcoe is a microcosm of what is going on around the world – these issues range from the major challenges of our time – urbanization and global warming to the threat of the Round Goby.

At the centre of this Report is a twofold desire:

1. To bring awareness to the collection of issues facing the Lake and watershed, and;

2. To provide an initial framework and sets of actions that can be undertaken by several of the key stakeholders of the Lake including the citizens, governments at all levels, developers, and businesses.

In order to really understand what is behind the science – we are offering four key lenses through which to read the Report. One is from the perspective of Mother Earth, the second is from the perspective of the citizens of Lake Simcoe , the third is through the lens of the watershed, and the fourth perspective looks into Nature's Cycles.

1. CONNECTING MOTHER EARTH TO LAKE SIMCOE'S SCIENCE

A good place to begin our thinking about Lake Simcoe is from the point of view that the Earth is our 'Garden of Eden'. Mother Earth gives us plants that provide the air we breathe and purify the water we drink. Water has the power to erode rocks and change landscapes. We, ourselves, are made mostly of water, and without it we – and all life – will die. The air moves seeds to plant new life. The sun and the moon signal energy cycles of tides, migration, hibernation, reproduction and seasonal changes. Fire gives warmth, transforms, devastates and generates new life. Mother Earth gives life, is life, and has the destructive power to destroy life.

The great mysteries of the world around us were revered and respected by our ancestors who knew instinctively that it was essential to maintain a harmonious balance between the sacred elements and all life.

Over time, science evolved by breaking apart the magic of nature into isolated pieces in order to define them. Science and the management of nature are now starting to come full circle. For example, animals and plants are no longer considered in isolation from one another but rather as an entire ecosystem.

We are slowly returning to the reverence of Nature. But, we still need to learn to flow with Mother Nature rather than fighting her –also, we have yet to learn to let Nature be our teacher. We are, however, at the cusp of learning to live better and more wisely.

... that which is sacred should be respected and loved.

We are still poisoning the elements that protect us with noxious chemicals. In the name of progress, we are reducing the diversity of life and habitat. Most of all, we are being way too careless and neglectful of the Earth that supports us.

... and like any good mother, Earth is patient and endures, and with time will rectify our mistakes.

...Suzuki

As we think about the Lake Simcoe watershed, we need to twig to the fact that science and the spirituality that our ancestors embraced can no longer afford to be mutually exclusive. It is time now to bring forward the best of our past, celebrate the intelligence we have gained, and rekindle our love and respect for Nature as magical and mysterious!

2. COMMUNITY

The second perspective that we wish to present is at the very core of this Report – community action. This document has been written for people who love Lake Simcoe, in order to create awareness and insight to the key issues that are facing the Lake and the watershed. People may be aware of individual issues such as phosphorus, invasive species or growing urbanization. When one combines these issues, then adds other indicators of the changes happening right now around the Lake and watershed, a different story emerges.

The findings of this research reflects a growing imbalance in the eco-system of Lake Simcoe and the watershed caused by a myriad of factors, all of which have one thing in common – humans. The impact of the growing force of these factors is that sometime soon there will be a 'tipping point' when these factors reach a critical mass. Then there is no going back – everything changes all at once. We have a window of opportunity right now to listen to the Lake's ecosystem.

This window of opportunity for an eco-system means that action is needed by a range of different stakeholders who unite, orchestrate and leverage their knowledge, wisdom, efforts and energy. This research is the beginning of a series of events to bring together, link and build on the action plans, strategies and people that are currently in play around the Lake. It is intended to provide an initial bridge on which to meet. From there we can work together to create ways to stop harming the Lake, start helping it and continue loving it so it can get on with healing itself.

3.OUR WATERSHED

The third important lens to look through for this Report is that of the watershed. Stand on any shoreline, and reflect on what is important about our lake. Then, turn around and look into the lands that drain towards the lake. As an eco-system these lands are just as important to the health of your lake because everything that happens there can end up in the lake. This is known as our watershed.

Figure 1 – A Watershed

In other words, a watershed is simply a localized boundary to define how the water cycle moves across a landscape and through the earth. Water flows downhill and is gathered in the lowlands, such as lakes and wetlands. Plants and soil in your watershed also trap water particles and filter out impurities.

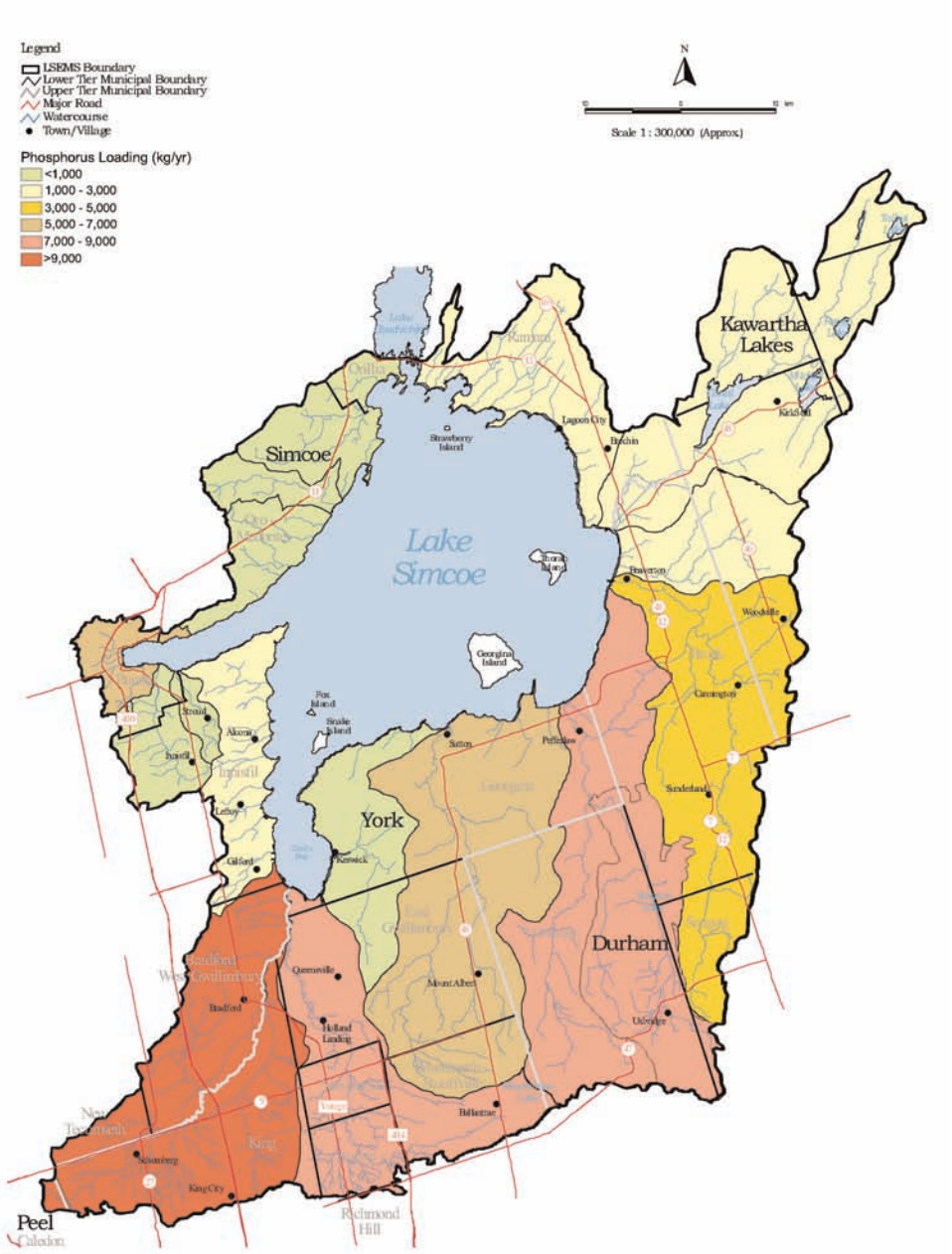
When landscapes are altered, water quality is compromised. When activities on the land emit pollutants and nutrients, destroy wetlands, pave natural areas and destroy organisms, water quality is degraded because the nutrient and energy cycles have been altered. Since water is constantly moving through the global water cycle, local issues become a global problem and compromise all life cycles on earth.

The Lake Simcoe watershed (Map 1) occupies an area of 3,576 km2. The land portion represents approximately 80% of the total area. The southern portion of the watershed is comprised of deep fertile soils and the northerly portion has thin sparse soils located over limestone, shale and granite bedrock. The watershed has been highly modified by agricultural and urban activity (Johnson 1997). About 40% of the watershed is agricultural land, 12% is urban and the remaining 48% is classified as woodland, wetlands or scrublands. Both agricultural lands, woodlands, wetlands and scrublands have decreased in area by about 9% since 1991 (LSEMS 2003).

The watershed is divided into 18 subwatersheds as indicated on Map1, and there are 35 streams and rivers flowing into the lake, and one major outflow, through Lake Couchiching to the Severn River. Five of the inflows are considered to be major tributaries: Black River, Beaver River, Talbot River, West and East Holland River and Pefferlaw Brook.

The watershed has 22 municipal governments (4 regions/counties and18 local municipalities). There has been a dramatic increase in population over the past ten years with 72 % of the growth in Barrie, Orillia, Aurora and Newmarket. In 2001 the population was 382,887 and this is estimated to be over 500,000 by the year 2021.

Map 1 – Lake Simcoe Watershed
Source: LSEMS 2003



According to the Lake Simcoe Environmental Management Strategy (LSEMS) the watershed has experienced considerable changes over the past 200 years from both human and natural causes. The greatest impacts that are still contributing to today's symptoms, occurred from the 1860s through to the 1950s when vast tracts of forest and wetland were cleared or drained for development, agriculture and timber extraction. At this time the lake's fisheries were exploited and pollution abatement was non-existent (McMurtry et al. 1997).

The Lake Simcoe Watershed is continuing to experience stress as human activity increases, which is showing up in a myriad of ways. This Report has been written to bring attention to these stressors and their causes. It is vital therefore that when reading this Report, the focus of attention not only be on the Lake, but also on the watershed in which the Lake lives.

4. NATURE'S CYCLES

First let's start with some simple definitions. Our natural **environment** is an organization of systems. Any community of living things which interacts with the environment is an **ecosystem**; it can be any size, your front lawn, the lake, or the planet. An ecosystem is an ecological system comprised of living and non-living things which are open to the flow of energy, water and matter. A **habitat** is simply the address where organisms live. **Sustainability** involves being able to satisfy our needs and aspirations without diminishing the chances for future generations.

Ecosystems are dynamically and constantly changing environments. One of the most important facets of ecosystems is that all the various facets are all interconnected and interdependent. Nature is not an assembly line – rather it is a intricate dance of living things that interact and impact each other. Nature also operates in cycles, i.e. a series of events that interact in such a way as to make life on earth possible.

The systemic understanding of life that is now emerging at the forefront of science is based on three fundamental insights:

1. Life's basic pattern of organization is the network;

2. Matter cycles continually through the web of life;

3. All ecological cycles are sustained by the continual flow of energy from the sun.

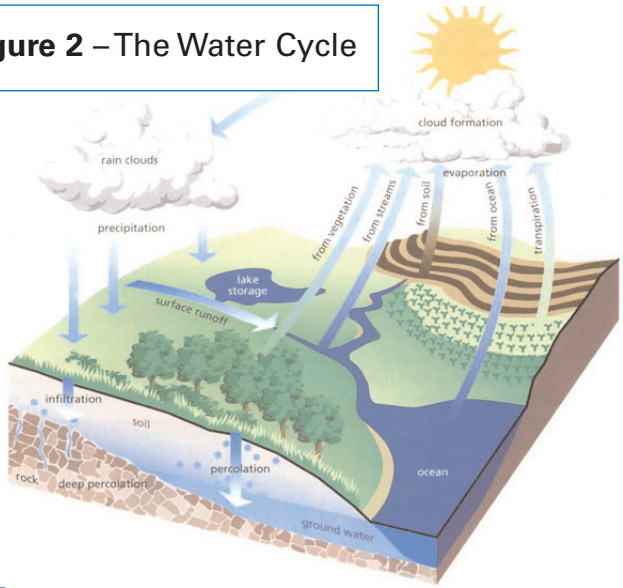
These three basic phenomena — the web of life, the cycles of nature, and the flow of energy are vital to understanding the issues facing Lake Simcoe. These three phenomena hold the key to sustainable health for all inhabitants of the Lake and watershed.

The Water Cycle

In order to understand how these three phenomena function – let's take the Water Cycle as an example.

The Water Cycle (Figure 2) is a global process that begins as water evaporates from water surfaces to condense into clouds. Water falls back to the earth in the form of rain, snow, or other precipitation and is stored in rivers, lakes, oceans, glaciers (ice caps) or underground in aquifers. The water then re-evaporates to begin the cycle anew. Plants and animals interact with this cycle because living things require water to function properly; living things therefore consume, transpire, excrete and exhale water. **Water quality and quantity are defined by the interacting relationship with living things and the watershed.**

Figure 2 – The Water Cycle



The figure on the left describes the cycle of nature. This cycle demonstrates the intricate interconnectivity of human action and our environment. When this system is imbalanced at any one of its stages of the cycle – the entire cycle is affected. This imbalance can threaten our way of living, as well as cost billions of dollars to restore.

Let's have a look at another cycle that is having a significant impact on Lake Simcoe – the Carbon Cycle.

THE CARBON CYCLE

The Carbon Cycle (Figure 3) is a complex series of processes through which all of the carbon atoms in existence rotate. The same carbon atoms in your body today have been used in countless other molecules since time began.

Carbon dioxide in the atmosphere is a 'greenhouse gas' - it traps some of the radiation that would otherwise be lost to space, and causes the Earth's atmosphere to be warmer than it would otherwise be. Man-made emissions of carbon dioxide have caused the amount in the atmosphere to increase by about 30% since pre-industrial times, and this is a major cause of global warming. Therefore it is important for us to understand how the carbon cycle works in order for us to be able to predict how it may behave in the future.

Carbon is continuously cycled between reservoirs in the ocean, on the land, and in the atmosphere, where it occurs primarily as carbon dioxide.

- On land, carbon occurs primarily in living biota and decaying organic matter.
- In the ocean, the main form of carbon is dissolved carbon dioxide and small creatures, such as plankton. The ocean takes up carbon dioxide when it is cold, at higher latitudes, and releases it near the tropics.
- Photosynthesis takes carbon dioxide from the atmosphere and transfers it to vegetation, while respiration releases carbon dioxide back into the atmosphere.

The burning of fossil fuels that have been sequestered underground for millions of years is the major source of green house emissions leading to human induced global warming.

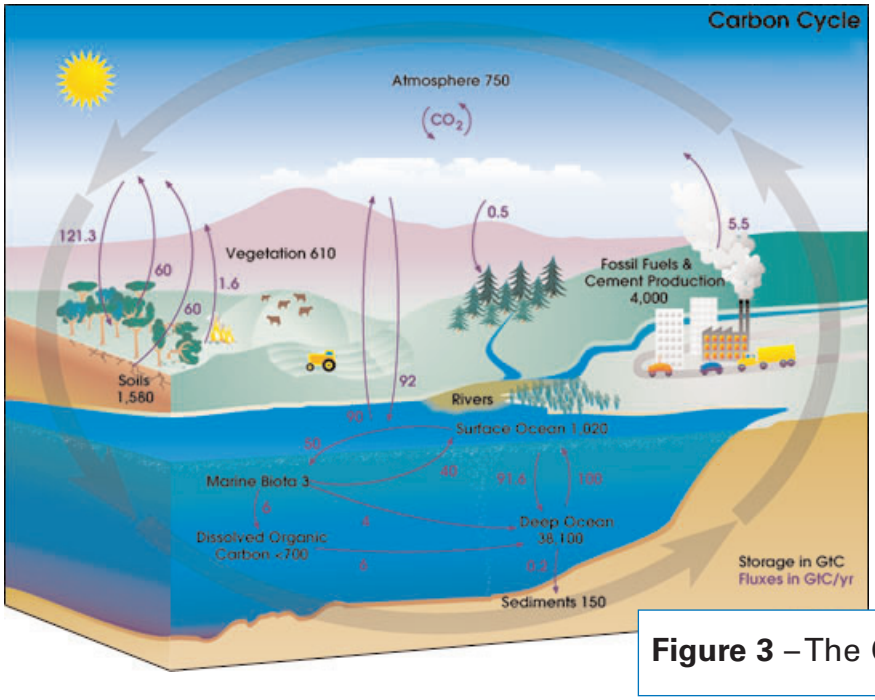


Figure 3 – The Carbon Cycle

The above 4 lenses – Mother Earth, the citizens, the watershed and nature's cycles are the backdrop and foundation on which this Report has been written. The following chapter now delves into the nature of the changes and their causes. This next chapter also provides some suggestions as to action that will be needed by the communities of the Lake and watershed.

CHAPTER 2 – INDICATORS OF CHANGE – WHAT IS CHANGING IN OUR LAKE?

Everyone from property owners, government agencies, anglers and recreationalists are witnessing many symptoms that indicate there is significant environmental and urban change occurring throughout the Lake Simcoe watershed. These indicators are noticeable changes in the normal functioning of our Lake, and they are providing clues about what ails our Lake. While some of these symptoms may be good, the symptoms that we are focusing on are the ones that affect the natural balance of the lake, especially in comparison to pre-settlement times.

Through our review of current and past literature and research documents we have found that there are "many canaries in our coal mine". We can no longer simply focus on one single issue or element because there are too many changes going on at the same time.

Canaries In Our Coalmine

- *natural reproducing lake trout*
- *natural mussels*
- *the quality of our "lake experience"*
- *water quality*

Figure 4 provides a summary of the common indicators and their possible causes. This figure shows that most indicators are the result of many causes and urges us to look at the problems in a comprehensive way that is – using 'eco-system thinking.' In the following pages you will find an explanation of the primary possible causes for these indicators as well as a starter list of solutions that must be considered.

Figure 4 – Summary of Indicators and Possible Causes

Indicators of Change	Possible Causes								
	Phosphorus	Global Warming	Invasive Species	Urbanization	Storm Water Runoff	Altering Natural Cover	Boating	Loss of Natural Areas	Fluctuatin Water Levels
1. There are more and more houses.				■					
2. The natural shorelines have been replaced.				■	■	■		■	
3. Sometimes my well runs dry.				■	■	■		■	■
4. There are signs posted saying I cannot swim today.	■	■		■	■	■		■	■
5. They say there is less phosphorus, but there are still lots of weeds.	■	■	■	■					■
6. There are more weeds and algae, and the lakebed is covered in goo.	■	■	■	■	■	■	■	■	■
7. There are new species in the lake and the water is clearer.		■	■	■			■		
8. I am catching lots of Lake Trout, what's the problem?	■	■	■	■	■	■		■	■
9. There seems to be fewer turtles and frogs.		■	■	■	■	■		■	■
10. The weather patterns are changing.		■							

1

INDICATOR 1... MORE & MORE HOUSES!

Urban development and population is growing exponentially in the Lake Simcoe watershed. Located within one hour of Toronto, many families are finding this area to be a most desirable place to live. To accommodate this growth, more houses and roads will be built, and if we are not careful in how this is planned, constructed and monitored, it could result in a significant detrimental impact on Lake Simcoe and its many streams and sensitive natural areas.

Managing growth, reducing traffic, creating sustainable development, and making smart transportation investments; these are all challenges we face today. These are becoming increasingly important issues as the population increases and development plans for available green space in the watershed are being drawn up. Like many of the other indicators, this is an extensive topic. However we are reviewing the highlights of the issue of urbanization by asking the following questions:

I. What Do We Know About Urbanization in the Lake Simcoe Watershed?

II. What Are the Key Trends to Deal with Urban Sprawl?

III. What Can Be Done? The Starter Action List

I. WHAT DO WE KNOW ABOUT URBANIZATION IN THE LAKE SIMCOE WATERSHED?

1. Human Use of the Lake Simcoe Watershed

The first inhabitants of the Great Lakes basin arrived about 10,000 years ago. They had crossed the land bridge from Asia or perhaps had reached South America across the Pacific Ocean. These First Nations people occupied widely scattered villages and grew corn, squash, beans and tobacco and relied on the abundance of fish and wildlife in the area to sustain their life. They moved once or twice in a generation, when the resources in an area became exhausted (US EPA).

The population in the Great Lakes area is estimated to have been between 60,000 and 120,000 in the 16th century, before the first Europeans began arriving. After the War of 1812, the transformation of the area from a sparsely inhabited wilderness into a home and workplace for millions began in earnest. The twentieth century saw a huge population growth in the Lake Simcoe watershed which continues today. Most of the growth occurred between 1991 and 2001 when the region's population grew by 30 percent, or 116,530 people. In 2001, the population was estimated at 382,887 (LSEMS 1995 and 2003).

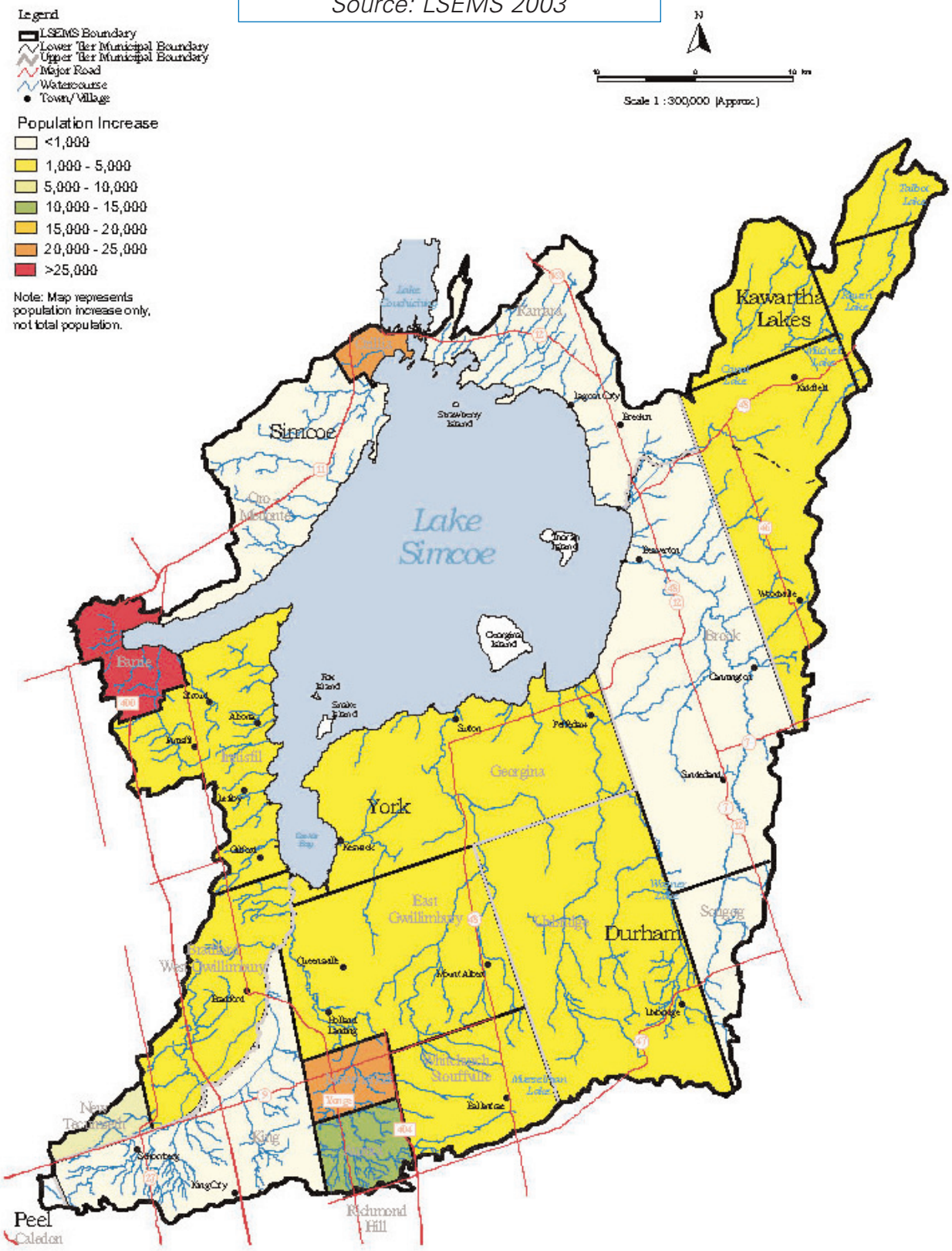
Did you know?

The Lake Simcoe watershed has:

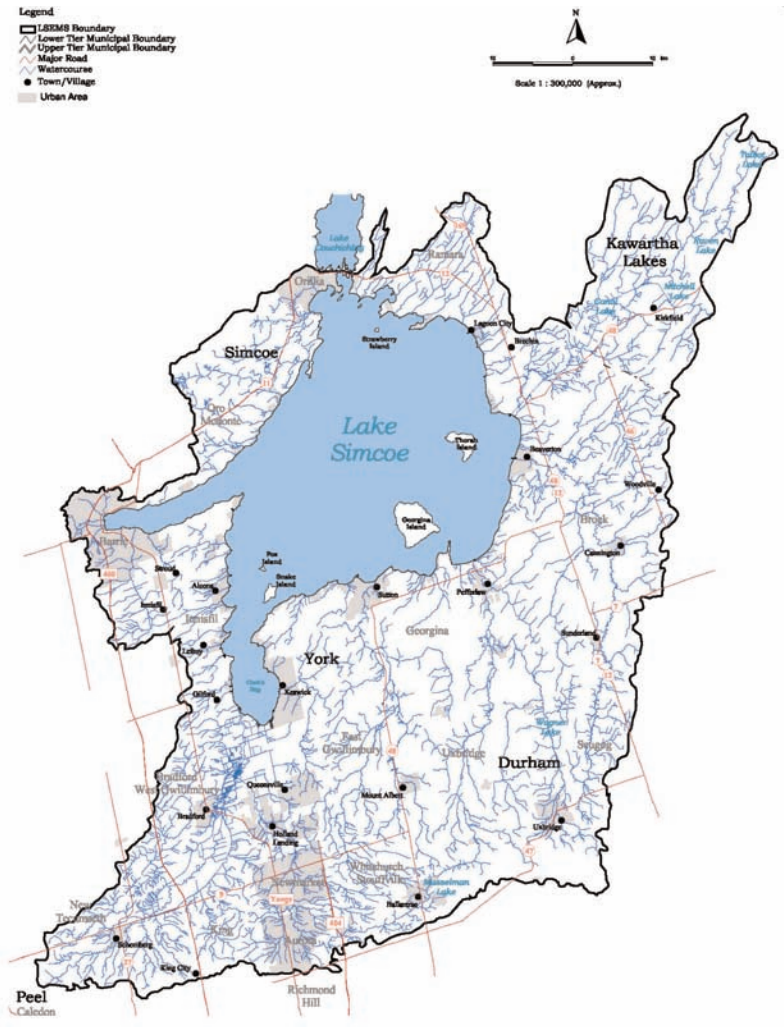
- *22 municipalities*
- *Over 380,000 residents in 2001*
- *Estimated population of over 500,000 by 2021*
- *12,000 cottages on the shoreline*
- *Just under 2,000 farms*
- *24 conservation areas and 3 provincial parks*
- *2 Moraines – The Oak Ridges and Oro Maraines*
- *58 species of fish*
- *65 species at risk*

Source: NEAC and LSEMS, Public Consultation Sessions, 2005

Map 2 – Population Increase
Source: LSEMS 2003



Map 3 – Urban/Built-up Areas
Source: LSEMS 2003



Map 2 shows the distribution of the population increase by municipality and Map 3 shows the areas of existing and already approved development. The most significant increases in population during this 10 year period occurred in the cities of Barrie and Orillia and the towns of Newmarket and Aurora.

Available information suggests that population growth will continue and this will increase development pressures for more urban areas within the watershed. Growth estimates received from municipalities have predicted that the population will increase to more than half a million by 2021. Most of the growth will be focused in the cities of Barrie and Orillia and the towns of Aurora, Bradford, Keswick, Innisfil, Newmarket and Queensville (LSEMS 2003).

Construction of new homes is essential to meet the demands of the growing population. In the city of Barrie 16,560 new dwellings were constructed between 1991 and 2001 and Newmarket was the next with 6,665 new dwellings. The total number of new dwellings constructed in the entire watershed was 66,965 (LSEMS 2003). Map 3 illustrates the built-up area in the Lake Simcoe watershed – the red is the existing build up, while the pink is the approved development. With more home construction, the response has been to expand infrastructure including roads and highways rather than looking to transportation alternatives. With the extension of Hwy 404, areas north of Newmarket are now open to further development and urban sprawl. The extension will pave over farmland and could result in low density housing developments and construction of other associated infrastructure like schools, community centres, and malls.

2. The Potential Effects of Urbanization

How will urbanization in the Lake Simcoe region manifest itself on its water, land and air resources? Some of the potential impacts to be concerned about include:

- **Non-point source pollution:** One of the major problems arising out of urbanization is non-point source pollution, which is described as contaminated run-off from impervious (paved) surfaces (such as roads, parking lots, and roofs), and from other sources, such as lawns and construction sites (IAGLR 2002). This water runoff can contain a lot of contaminants including; oil, other petroleum and chemical by-products; nutrients, including phosphorus; as well as garbage which can enter into the streams and lakes directly. And with the increased construction and population, non-point source pollution is even harder to detect or manage.

- **Use of road salts:** With increasing density of developed areas, the use of road salt also increases. Road salt washes directly into the streams and lake, and infiltrates into groundwater. Excessive use of road salt over the years can have negative impacts on aquatic organisms as well as large animals like moose, elks, etc., making them less responsive to moving vehicles (Sierra Legal Defence Fund and RiverSides, 2006).

- **Loss of forest cover, natural areas and farmland:** With increased development, forests and other sensitive natural areas may be impacted or lost. With large scale urbanization, the prime agricultural land is swallowed. The natural areas and forest covers are other attractive sites for the developers.

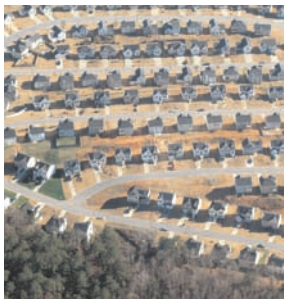
- **Increase in natural hazards:** Flooding may increase due to increased peak flows from uncontrolled urban areas. There will be increased erosion along streambanks associated with changes in the stream hydrology and morphology, potentially threatening human safety and causing property damage (LSEMS 2003).

- **Decreasing water quantity:** Increased development will also put a burden on groundwater supplies. With expanding population there will likely be acute pressure on the groundwater resource of the region to meet the growing demand.

- **Discharge of pharmaceuticals in water:** An emerging issue in the context of urbanization is the discharge of pharmaceutical products into the water. When human residences are built, supporting infrastructure like hospitals, schools, sports fields, community centres, and shopping malls are also required. Pharmaceutical products get into the water system through waste water treatment facilities, hospitals, homes, veterinary clinics, etc. Studies have shown that chemical-based compounds like blood pressure medication and endocrine disrupting substances are showing up in our water system in greater and greater concentrations (Holtz 2006). So far, the emphasis has been on testing for phosphorus in the water in the Lake Simcoe region but with the increasing evidence of pharmaceutical discharge into water bodies, another focus has to be on testing for other substances as well.

In addition to the above, there is the increased 'cost' of suburban sprawl. Sprawl is defined as development that is dispersed, auto-dependent, single use, and impossible to walk to your daily needs. It is usually located along highways and in rural areas outside urban and village centers. There is a growing general awareness that low-density residential development threatens farmland and open space, raises public service costs, encourages people and wealth to leave central cities, creates serious traffic congestion, and degrades the environment and our quality of life.

The costs include:



- **Low density means increased infastructure costs** – for example neither the development charges nor the property taxes actually pay for all the new infrastructure costs. As a result, Canada will have to fill an enormous infrastructure gap of inadequate sewer and water works and insufficient public transit, among other needs. That will cost billions of dollars to close.

- **Increased household costs** - for example, the cost of transportation. In Canada, buying, maintaining and fuelling individual vehicles cost more than food consumption, which accounts for only 11 per cent of family spending. This doesn't take into account the time and health cost in commuting.

- **Consuming precious land** - When open land is converted to subdivisions, pavement creates one of the most evident and dramatic changes. It has major impacts on hydrology, recreation, tourism, culture and the environment in general.

- **Public health risks** – These include the health risks associated with air pollution and automobile accidents. Most neighbourhoods have been designed so that it is not possible to accomplish most trips on foot, and physical activity is not a built in feature of these communities. This can contribute to obesity, a possible health risk.

- **Climate Change** – The more cities are extended outward, the more greenhouse gas emissions grow. The impact of these emissions was highlighted in the previous section.

- **Energy Costs**– Sprawl depends on an abundant supply of energy.

- **Aesthetics and Quality of Life** – The loss of 'sense of place' and the increased isolation that comes with urban sprawl has a cost that is recognized, but whose impact is not yet fully grasped.

As stated in 'Understanding Sprawl: A Citizen's Guide' published by the David Suzuki Foundation: 'Suburban sprawl is not sustainable. It neither conserves resources, nor creates efficient infrastructure, nor protects nature. It relies on transportation that consumes fossil fuel at wasteful rates, diminishes scarce agricultural land and assaults natural habitat on a massive scale. Unchecked suburban encroachment on the land will leave an unsustainable environment to future generations. In Canada, this is especially true around the bigger cities.'

The urbanization and sprawl issues being experienced by Lake Simcoe and the watershed are at a stage where there is a key opportunity to influence how development is undertaken. This area of the world could be a leader in two important ways:

- **Developing the type of communities that are sustainable and that honour and protect the natural habitat and quality of life for all – as well as,**

- **Creating a unique governance infrastructure and process that enables the citizens to work with the government (municipal, regional, provincial and federal) and developers in the sustainable development of Lake Simcoe and the watershed.**

II. WHAT ARE THE KEY TRENDS TO DEAL WITH URBAN SPRAWL?

There are a number of key trends that are already underway that would assist governments, citizens, and developers to build up Lake Simcoe and the watershed in ways that provide for population growth, but that also honour and sustain quality of life for all in this watershed. This section will address two – New Urbanism and Citizen Action.

1. New Urbanism

New Urbanism is a development strategy that addresses the issues of (sub)urban sprawl and more by creating communities that are livable, walkable, & sustainable, while raising the quality of life. Figure 5 shows the 10 Principles of New Urbanism.

Figure 5 – 10 Principles of New Urbanism	
Principle	**Description**
1. Walkability	– Most things within a 10-minute walk of home and work – Pedestrian friendly street design (buildings close to street; porches, windows & doors; tree-lined streets; on street parking; hidden parking lots; garages in rear lane; narrow, slow speed streets) – Pedestrian streets free of cars in special cases
2. Connectivity	– Interconnected street grid network disperses traffic & eases walking – A hierarchy of narrow streets, boulevards, and alleys – High quality pedestrian network and public realm makes walking pleasurable
3. Mixed-Use & Diversity	– A mix of shops, offices, apartments, and homes on site. Mixed-use within neighbour hoods, within blocks, and within buildings – Diversity of people - of ages, income levels, cultures, and races
4. Mixed Housing	– A range of types, sizes and prices in closer proximity
5. Quality Architecture & Urban Design	– Emphasis on beauty, aesthetics, human comfort, and creating a sense of place; Special placement of civic uses and sites within community. – Human scale architecture & beautiful surroundings nourish the human spirit
6. Traditional Neighborhood Structure	– Discernable center and edge – Public space at center – Importance of quality public realm; public open space designed as civic art – Contains a range of uses and densities within 10-minute walk – Transect planning: Highest densities at town center; progressively less dense towards the edge. The Transect integrates environmental methodology for habitat assessment with zoning methodology for community design.
7. Increased Density	– More buildings, residences, shops, and services closer together for ease of walking, to enable a more efficient use of services and resources, and to create a more convenient, enjoyable place to live. – New Urbanism design principles are applied at the full range of densities from small towns, to large cities.
8. Smart Transportation	– A network of high-quality trains connecting cities, towns, and neighborhoods together – Pedestrian-friendly design that encourages a greater use of bicycles, rollerblades, scooters, and walking as daily transportation
9. Sustainability	– Minimal environmental impact of development and its operations – Eco-friendly technologies, respect for ecology and value of natural systems – Energy efficiency – Less use of finite fuels – More local production – More walking, less driving
10. Quality of Life	– Taken together these add up to a high quality of life well worth living, and create places that enrich, uplift, and inspire the human spirit.

For more information visit: www.newurbanism.org

This is one concept for the development of progressive and sustainable communities. The key here is to know that there are other approaches than the housing developments we have built in the past. If as citizens we want to see things change, we have to get involved. This brings us to the next trend – Citizen Action.

2. Citizen Action

According to 'Understanding Sprawl: A Citizen's Guide' "...sprawl does not have to be Canada's urban future. It is possible to set boundaries around urban development, and within these boundaries to build communities that integrate homes, work, shopping, schools and all the amenities of modern urban life. This will happen only through the concerted efforts of citizens to convince governments to change the planning rules and to make the necessary investments, especially in public transportation. Citizens who understand the history of urban development and who use the toolkit for action can help eliminate the chaos and expense of sprawl and advocate instead for strong cities surrounded by fertile countryside."

We are seeing this in our own backyard. Given the reasonable proximity of Lake Simcoe and the watershed to the GTA, and the beautiful nature of the land with its varied lifestyle benefits found around the watershed, this area is being eyed by developers as fertile ground. **Campaign Lake Simcoe** is a partnership between Rescue Lake Simcoe Coalition, Ontario Nature and Environmental Defence to advocate the protection of greenspace in Simcoe County and the improvement and protection of Lake Simcoe's water quality. Campaign Lake Simcoe is working to 'green' the provincial government's proposed Greater Golden Horseshoe Growth Plan to maximize protection of forests, wetlands, farmlands and waterways in existing and new urban growth areas, which covers a broad area including Simcoe County.

According to Campaign Lake Simcoe, maximum amount of greenspace in Simcoe County must be protected through the "Places to Grow" initiative. The use of phosphorus must be reduced and restricted to improve the water quality. Also, the upcoming legislation on drinking water source protection must work together with the Growth Plan under "Places to Grow".

What is Places to Grow?

The Places to Grow Act intends to control urban growth in Ontario outside those areas already protected by the Greenbelt. Under the Act, the Growth Plan for the Greater Golden Horseshoe will apply to an area which stretches from Niagara through Hamilton and Kitchener-Waterloo to the GTA, Simcoe County and east to Peterborough.

What is Source Water Protection?

The drinking water source protection legislation is meant to protect our drinking water by ensuring that plans to protect water at its source are developed and implemented across Ontario.

For more information please visit the following websites:

Campaign Lake Simcoe	www.campaignlakesimcoe.ca
Environmental Defence	www.environmentaldefense.ca
Ontario Nature	www.ontarionature.org

Rescue Lake Simcoe Coalition is a lake-wide citizen umbrella organization that was formed to be an effective advocate for the restoration and protection of the environmental health and quality of Lake Simcoe. Their goal is to reduce the amount of phosphorus entering Lake Simcoe on an annual basis by 30 tonnes. Their approach is to engage the community and government to reduce the phosphorus goals.

These are two of the community groups that have emerged in the recent years to bring awareness and action to the state of health of Lake Simcoe and the watershed.

In addition to these groups, legislation is also a tool to help protect the natural habitat as well as protection of Lake Simcoe's green space from poorly planned development. On April 25, 2006 the Ontario Government introduced the **Lake Simcoe Protection Act (Bill 106)**. The intent of the legislation is to establish a comprehensive protection program for the natural heritage system and watershed for Lake Simcoe and the Nottawasaga River. The key objective of the legislation is to protect and enhance the ecological and hydrological integrity of the watershed for the benefit of present and future generations. When finally approved, this Act will be a welcome addition to the tools that can be used to ensure that the use of land and the construction of buildings and structures respect the ecology of the lake and its watershed.

A copy of the Bill is available at - www.ontla.on.ca/documents/Bills/38_Parliament/session2/b106_e.htm

More information on the proposed Act can be found at the Environmental Defense website www.environmentaldefence.ca

As we can see from the above, citizen participation in decisions concerning our community is key to stopping sprawl and creating sustainable quality of life for all. In the document 'Understanding Sprawl', it is suggested that the best place to start is by establishing a set of community goals. This will help catalyze citizens. The following set of goals and recommendations can form a part of every community plan:

- Protect the environment by preserving parks, ravines, natural areas and watercourses.
- Intensify town centres by enhancing economic activity and promoting mixed use development.
- Reinvest along empty corridors and brownfields and redevelop strip mall type roads.
- Promote regional planning.
- Promote alternative transportation.
- Increase housing and jobs.
- Protect the downtown.
- Protect existing compact residential neighbourhoods.
- Protect agricultural and rural areas by establishing a legislated urban growth boundary.

III. WHAT CAN BE DONE – THE SOLUTION STARTER LIST

The above section outlines two key trends in addressing sprawl. To create sustainable futures and quality of life for all, while dealing with urbanization and massive build-up, requires all of us will have to make an effort. It is through our collective sense of responsibility towards the ecosystem we live in, that we can heal and restore the health of our watershed. Here are some of the things we can do:

Government

- Legislation: Legislate protection for Lake Simcoe that aims to protect and enhance the ecological & hydrological integrity of the watershed.

- Policy Enforcement: Create and enforce policies that ensure new development does not impact our water, land, fish and wildlife resources.

Developers

- Become stewards of the environment: Introduce progressive development concepts such as New Urbanism into development designs.
- Become a part of the citizen action movement: Align with Campaign Lake Simcoe.

Individuals

- **Educate Yourself:** Learn about the impact of growth, urban sprawl and the ways of sustainable living.
- **Get Excited**: The new community models offer significant benefits for our quality of life. Become an advocate for sustainability and innovation.
- **Become part of the solution:** Check out www.campaignlakesimcoe.ca.
- **Conserve water:** Do not get onto the mindset that water is an infinite resource and we can use as much water as we want. The truth is as the population grows, the strain on the quality and quantity of our water supply will also grow, so it is imperative not to waste water. Some of the things we can do to conserve water are:
    - Check for and eliminate any leaks in faucets, toilets, hoses and pipes;
    - Run dishwashers and clothes washers only when they are full;
    - Compost biodegradable garbage;
    - Install high efficiency toilets which use less water per flush;
    - Clean walks and driveways with a broom instead of with water;
    - Take shorter showers;
    - Water your garden and lawn efficiently and only when needed;
    - Consider flushing your toilet for "solid reasons" only;
    - Turn the tap off while you are brushing your teeth, shaving, washing or rinsing dishes or washing fruits and vegetables; and
    - Wash your car using a bucket (LSEMS 2005).
    - More ideas are available at www.lsrca.on.ca/PDFs/actgui.pdf
- **Go on a "low salt" diet:** We need alternatives to de-icing rather than using salt. For more information, visit the following website at www.riversides.org/.
- **Put your yard and household on a "Low Phosphorus" diet:** Phosphorus (P) is found in everything from toothpaste to fertilizer and in most of the food we eat. While some phosphorus is natural and necessary for Lake Simcoe's health, the excessive amounts found in the lake are a result of human activity within the watershed. Figure 6 shows how putting your house in a low "P" diet would help the lake. Compare how much phosphorus is used, in these two households, in just 90 days.

Figure 6 – Low Phosphorus Diet			
High Phosphorus Use	**Grams Used**	**Low Phosphorus Diet**	**Grams Used**
Human waste	535 g	Human waste	535 g
One Load of Dishes, in the Dishwater, per day...using powdered detergent	650 g	Switching to phosphate-free detergent	0 g
Fertilizing a 30 x 30 m lawn, once per year, with a fertilizer containing 10 % of each of the following: nitrogen, phosphorus and potassium 10-10 -10	1,960 g	No Fertilizer	0 g
Lot cleared of trees increases runoff	30 g	Leave trees standing	20 g
Using commercial household cleaners	180 g	Using phosphate-free household products	20 g
Total Phosphorus Load	**3,355 g**	**Modified Phosphorus Load**	**575 g**

Source: www.lsrca.on.ca

- **Join "THE WAVE":** THE WAVE is a citizen's based action program to help residents make their yards water-friendly. It is the first education and outreach project of the Rescue Lake Simcoe Coalition. With 3 steps towards waves of success, this program offers advice to the residents regarding water conservation, native species plantings, organic lawn care, shoreline naturalization and home composting. For more information please visit www.thewaveprogram.com

- **Learn about the Lake Simcoe Protection Act:** In order to ensure that new developments are planned properly and are not negatively impacting on water, land and wildlife, we have to ensure that appropriate legislation, planning policies and review processes are in place.

- **Learn to love high density areas**: Because of the huge landmass available to Canadians, we have all become used to living in low-density and sprawling suburbia. In order to decrease urban sprawl, we need to use less room for residential and commercial uses. We have to redirect our growth "upwards" and not "outwards". In Europe and many other countries, high density, high rise buildings and self-sustaining urban areas are the norm- they encourage less encroachment on natural lands and promote the use of public transport.

- **Dispose of medications appropriately:** With the increasing evidence of pharmaceutical components and residues in our drinking water, we have to be careful in how we dispose of unused drugs. They should not be flushed or thrown into the garbage, but disposed of at hazardous waste depots where they are processed safely. For more information, go to the Canadian Institute for Environmental Law and Policy website at www.cielap.org.

- **Take Care of Septic Systems:** It is essential that septic wastewater does not reach the surface or groundwater supplies as it contains bacteria and viruses harmful to human health, as well as nutrients (e.g., phosphorus and nitrate) that promote algae and weed growth in the lake. Consider the following:

    - If purchasing a home, have a trained professional look for indications of a failing septic system. If there is a problem, improve or upgrade the existing septic system.

    - Submit an application to the local municipal health unit before installing a septic system. Even if a licensed contractor does the work, a certificate of approval will be required. Septic systems must pass a final inspection before a use permit is issued.

- Know the location of all the components of your septic system and keep heavy vehicles, large shrubs and trees away from these areas. Check the sludge level in your septic tank yearly and have a reputable contractor remove sludge and scum every 3-5 years – depending on how much the system is used.

- Dispose of household chemicals properly – at a Household Hazardous Waste Depot – do not pour them down the toilet or drain. They can destroy the bacteria that help decompose septic waste.

- Use food waste disposal systems (e.g., garburators) sparingly as they contribute unnecessary solids and grease to your septic system.

- Avoid using toilets as garbage cans - unnecessary solids reduce the efficiency of the system.

- Avoid using septic system additives to eliminate the need to periodically pump out the sludge.

- Call the local health unit if you think you or your neighbour is having a problem with a septic system. If you feel uncomfortable about reporting a neighbour, remember it's your water supply and your Lake that is at risk (LSEMS 2006).

- **Keep "Ecological Footprint" to a minimum:** Every human being consumes natural resources and thus leaves "ecological footprint" in our land. The Ecological Footprint is the amount of impact a person has on the consumption of natural resources. Therefore, in order to reduce our consumption of resources, we must try to mimic the natural environment that existed before development as much as possible. Replace lawns with a native plant ground cover, let the trees grow, and keep building sizes under control. A shoreline should be maintained as natural as possible. In addition, each and every citizen can do their part to reduce their personal ecological footprint by taking the David Suzuki Nature Challenge. Sprawl is not inevitable.

2

INDICATOR 2 – The natural shorelines have eroded and have been replaced by "hard structures".

The Lake Simcoe shoreline has been extensively transformed by human settlement. Cottages and permanent residences with a variety of break walls, docks and boathouses adorn the shoreline. These structures may be intrusive and disturb the land water interface.

There is an opportunity to reverse the degradation that has occurred around the lake and tributaries through the re-naturalization of shoreline areas with plantings of native plants and bio-engineered solutions to stop erosion problems. Preventing livestock access to tributaries and re-vegetating degraded stretches of streams and rivers flowing to the lake can limit further phosphorus loading.

The re-naturalizing of shorelines is a topic that crosses a number of issues that we are reviewing through the following questions:

I. What Do We Know About Shoreline Development?

II. What Can Be Done? The Solution Starter List

I. WHAT DO WE KNOW ABOUT SHORELINE DEVELOPMENT?

Historically, many river shorelines were stabilized and hardened with concrete and steel to protect developments from flooding and erosion, or to accommodate commercial navigation or industry. Typically shorelines were developed for a single purpose. Today, there is growing support for development of shorelines for multiple purposes so that additional benefits can be accrued.

Natural Shorelines Provide Multiple Benefits, including:

- *Shade and water temperature stability.*
- *Shoreline bank stabilization.*
- *A source of insects for foraging wildlife.*
- *Protective cover from overhanging branches and leaves.*
- *Under water cover from sub merged vegetation*
- *Protection from wind and wave action.*
- *Reduction and filtering of stormwater runoff.*

1. Why is it important to keep shorelines natural?

Shoreline ecosystems are diverse, dynamic, fragile and sensitive environments. Protection and management of these areas is important to preserve ecological functions and values of our natural environment, as well as the protection of the public health, safety and welfare of our community. Unregulated or inappropriate development on or near shorelines can result in impacts that threaten the public welfare and shoreline resources, including pollution, erosion and sedimentation, habitat loss, flooding, or loss of property.

A shoreline is more than a sandy beach. Shorelines support and sustain their own micro-ecosystems. The Lake Simcoe shoreline is a place for the fishes to spawn, for native plants to flourish and diverse habitat to survive. Natural shorelines also provide for aesthetic enjoyment and therefore are an important recreational and economic resource.

For an interactive look at the difference between natural and built up shorelines, as well as learn about the benefits of the natural approach check out www.windfallcentre.ca/shoreline.

Source website: www.co.whatcom.wa.us/pds/shorelines_critical_areas/index.jsp

2. Impacts of Lost Shorelines

Lake ecosystems are affected by a variety of influences that occur on the land, particularly due to urban style development along lake shorelines. Common impacts of development include the removal of native shoreline vegetation, introduction of non-native species, lawns and retaining walls. These impacts can manifest the additional problems in the following ways:

- Introduction of dissolved nutrients and pollutants.
- Loss of fish habitat, shade, insects and other aquatic organisms important to fish foraging.
- Lake shore protection works, like marine shorewalls, may also result in increased erosion of lake sediments which can disturb or destroy fish spawning and rearing habitat, as well as erode neighboring beaches and uplands.
- Increased stormwater runoff and toxins potentially decrease overall water quality, increase sediment inputs and turbidity, and increase nutrient inputs which may contribute to more frequent occurrences of aquatic weed growth and algae blooms.

Source website: www.co.whatcom.wa.us/pds/shorelines_critical_areas/index.jsp

3. A Shift from Hard to Soft

Hard engineering of shorelines is generally defined as the use of concrete breakwalls or steel sheet piling to stabilize shorelines and achieve safety. However, there is growing interest in using soft engineering of shorelines in appropriate locations. Soft engineering is the use of ecological principles and practices to reduce erosion and achieve the stabilization and safety of shorelines, while enhancing habitat, improving aesthetics, and saving money. Soft engineering is achieved by using vegetation and other materials to soften the land-water interface, thereby improving ecological features without compromising the engineered integrity of the shoreline.

Source website: www.fws.gov/midwest/DetroitRiver/pizza1.html

II. WHAT CAN BE DONE – THE SOLUTION STARTER LIST

Government

- **Develop educational tools to help residents and developers understand the impact of shoreline erosion.** Many people have just become accustomed or acclimatized to the building of the hard structures along the shoreline, without knowing the impact. Truly understanding and connecting to the impact of the loss of natural habitats on the future of the Lake's eco-system is a key tool for the survival of the Lake. Also the naturalizing of the shoreline can be aesthetically pleasing as well as environmentally sound.

- **Develop guidelines:** Policy guidelines are needed to ensure that natural shorelines are restored, as well as ensuring that they are preserved as new developments are built.

Developers

- **Create development plans that preserve natural shorelines.** There are ways to build developments that work with the land and water, rather than by creating an imbalance. Natural shorelines are alive with diverse inhabitants that one can't find elsewhere – a great selling feature. Sustainable living is becoming an increasingly important aspect of community development and developers can be on the frontier of this future.

Individuals

- **Learn about soft engineering:** Soft engineering is the use of ecological principles and practices to reduce erosion and achieve the stabilization and safety of shorelines, while enhancing habitat, improving aesthetics, and saving money. This is certainly an approach which would interest many people.

- **Reduce Urban Styled Shorelines:** One step in reducing the impact on shoreline structures on the health of your lake or river is to set aside an area, no larger than 25 percent of the frontage, with little or no vegetation to build your dock, boathouse, and swimming area, and to retain the remaining 75 percent as untouched, in its natural state. Even within the 25% of shoreline that you have set aside for development, you should still minimize the removal of shoreline vegetation because this vegetation prevents the shoreline from eroding and causing sedimentation problems in your lake or river. Building a small walkway from your cottage to the dock or boathouse will help maintain the shoreline vegetation by keeping people from trampling it.

- **Obtain Necessary Permits Before Starting:** Before you begin altering the shoreline, it is important to remember to obtain all the necessary permits. At least six federal and provincial laws affect shore work in Ontario. According to the federal Fisheries Act, the responsibility is on the landowner to ensure that shoreline work does not "harmfully alter, disrupt, or destroy" fish habitat.

- **Adopt Environment Friendly Practices:** When developing your shoreline, there are a few environmentally friendly practices you can follow to help ensure that your activities do not affect fish or fish habitat.
    - Select structures that minimize disturbance to the river or lake bottom. Cantilever, floating and post-supported docks and boathouses are recommended because they only disturb river or lake bottoms minimally, and they do not restrict the movement of water near the shore.
    - If you need to use a crib structure, it is best if you use an open-faced design. Open-faced cribs without solid planking provide fish and aquatic organisms with spaces to hide from predators. Cribs should be placed at least six feet out from the high-water mark.
    - Vertical planking should not be used along the sides of your dock because it can restrict the movement of water. Instead, you should use bridging between cribs or poles that allows the water to circulate.
    - Consider bio-friendly approaches to protect eroding areas. Concrete walls create an obstacle for wildlife that travel to and from the water.
    - The safest materials to use in shoreline structures are untreated wood such as cedar, fir, hemlock and tamarack. When submerged, these timbers will not decompose. Plastic wood can also last a long time if it is installed properly.
    - Avoid constructing private boat ramps out of cement as this destroys the fish habitat it is placed on. Consider the use of a marine railway to lessen the impact.
- **Avoid Dredging and Filling Shoreline Areas:** You want to avoid projects that require in-water dredging. Dredging may be harmful to fish and their habitat and permits will be needed to carry out this work.
- **Avoid construction at critical fish spawning times:** You need to ensure that your in-water activities do not occur during local fish spawning and nursery periods as the work can disturb spawning behaviour, smother eggs and kill young fish.

3 Indicator 3… Sometimes my well runs dry …

Canadians have always felt a sense of security when it comes to the availability of fresh water. While Canada is blessed with an abundance of freshwater, its quality and quantity is limited just like oil or gold resources. It is really important to manage and used this precious resource so that the future generations can avoid a shortage of water. With increasing population and unprecedented growth in the Lake Simcoe watershed region, the demand for water is increasing at an amazing rate and the resource we all have taken for granted, is now under significant strain.

Water not only supports a rich wildlife and fisheries resource, but also provides abundant beauty and serenity to the area. It gives people a sense of place and a sense of belonging. The most important aspect about water however is that we need it to live on this planet. Every past, present and future action about water use will have a profound impact on how much clean water will be available for the use of future generations.

We are reviewing this indicator by asking the following questions:

I. What Do We Know About Water Quantity?

II. How Do We Measure Water Quantity?

III. Why is Groundwater Important?

IV. What Can Be Done? The Starter Solution List.

I. WHAT DO WE KNOW ABOUT WATER QUANTITY?

Use of Water Resources

According to a report on the State of Lake Simcoe Watershed (2003), both surface and groundwater is used for the following purposes:

- **Drinking Water:** Lake Simcoe provides drinking water for the communities of Beaverton, Brechin, Sutton, Innisfil and Keswick. Keswick and Innisfil account for the bulk of this amount (8,500 cubic metres per day), followed by Sutton, Beaverton and finally Brechin.
- **Sewage Disposal:** Seven communities use Lake Simcoe to assimilate treated wastewater from their sewage treatment plants. The communities of Barrie, Orillia, Innisfil, Keswick, Beaverton, Lagoon City and Sutton discharge their treated waste water directly in to the lake, and another seven communities discharge to streams which eventually drain to Lake Simcoe (LSEMS 2003).

Did you know that?

First Nation people used to walk from the mainland to Georgina Island across land. The construction of the Trent Severn Waterway raised the level of Lake Simcoe by several feet. This flooding resulted in the drowning of all the wild rice around Georgina Island, which was a main staple in their diet, and also changed their means of travel.

- **Recreation:** Tourism is the most important industry associated with the lake: approximately $200 million is spent annually on tourism and recreational activities in the Lake Simcoe watershed. Related tourism events such as the Orillia Annual Perch Festival, the Georgina Annual Ice Fishing Festival and the Kempenfest Arts and Crafts Festival are an important social and economic contributors. A significant number of public and commercial services and facilities are dependent on the tourism market of the area.
- **Recreational Boating:** The size and location of Lake Simcoe and its link to the Trent Severn Waterway have made recreational boating activities very popular in the Lake. Most of the 14,000 cottages and homes along the shore have docking facilities and there are many public boat launching and docking sites. There are 29 marinas on Lake Simcoe providing a total of 4,246 boat slips and in 1990 about 11,500 transient boaters passed through the Trent Severn Waterway (LSEMS 2003).
- **Fishing in Summer and Winter:** Lake Simcoe receives the greatest angling effort of any Ontario inland lake. In 1990 an estimated 144,000 anglers visited Lake Simcoe. Ice fishing accounts for most of the angling effort, with an estimated 2,000 to 4,000 ice huts on Lake Simcoe each winter. During the ice fishing season the two most sought after species are lake trout and lake whitefish, both are coldwater species that are in danger. This extremely large and valuable recreational opportunity is not offered by any other inland lake in Ontario (LSEMS 2003).

II. HOW DO WE MEASURE WATER QUANTITY IN OUR LAKE?

A water budget is often used to help us determine how much water is flowing into (inputs), and out of (outputs) the lake, as well as accounting for changes in water storage. Lake Simcoe receives water from the atmosphere through rain or snow, from underneath through groundwater discharge and from surface runoff through its 35 tributaries, and waste effluent from sewage treatment plants. Water leaving the watershed is called "outputs" and includes: evapo-transpiration, water removals (taking), as well as surface or groundwater outflows.

A water budget is stable if inputs are equal to outputs, but serious consequences can occur when the budget is off balance.

This pie chart (Figure 7) demonstrates that surface water runoff from the surrounding land and streams is the most significant inflow of water to the lake, which makes sense given that the watershed is quite large. The largest loss of water from the lake is the outflow through Couchiching Lake and the Severn River, and the second largest loss is evaporation. The amount of area surrounding the lake that can store water during heavy rains or high water events has decreased slightly over the period 1990-1998; however, this figure is too small to be shown on the chart.

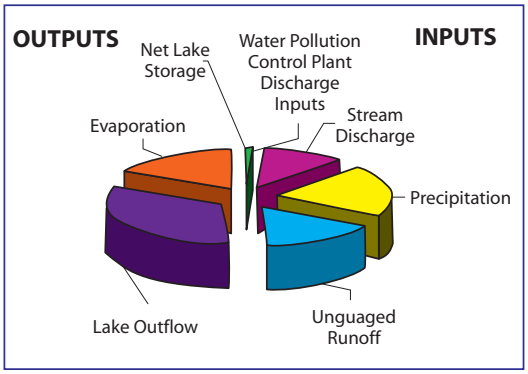


Figure 7 – Lake Simcoe Water Budget
Source: LSEMS 2003

Calculation of water budget plays a very important role in assessing and evaluating the availability of this precious resource. However, one factor that has not been adequately considered so far is the contribution of groundwater resources to the water budget of the lake. Perhaps this is because we have always felt secure in having access to one of the world's largest supply of freshwater resource. But this view is now changing due to increasing evidence of depleting groundwater resource due to changing landscapes and climate.

III. WHY IS GROUNDWATER SO IMPORTANT?

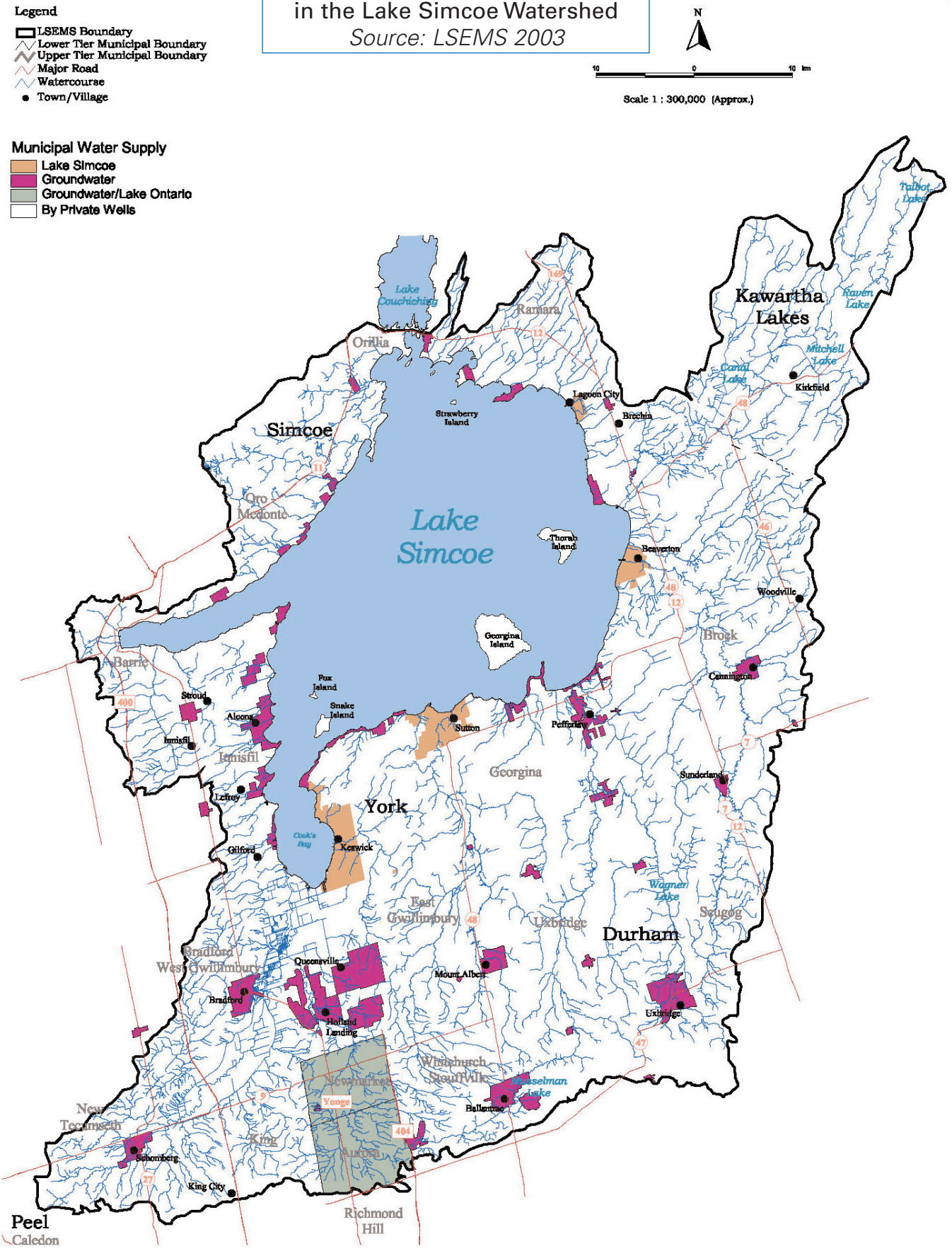
Historically, civilizations settled near a water body in order to draw water from lakes, rivers and streams because it was the easiest way to obtain it. Where surface water was not available or not drinkable, they dug deep into the earth to draw the purest source of water available – groundwater. Groundwater depletion, a term often defined as long-term water-level declines caused by sustained groundwater pumping, is a key issue associated with groundwater use. With increasing demand for water in the near future, this valuable resource will be threatened. The Lake Simcoe watershed is under increased pressure for urban-based development and a significant increase in population. This translates to a significant increase in groundwater use.

Within the Lake Simcoe watershed, groundwater is the primary source of drinking water (Map 4). Most communities in the watershed depend on either private or municipal groundwater supplies (LSEMS 2003). Therefore the abundance of clean groundwater is extremely crucial for our current and future inhabitants of the watershed.

So far, the emphasis of Lake Simcoe managers has been on monitoring the quality of groundwater and not the quantity. Current focus is on phosphorous loadings in the lake as well as seepage into groundwater. The water budget formula used by the Lake Simcoe Region Conservation Authority (LSRCA) indicates that there is no monitoring being done to determine how much water flows in and out of the ground. There is a huge information gap on groundwater quantity and we need to closely monitor how much water we are withdrawing and how much is going back into the ground.

Map 4 – Municipal Water Supply in the Lake Simcoe Watershed

Source: LSEMS 2003



Why is measuring groundwater important?

Pumping groundwater at a faster rate than it can be recharged can have some negative effects of the environment and the people who make use of the water. According to the US Geological Survey, following reasons are important to undertake groundwater balance studies:

- **Lowering of the water table:** A severe consequence of excessive groundwater pumping is the lowering of the water table and if groundwater levels decline too far, then wells may have to be deepened or a new one drilled. Also, as water levels decline, the rate of water that the well can yield may decline.
- **Increased costs for the user:** As the depth to water increases, the water must be lifted higher to reach the land surface, and larger pumps requiring more energy may be required to lift the water.
- **Reduction of water in streams and lakes:** Groundwater can be a significant source of inflow into a lake or river. Groundwater pumping can alter how water moves between an aquifer and a stream, lake, or wetland, and a related effect could be the lowering of groundwater levels below the depth that streamside or wetland vegetation needs to survive. The overall effect is a loss of riparian vegetation and wildlife habitat.
- **Land subsidence:** Sometimes when water is taken out of the soil, the soil collapses, compacts, and drops. This depends on a number of factors, such as the type of soil and rock below the surface. Land subsidence is most often caused by human activities due to the removal of subsurface water (USGS).

IV. WHAT CAN BE DONE – THE SOLUTION STARTER LIST

To avoid further groundwater depletion and to improve its quality, these three primary stakeholders must work together.

Government

- Municipal Governments must continue to monitor water quantity, and practice the same accountability to the water budget as to the fiscal budget. LSRCA is currently in the process of developing water budgets for a 25 year planning horizon through the Source Water Protection program. These are based on existing and projected water takings versus the hydrological cycle. These models look at a variety of factors, including geology, water transport, recharge rates, land use changes, etc.

Developers

- When undertaking any development projects, developers need to provide an assessment of the impact on water quantity. They will have to work with the other stakeholders to arrive at acceptable solutions with regards to pumping and usage.

Individuals

- **Learn about groundwater basics:** There are certain key principles that are important to know about where your well gets its water, and how to take care of this valuable resource – groundwater. There are vital considerations that must be taken into account when planning a new well (e.g. location, construction, and casing) or in the maintenance of existing wells –(e.g. contamination). The plugging and sealing of unused wells is also of major importance in ensuring that the groundwater is safe guarded from contamination. There are great resources available such as Well Aware – a project of Green Communities Canada. (www.wellaware.ca)

- **Undertake a free well assessment:** Well Aware offers home visits conducted by trained Water Guides to help rural well owners identify priority for action to protect their drinking water source. Visit the Windfall ecology Centre to find out more about free testing. www.windfallcentre.ca.

- **Get well water tested on a regular basis:** It is also vital that you get your well water regularly for bacteria including total coli forms and E.coli. The Ontario Ministries of the Environment and Health recommend testing the water 3 times a year for bacteria. Call your local health unit which provides the testing free of charge.

- **Learn how to maintain wells, have them inspected and maintain well records:** Wells provide us important information as to the state of health of our groundwater. Understanding the basics of well maintenance and operation, and taking the necessary actions to keep your wells in safe running order is the responsibility of each private well water owner. Help is available through Well Aware.

- **Conserve, conserve, conserve:** This statement could be made under all Starter lists as this action represents a key mindset shift in honouring that water is a finite resource. Particular steps that can be taken are found in Indicator 2 – more and more houses.

- **Take care of your septic system.** Taking care of a septic system is also an action that falls into a number of areas – the good news is that when people follow proper maintenance of use of their septic systems, many functions of the watershed benefit. Septic system care includes: knowing your septic system, getting a professional assessment, not using toilets as garbage cans, and not using food waste disposal systems. See Indicator 2 for more details.

4 Indicator 4… There are signs posted saying I cannot swim today.

There is nothing more discouraging than arriving at the beach for a day of fun and then learn that the beach has been "posted" because there are high bacteria counts that would endanger swimmers.

The common reason for beach closures is the effects of recent rainstorms that wash all kinds of bacteria, waste and animal poo into the lake. While this may be a temporary problem that soon goes away because of wind and water currents and dilution, it is a definite sign of how our activities impact water quality and our recreational enjoyment of the lake.

We are reviewing this indicator by asking the following questions:

I. What Do We Know About Beach Closures?

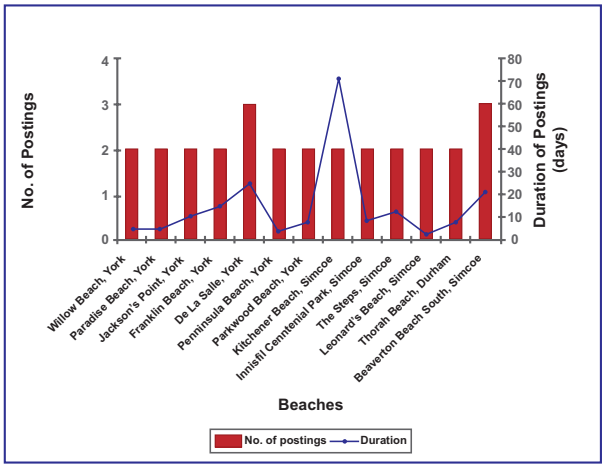
II. What Can Be Done? The Starter Solution List

I. WHAT DO WE KNOW ABOUT BEACH CLOSURES?

Beach counts are taken regularly over the summer (weekly or more often) by municipal public health units (Simcoe Muskoka District Health Unit, York Region Health Services Department, and Durham Region Health Department). We know that some of the public beaches around Lake Simcoe are being "posted" every summer, and a few are closed on occasion. In 2002, public beaches in all parts of the lake had at least one "posting." The worst locations were in the south, at beaches in York and Durham Regions.

According to the 2005 State of the Environment Report by York Region, things are not getting better. The report notes that, "despite the fact that water quality at some beaches has improved, there has been an increase in postings and closures of beaches since 2000."

Figure 8 – Number and Duration of Beach Postings, 2002



Of course, there is also the risk of health concerns at private beaches, or in the water at your dock, or the water that you draw from the lake for personal use. Some private beaches are monitored by the residents but most people do not regularly test the water off their docks or private beaches.

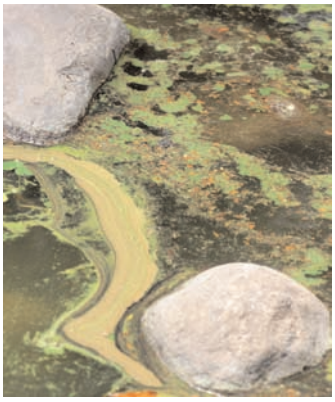
The prime sources of bacterial loadings include:

- **Run-off from the ground during rain storms:** Typically, bacterial counts go up after a rain storm and will stay elevated for 24 to 48 hours, until the materials and sediments that are washed into the lake settle out or are diluted by the cleaner lake water. As we have been experiencing more intense rain storms over the past decade (even though there is less rain overall), these storms can lead to more substantial amounts of material being washed into the lake, carrying more bacteria, and contaminating our swimming water.

- **Outfalls from sewage treatment plants:** Normally, the plants around the lake will do a good job of removing bacteria, and the efforts of LSEMS over the past twenty years has led to a much higher quality treatment than previously in place. All of the treatment plants with the exception of Cannington, Sunderland, and Holland Landing provide tertiary treatment (most proficient cleansing process vs. primary and secondary treatments). However, some of the treatment plants may overflow during heavy rainstorms, and in these cases, flush raw sewage and associated bacteria into the lake.

- **Run-off from agricultural feedlots and manure storage:** When manure is improperly stored, or cattle are allowed to walk into streams, more bacteria may be getting into the lake. Many farms in the agricultural community have embraced new management practices to reduce this, and LSEMS has helped with advice and funding over the years, but agricultural runoff continues to be a source of bacteria to the lake.

- **Septic systems that are not working properly:** Private septic systems, if they are not being properly maintained or replaced, are going to cause bacteria to get in the lake as well. This is especially a problem in front of your own home or cottage if you are on the lakefront.



- **Boat wastes:** Not every boater is responsible enough to have his/her waste properly pumped and disposed of, and this remains a source of pollution.

- **Waste from dogs and waterfowl:** If the geese can find nice grassy areas to feed on (like picnic areas and private lawns) they will congregate in large numbers and deposit waste that gets washed into the lake when it rains. And the same thing is going to happen if people don't pick up after their dogs.

- **Warm water temperatures also have an affect:** While warming temperatures aren't responsible for bringing bacteria into the lake, it does help bacteria to multiply. So, on those hot days when you really need to go for a swim, bacteria may be there to stop you from enjoying the day.

II. WHAT CAN BE DONE – THE SOLUTIONS STARTER LIST

Governments

- **Keep testing the water and reporting the results:** We know a fair amount about what is happening and what the sources are, and we have good information on bacterial counts over a period of time thanks to the work of the local health authorities. The health authorities will continue to do their monitoring and reporting of bacterial counts, and this is important. Since there isn't a lot known about the bacteria counts in front of individual docks and beaches, it might be useful to see if the health authorities would support a program of testing these waters on a regular basis.

- **Keep up/improve the good remedies:** Over the years, the LSEMS program has worked hard with the municipalities to improve the way our sewage is treated, and as long as we continue to apply today's standards, we'll keep this source of bacteria in check. Another one of LSEMS' priorities has been to increase the awareness of the farm community of how they can better manage farm wastes, and to help them to put these practices into place.

- **Research the impacts of geese at the beaches:** We know that the large geese populations contribute to the bacteria at our beaches, but we don't know just how much they contribute. Studies of specific beaches for the impact of waterfowl droppings could be useful, especially to discover ethical ways to discourage geese where a problem exists.

Individuals

- **Lobby health authorities for regular testing of bacteria count in front of individual docks and beaches.** The areas where residents live and make most use of the Lake is a very key place to be not only testing, but educating people.

- **Keep your own bacteria out of the water:** There are things that you can do as an individual to keep bacteria out of the lake:

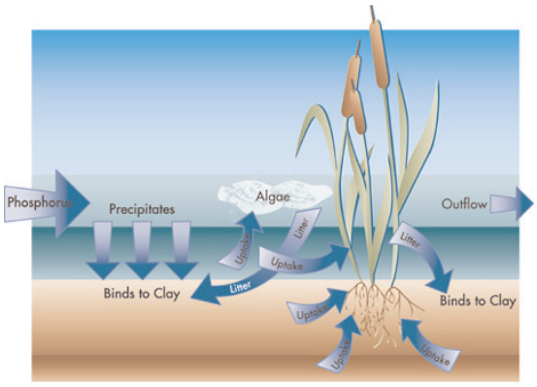
- **Keep your septic system in a healthy working state;**

    - Clean up after your dogs;
    - Discourage geese from your property by reducing the amount of grass;
    - Make sure your boat waste is properly pumped and treated; and
    - Don't pee in the lake.

5

Indicator 5… They say there is less phosphorus, but there are still lots of weeds.

Phosphorus (P) is a natural part of any lake's makeup and is one of several nutrients that are necessary for normal, healthy plant growth. In Lake Simcoe, excess P is also a symptom of human impacts, as it has been measured at extremely high levels, up to three to four times the "natural" levels (pre-1800). And this increase comes with serious consequences – increased weeds and algae, more "goo" and sediment, and problems for some of the cold water fish, like lake trout. Phosphorus entering the Lake according to latest monitoring numbers may be significantly reduced compared to the early 90s. Yet weeds and algae are present in large amounts. So what is going on?



The topic of phosphorus is one that has received a significant amount of attention over the past number of years. In some ways this subject has served as the lightening rod that has brought attention to a number of the key issues surrounding the Lake. As we are talking here about an eco-system, it is important to remember that phosphorus interacts with many other dynamics in the Lake and watershed. To understand what's going on requires looking at the range of factors at play – rather than trying to zone in on one cause.

The Issue of Phosphorus is being reviewed under the following headings:

I. What Do We Know About Phosphorus?

II. Where Does Phosphorus Come From?

III. How is Phosphorus Measured and the Data Interpreted?

IV. What Can Be Done? The Starter Solution List

I. WHAT DO WE KNOW ABOUT PHOSPHORUS?

1. The Effect of Phosphorus:

There are some good reasons why scientists have been looking at phosphorus in Lake Simcoe so carefully for so many years, and why LSEMS set a target level for P back in 1985:

- **Weed and algae growth:** Just as P is important in gardens, it is essential for the growth of plants in the lake. Excess P, however, results in overgrowth of plants and algae. Growth of weeds in the shallow waters near to shore is probably more dependent on accumulated P in sediment than on concentrations in the water column. Shallows close to shore and shallow bays like Cook's Bay suffer the most. Swimming is unpleasant, boats have trouble getting through weed beds, and rotting weeds cause bad odours along the shoreline.

- **Fish:** In the deep parts of the Lake, big algae blooms die off, and along with some floating weed, sink to the bottom and add to the phosphorus–rich sediment. Bacterial action on the decomposing algae releases phosphorus back into the water column, and utilizes the oxygen in the water creating anoxia (a pathological deficiency of oxygen) which interferes with fish reproduction.

2. The Measurement of Phosphorus in the Lake

- The Ministry of the Environment (MOE) has been measuring levels of phosphorus across the lake for twenty years, and some of their findings are summarized in a 2005 LSEMS Technical Report - # Imp. B. 20.

What has MOE found?

- The highest levels are routinely found in Cook's Bay, and in Kempenfelt Bay; however, both areas have shown a drop since the 1980s.
- The lowest concentrations are found in two areas of the main lake.
- Levels vary year-to-year.
- The overall trend has been:
  - Highest levels in the early 1980s;
  - Lowered in mid-80s; peaked in mid 90s; and declined through the late 90s; and
  - Rose again to a point in 2003-2004 that is slightly lower than the levels of the 1980s (Figure 9).

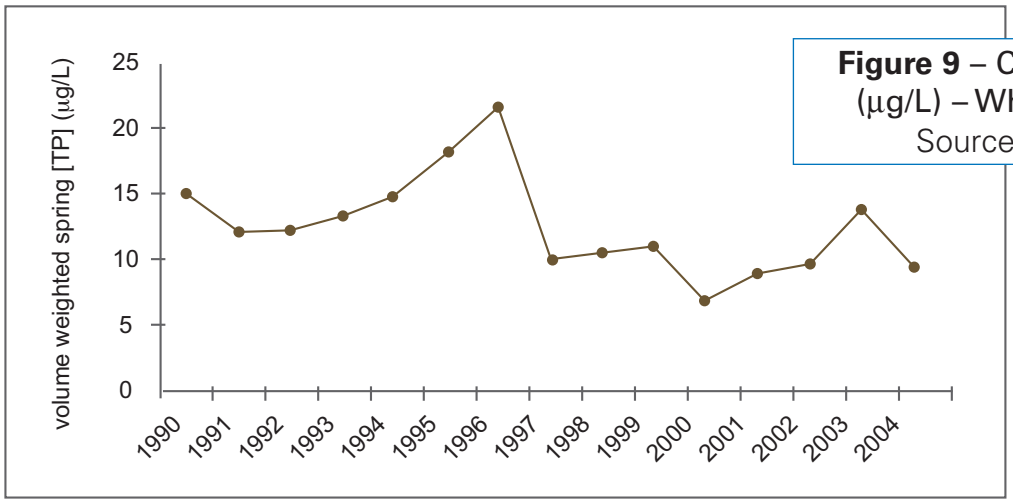
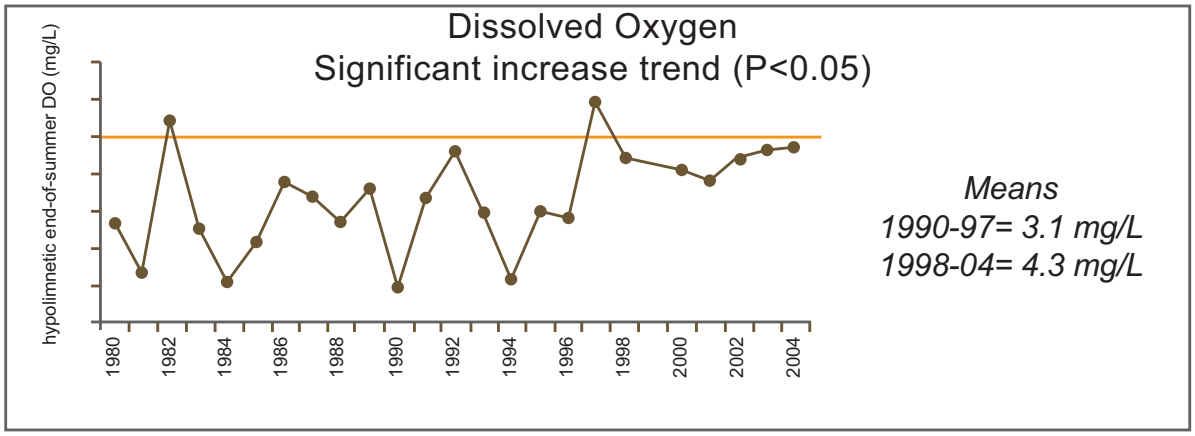


Figure 9 – Change in Spring TP (µg/L) – Whole Lake Average
Source: Winters 2005



Plants and algae in the lake. Source: Winters 2005

Generally, the actual measurements of phosphorus in the Lake have declined since the 1980s, and if you look at the oxygen levels, you'll see a slight improvement also. But still things aren't great, since the amount of oxygen is not high enough yet to satisfy the needs of the fish in the deep parts of the lake. The minimum target level is 5 mg/l for dissolved oxygen, but it's not there yet.

II. WHERE DOES PHOSPHORUS COME FROM?

1. Where Does Phosphorus Enter From?

We have a sense of the effect of phosphorus and recent measurements , but where does it come from? The following 2 Maps provide evidence as to where in the watershed the phosphorus is entering – through:
1) rural runoff
2) urban runoff
The rural run off is measured in terms of tributary loads which is an estimate of the P that comes from agricultural and other rural areas. The urban run off is referred to as urban stormwater and is the estimate of the run off coming in from towns and cities.

Tributary Phosphorus Load (Map 5)

Map 5 outlines the estimated phosphorus load measured by kilogram per year. The heaviest loadings is indicated by the red – loading of greater than 9000 kg/yr. and pink - between 7,000 and 9,000 kg/yr. It is no surprise that the heaviest area is the subwatershed that houses the rich agricultural land that surrounds the Holland River.

Stormwater Runoff Loads (Map 6)

Map 6 also outlines the estimated phosphorus load measured by kilogram per year. The larger circles indicate loading of greater than 5000 kg/yr, which are Aurora and Barrie followed by Newmarket which is between 3000 and 4999 kg/yr.

2. What Causes Increases in Phosphorus Loading?

The main cause of increased phosphorus is human habitation – clearing the land, agriculture, and building of homes and towns. We might be able to forgive our forbearers, as they really didn't know the effects of their activities. Today, we do know, and we are also trying to do something about it. Phosphorus comes in things that are part of our daily lives – detergents, fertilizers, human and animal waste, and it gets into the lake in a number of ways:

a) Land clearing and erosion: Phosphorus loading from human activities was at its all time peak in the 1800s when land was being cleared for farming. Massive amounts of soil erosion brought phosphorus (found naturally in the soil) into the lake to levels double that before 1800. Although we're not clearing land to the extent that was done back then, we are still removing bits and pieces of our forests and wetlands. And whenever we lose wetlands and forests, the land is less able to hold the phosphorus, as has been shown in scientific studies (see a summary in Nichols 2001).

By the end of the 1800s, 87% of the Lake Simcoe basin had been converted from forest to farmland.
Nichols 2001

b) Urbanization: The increased numbers of people living around the lake and the growth of towns and cities with roads, driveways and lawns has meant that a lot of things are getting into the lake that weren't there before, and increasing amounts of phosphorus is one of them. Here are some of the prime sources:

- Septic Tanks: Even the most efficient septic system is not going to remove phosphorus from human waste, and the type of soil that the tile bed drains into is also a consideration. Also, if a septic tank and its tile bed are too old or in poor working order, there is a good chance that it will be leaking phosphorus and other materials into the ground, and this could increase the P flowing to the lake.

- Sewage Treatment Plants: From many "urban" households and industries, human wastes are flowing to treatment plants located around the lake. And the treated waste is released to ultimately end up in the lake; this was a major source of P in the 1950s, 60s and 70s. LSEMS and the municipalities around the lake have done an extremely good job of improving our sewage treatment, and now a smaller amount of P is going to get through.

- Urban Runoff: When subdivisions are built, with paved roads and driveways, more rain and melting snow is going to run into streams and rivers and directly into the lake, rather than be filtered through the soil or captured by plants. When you wash your car, fertilize your lawn, or you don't pick up after your dog, all this stuff can be washed away with the stormwater and it is full of P.

Figure 10 – Vegetable Production in Holland Marsh
Source: LSEMS 1995

Vegetable Production in the Holland Marsh Polders as a percentage of total production.

Vegetable	Ontario	Canada
Lettuce	72%	12%
Carrots	70%	32%
Onions	67%	45%
Celery	64%	47%

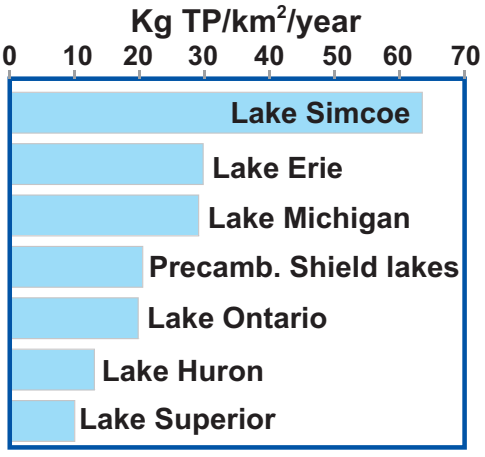
Pers Comm. McDonald, M.R., 1994 OMAFRA Muck Research Station

c) Agriculture: Farming is an extremely important activity in the Lake Simcoe watershed, and has been since the early 1800s. With farming comes fertilizers, animal manure and milk house waste, which all carry a lot of P. We are extremely thankful that farmers continue to update their farm practices by undertaking best management practices to reduce impacts. Some areas that have received a lot of positive attention lately are:

- The Holland Marsh: The Holland Marsh is a special place as it produces a massive portion of the vegetables produced in Ontario and Canada. Along with this comes an increased use of fertilizer and more P into the lake.

- General farming practices: Farmers rely on use of chemical and natural fertilizers (manure), and along with farm animal waste generally.

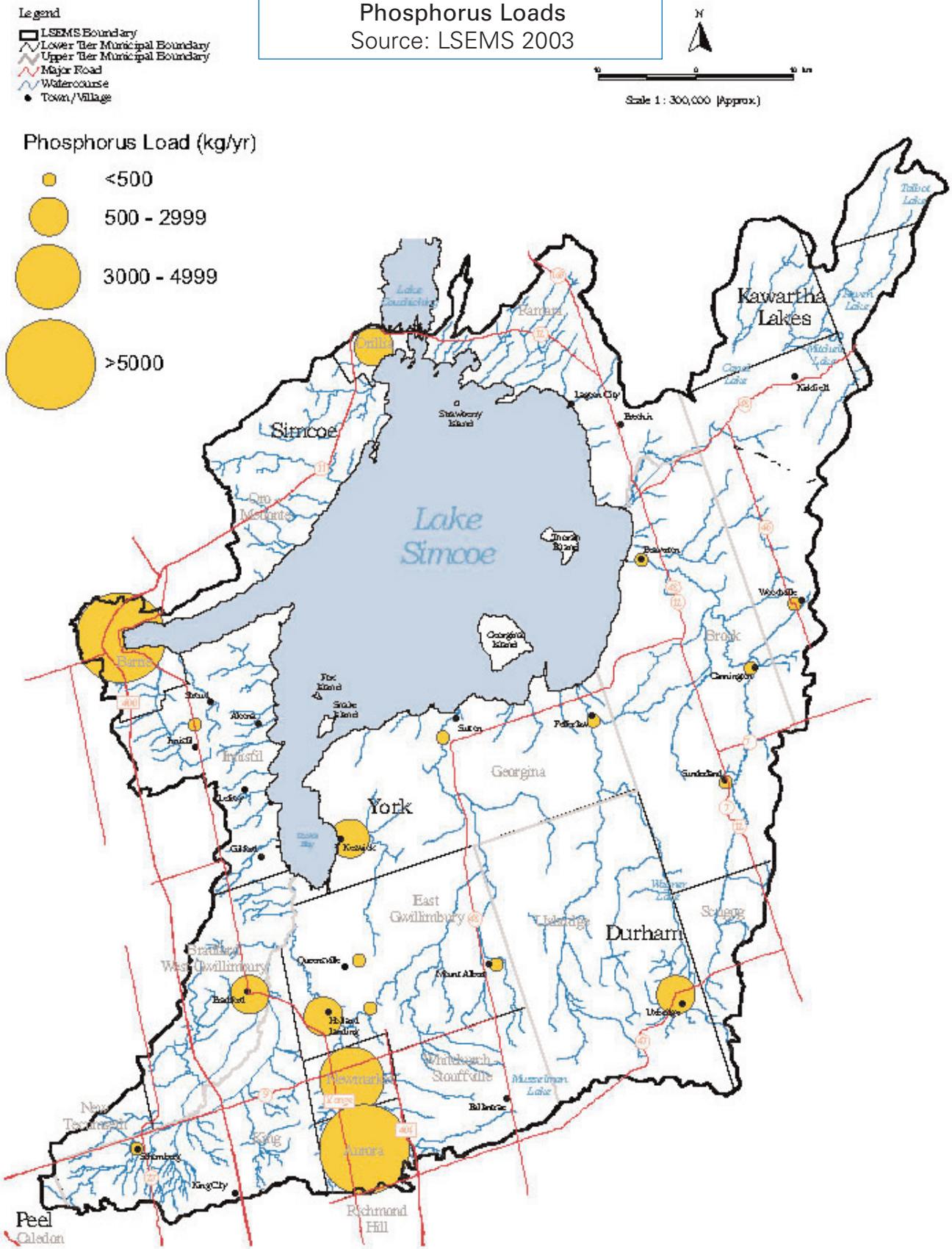
Figure 11 – Atmospheric Deposition of Total Phosphorus
Source: Nicholls 2001; Eisenreich et al. 1977; and Dillon et al. 1993



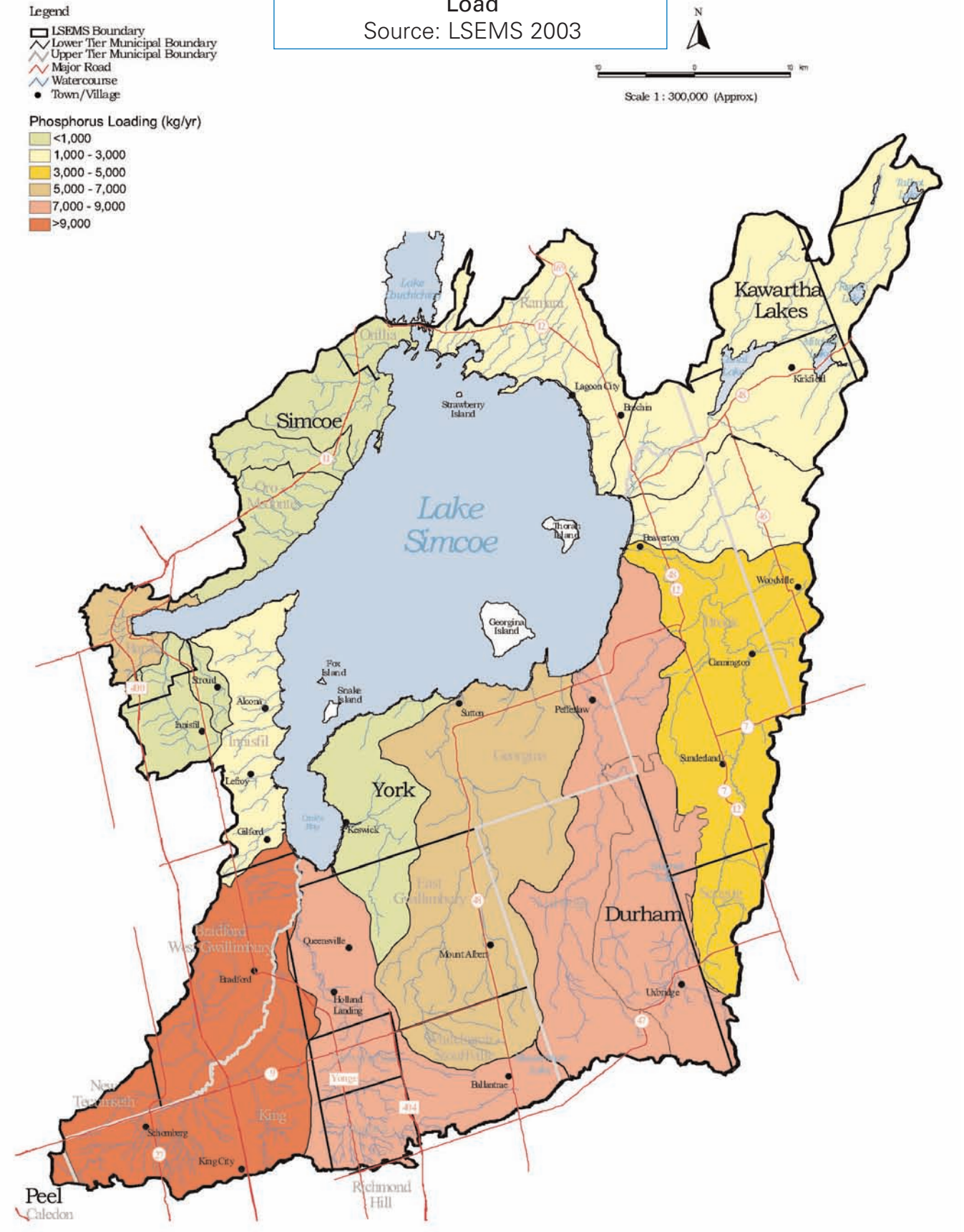
d) Golf courses: Golf Courses are not an agricultural use, but their use of fertilizers can be similar to intensive cropping. Many golf courses have hired trained Grounds Keepers who follow comprehensive Turf and Pesticide Management Plans to reduce their impacts .

e) The atmosphere: A surprising amount of phosphorus comes into the lake from precipitation and from dust in the air. The rain and winds pick up particles of P, from industrial smokestacks and from agricultural fields, and can carry

Map 6 – Stormwater Runoff Phosphorus Loads
Source: LSEMS 2003



Map 5 – Tributary Phosphorus Load
Source: LSEMS 2003



them for thousands of kilometres before they get dropped. It seems that Lake Simcoe gets more than its fair share of this P and in Nicholls 2001 report, other studies were quoted that showed far more P coming into Lake Simcoe than the Great lakes or some of the shield lakes (Figure 10). It is also suggested, that maybe the main source of the P is from local sources and not from thousands of kilometres away.

f) Internal P loading from lake sediments: Another source of P comes from the sediments in the lake. At the end of the summer, when plants die and oxygen levels are reduced, the anoxic sediment at the bottom of the lake releases phosphorus. This is especially noticeable in Cook's Bay and Kempenfelt Bay.

g) Zebra mussels and phosphorus and weeds: Researchers at the University of Waterloo have been studying what they call the 'near shore phosphorus shunt'. They have found that zebra mussels are causing an increase in the concentration of P in sediments close to shore, and they suggest "...even more stringent P management for lakes strongly impacted by... "zebra mussels..." to maintain nearshore water quality...." (Hecky et al. 2004)

III. HOW IS PHOSPHORUS MEASURED AND THE DATA INTERPRETED?

1. Predicting Phosphorus Inputs

Scientists are unable to directly measure phosphorus from all sources and determine an exact total loading for the entire Lake, so instead, they use actual set of mathematical models. These models help them to understand the total system.

Figure 12 – Past Phosphorus Inputs to Lake Simcoe
Sources: Nicholls 2001; Draper et al. 1985; and Winter et al. 2005.

Pre-1900 (natural levels)	30 Tonnes/year
1974	140
1984	139
1990-91	156
1991-92	92.5
1992-93	154
1993-94	102
1994-95	95
1995-96	121
1996-97	101
1997-98	101
1998-99	65
1999-2000	76
2000-2001	71
2001-2002	53
2002-2003	67
2003-2004	73

A number of weaknesses in the system make it necessary to interpret results with caution. Data are missing in the reports for years 1990-98 and also for the years 1998-2004. For example, 10 tributaries were monitored and gauged, 5 were monitored and not gauged, 6 were not monitored and not gauged. Samples for atmospheric depositions were taken from only two sites and no data were collected for 1990-95. Apparently 40 percent of the watershed was not directly measured. In addition, the results from year to year vary dramatically –from a high of 156 tonnes to a low of 53 tonnes. It seems justified to reserve judgement on whether the recent finding (1998-2004) represent real reductions in P loading from the previous period(1990-98).

A new model, the "Assimilative Capacity Model" has recently been developed to help to predict the impacts of new development and urban expansion on the phosphorus levels and total capacity of the Lake. A report will be released soon that might help to explain some of the numbers we see in Figure 12.

2. The Phosphorus Quandary

While the phosphorus inputs or loadings appear to be dropping – they are not being matched by significant drops in the phosphorus being measured in the waters of the lake. What could explain this? Here are the possibilities:

It takes some time for the natural system to react and lake water to be flushed out of the lake, so the phosphorus levels in the lake will take years to reflect changes to the amount of phosphorus coming into the lake. Recent concentrations might be showing that this is starting to happen.

Previous data showing phosphorus loadings from earlier years are not completely reliable because of the inaccurate modelling, inconsistent or non-standardized data sampling and interpretation, and nature's variability.

It is also possible that the conclusion about atmospheric input may have been inaccurate, and since deposits from the air makes up a large portion of the total loading, it would skew the results quite a bit.

The measures of precipitation are also used to calculate the loading from urban run-off and from the flows into rivers and streams, so any inconsistencies in quantifying the amount of rain and snow will also exaggerate or underestimate phosphorus values.

Trends are not easily predictable because the levels of phosphorus measured in the Lake from the various sources have varied a great deal from year-to-year. Perhaps the new sophisticated model is going to help clarify predictive error.

The Lake's P cycle also releases phosphorus from anoxic sediments (internal P loading), and this may be contributing to high P levels.

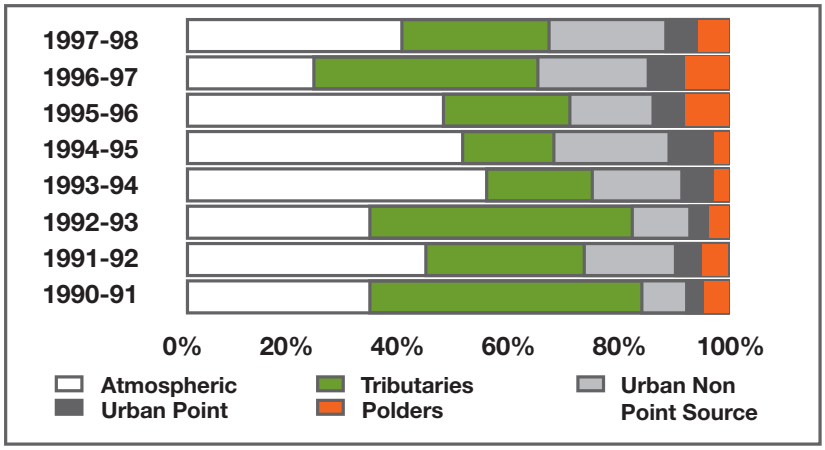
Reduction in rain and runoff from a hot and dry climate (global warming) may also account for some reduction of P, but annual runoff only decreased by a maximum of 20% over this period.

In reviewing Figure 12 – it is evident that the biggest changes have happened after 1998. It is therefore interesting to see the figures that have been calculated for the different sources in 1997-98 and 2003-04. As can be seen in Figures 13 and 14 there appears to be a substantial reduction in phosphorus coming from all sources except streams and rivers, which is a measure of the runoff from non-urban areas (that is, from agricultural and other rural uses).

Figure 13 – Number of Tonnes of Phosphorus Estimated to Enter Lake Simcoe from Different Sources		
	1997-98	2003-04
1. Streams and rivers	29	31
2. Holland marsh	6	3
3. Sewage treatment plants	6	4
4. Urban run-off	22	9
5. Atmosphere	40	22
6. Septic systems	Included in streams/rivers	4
TOTAL	**106**	**73**

Sources: LSEMS 2003; and Winter et al. 2005.

Figure 14 – Sources of Annual Total Phosphorus Load
Source: LSEMS 2003



3. A Community Response

The combination of the reported data on P loading and the uncertainties about the reliability of the data caused a group of concerned organizations comprised of the Rescue Lake Simcoe Coalition, Ontario Nature and Environmental Defense to adopt the following statement representing their views on the interpretation of P data and their conclusions about the continuing importance of all efforts to reduce phosphorus in the Lake. (Note: This statement has not yet been approved by LSEMS.

As this section attests, phosphorus is a complex issue. There are however very clear actions that can be taken to decrease the phosphorus loading, as well as the causes. These are profiled below.

HEALTH OF LAKE SIMCOE AND PHOSPHORUS 2006—CONSENSUS

The many projects of the Lake Simcoe Region Conservation Authority and improved agrarian management practices by Lake Simcoe watershed farmers have made valuable contributions in the battle to reduce the amount of phosphorus entering Lake Simcoe.

Drier climate during the latest study period may have contributed significantly to the apparent reduction of phosphorus input as have the methods of measurement themselves and even the method of reporting the phosphorus input.

At this point, it is impossible to state with confidence what the phosphorus input numbers would have been had the climate remained similar, the measurement techniques not changed, and the method of reporting stayed constant.

Over the last fifteen years the data imply a significant decline in the amount of total phosphorus in the Lake, but during the last six or seven years, decline has been statistically insignificant. Nevertheless, there have been some signs of improvement to water quality in the deeper parts of the Lake as evidenced by the first signs of deep water fish reproduction. The deep water fishery is still very fragile.

Littoral areas, especially in Cook's Bay, have not been sufficiently studied to allow any conclusion regarding near shore water quality or, for that matter, total phosphorus near shore. Due to zebra mussels and weed growth much of the phosphorus entering the Lake appears to have been captured and filtered by the zebra mussels or by the weeds and transferred from the water column to the lake bed. Excessive weeds and an observed increase in large algal blooms near shore lend credibility to the worry that existing phosphorus targets may be too high.

Given the scientific uncertainties regarding phosphorus inputs to Lake Simcoe and total phosphorus levels in the lake's water column, it is prudent to continue to strongly promote with the public in the Lake Simcoe watershed the importance of reducing phosphorus inputs to the watershed and the lake as much as possible.

IV. WHAT CAN BE DONE – THE SOLUTION STARTER LIST

Here are some solutions for us to consider and take action on:

Government

The Government, along with community members, must continue to work together to improve the situation around the Lake. Below are key areas where their efforts are required:

- **Better sewage treatment.** There are several innovative approaches that can be considered for sewage treatment improvements. One example is the Canada-Ontario optimization program that was created to bring existing municipal sewage treatment plants to maximum performance at low cost. The program, developed in 1990, helped implement the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA).This agreement set a clear agenda for action which includes upgrading sewage treatment plants to improve effluent quality and enhance phosphorus and ammonia removal at Areas of Concern (AOCs) in the Great Lakes basin.

- **Agricultural Improvements:** As outlined in the actions identified for the farmers, there have certainly been improvements in the farming practices. These changes need to be leveraged and the government at both the federal and provincial levels needs to stimulate 'Best Management Practices' for agriculture and the Holland Marsh.

- **P Level Testing:** As indicated in this section – there are a number of divergent perspectives concerning the means and interpretation of P level testing. It will be key for the government, along with community specialists to develop tools and strategies for consistency of P level testing. There needs to be :

    - Ongoing measurement of levels of P in the lake, and P loadings to the lake;

    - Refinement and improvement of the model with the results shared publicly;

    - Improvement of our knowledge of how P is being released from sediments, and continue the research on the "nearshore phosphorus shunt".

- **Guidelines for Development:** There needs to be ongoing study of the effects of, and improve, stormwater management techniques in development practices.

Developers

- **Stormwater Management Plans:** New subdivisions must have stormwater management plans in place to contain runoff and allow nutrients to be absorbed into the sediments before the stormwater flows out to streams and rivers. In addition, some of the municipalities are retro-fitting older subdivisions, many have ongoing maintenance programs, and new techniques for treatment are being used. This is one of those solutions that needs to be diligently pursued, and new techniques need to be studied and applied. The reality is that there will be new subdivisions, and these new developments should be applying the best possible techniques for reducing the amount of P they contribute, if we want to see real improvement on the Lake.

- **Sustainable urban development:** Given that phosphorus is interconnected to a number of issues, including urbanization and population growth and density, it is important that the new developments proactively address the phosphorus issue. This includes introducing and enforcing regulations that require overall phosphorus reduction programs with every new development.

Farmers

- **Farming Practices:** Improvements to farming practices must be continued in the watershed. Projects to manage farm waste, keep animals out of streams, restore the shorelines of streams, are all part of the package of projects that LSEMS has encouraged and helped to fund over the years. Farmers have been receptive and major improvements have been made.

- **Reduction of Fertilizer:** Over the years there has been a reduction in the amount of fertilizer used in the Holland Marsh and more reductions may be achievable. A project to build a treatment plant for the water flowing out of the marsh has been considered, but not initiated. Options for treating the outflow from the Holland Marsh should be reconsidered.

Individuals

- **Practice the 3 Waves:** Lawn run off is one of the greatest contributors to higher phosphorus levels. In order to help residents make their yards more water-friendly and reduce the run off from yards, thereby reducing the phosphorus from fertilizers entering the watershed, The WAVE was created. This is an action program to help residents —community by community, home by home, and is the first educational project of the Rescue Lake Simcoe Coalition, a three-year-old citizens group. The 3 Waves are:

- **Wave 1 – Be Water Wise**
  Water in the morning.
  Water no more than 1 inch/week.
  Don't flood your driveway

- **Wave 2 – Grow Grass Naturally**
  Cut it High. Let it Lie.
  Overseed.
  Aerate.
  Fertilize in the Fall, if at all

- **Wave 3 – Try trendsetting**
  Plant native species.
  Go for less lawn.
  Pass the message on.

For more information visit: Visit www.thewaveprogram.com

- **Live life with less phosphorus:** Every individual can make a difference. Use phosphorus-free products around the home, especially detergents;

- **Stop using chemical fertilizers on lawns;** in fact, we should be replacing our lawns or part of them with native vegetation if at all possible (it will help with P reduction, and it will discourage those pesky geese).

- **Naturalize Shorelines:** People beside the lake should renaturalize shorelines to stop erosion and to reduce the flow of P into the Lake.

- **Septic Tanks:** Keep septic tanks in good order and have them pumped regularly. Pump out boat wastes and have them properly treated.

6

Indicator 6… There are more weeds and algae and the lake bed is covered in goo.

There are more weeds and algae and this is an indicator caused by too much phosphorus, that confronts people using the Lake in a very direct way. We may not see the phosphorus, or the bacteria, or some of the changes in the fish, but people do see the weeds, the algae, and the goo. Weed growth is extensive, especially in places like Cook's Bay, and people are observing more algae slime on rocks and ladders.

We will review the topic of goo, weeds, and algae by asking the following questions:

I. What Do We Know About Goo, Weeds and Algae?

II. Why Are There More Weeds?

III. What Can Be Done? The Starter List

I. WHAT DO WE KNOW ABOUT GOO, WEEDS AND ALGAE?

There have been some studies done on the weeds in the Lake, notably studies of Cook's Bay in the 1980s (Neil et al. 1985), and some work on near-shore weeds in 2003 (LSEMS 2003), but there isn't any comprehensive knowledge on this subject. However, we do know a few things about the plant material in the lake:

- **Sediment:** Although it hasn't been scientifically measured, people are observing more sediment along the shoreline areas of the lake than there used to be, which offers aquatic plants a place to take hold and grow. The sediments are full of phosphorus as well, and this gives the plants a key nutrient they need to thrive. (Our non-scientific word for sediment is 'goo')

- **Eurasian milfoil:** There is a well-established population of an exotic species, Eurasian milfoil, a species that has become established in many other lakes in the province. This weed grows very well in Lake Simcoe, and often crowds out other native plant species. As with many exotic species, once it comes in, it grows very well until it finds an equilibrium point, and then it becomes better balanced with the ecosystem as a whole This seems to be happening on some of the lakes in the Kawartha area. (For more information see the next Indicator – New Species.)

- **Algae:** is being noticed more than in the past. We haven't found any specific scientific work on the algae of Lake Simcoe, but an increase in algae blooms is a common concern being expressed by a lot of lake associations in the province. One of the culprits might be the filamentous algae known as Cladophora, the algae that was responsible for some of the nasty algae blooms on Lakes Ontario and Erie in the 1960s and 70s. There is some current work being done for the Ontario Water Works Research Consortium by researchers at the University of Waterloo on this algae, as it is re-appearing in Lakes Ontario and Erie. (Website: www.owwrc.com)

II. WHY ARE THERE MORE WEEDS?

Weeds and algae are a normal part of a healthy lake's ecosystem, and Lake Simcoe would be expected to have a healthy level of plant growth, particularly in places like Cook's Bay, other shallow bays and in many areas nearshore. However, it looks like things are out of balance, and there are a few reasons for this:

- **Too much Phosphorus in the lake:** The extra nutrients, especially phosphorus and nitrogen that have been getting into Lake Simcoe over the years have led to much larger amount of plant growth than would be there under natural conditions. Weed growth is dependent mostly on P plus nutrients in sediment, not the water column. Nutrients are renewed by decomposition of weeds and therefore not dependent on the loading to the Lake.

- **Alien plants take over:** The shift from native plants to exotic species changes the dynamics of the ecosystem, and with the introduction of Eurasian milfoil to Lake Simcoe, this change has been one of an explosion of new growth. Eventually this will settle into a better balance. In the meantime, it is causing unpleasant changes to the lake today.

- **The zebra mussel invasion:** Zebra mussels have helped to get more weed growth in the Lake. They consume the microscopic floating plant material known as phytoplankton, and by doing so improve water clarity. When the water is clear, aquatic plants get more light, and are then able to grow better, and at deeper parts of the lake than normal. The cycle continues as the plants die and sink to the bottom and build up more sediments – creating goo and giving more rooting potential for new plants. The plants also return more phosphorus and other nutrients to the sediment to help future generations of plants.

- **Boat traffic:** doesn't help the problem of weeds (although the weeds don't help boat traffic either). When motorboats go through a weed bed, they break up the plants, and a species like Eurasian milfoil will readily spread through the bits and pieces that are left behind, or brought to different parts of the Lake.

III. WHAT CAN BE DONE – THE SOLUTION STARTER LIST

Governments

- **Research:** Undertake research on the relationship between zebra mussels, phosphorus, and plant and algae growth. (Follow up on work that has been done by University of Waterloo in lake Erie);

- **Develop a basic inventory of the types of weeds and algae.**

A basic inventory of the types and amounts of weeds and algae would be helpful, as well as the sediment status in all parts of the lake, notably along the shoreline areas and shallow bays;

During the summer months of 2006, the Lake Simcoe Region Conservation Authority will undertake an inventory of all the aquatic vegetation within the Lake, including identifying species and mapping their distribution to understand the extent of the situation and provide better management strategies to eradicate the bloom.

Individuals

- **Research how to remove it:** We can try to get rid of the weeds through different ways, but none are considered particularly effective, or they bring along other problems with them. These methods should be researched carefully as in some cases, the methods commonly used are dangerous and contrary to existing regulations.

    - Mechanical harvesters – some of the plant species, especially Eurasian milfoil, will quickly regrow and the large number of plant fragments can spread the plant to other parts of the lake;

    - Underwater tilling and cultivating – a slow and costly operation that frees a large number of plant fragments that are then able to spread to new sites;

- Water level manipulation – winter drawdown exposes the plants to below freezing temperatures (as well as fish eggs and hibernating frogs and turtles) that may cause winter kills; there is also the possibility of damage to docks and boathouses, and the rapid re-infestation from adjacent areas;

- Fragment or bottom barriers – useful for small infestations but is expensive and requires regular maintenance;

- Chemical treatment – applying a chemical herbicide will get rid of the plants, but pouring chemicals into the lake is not a desirable approach, and would need approval of several government agencies;

- A promising new approach involves the use of high intensity ultrasound to kill the plants in situ. This creates limited environmental disruption compared to many other methods; and

- Biological control programs – may bring in another exotic species (e.g., grass carp which feeds on milfoil) will cause unknown, and often equally devastating impacts.

More information provided at the Environment Canada – Canadian Wildlife Service website: www.cws-scf.ec.gc.ca/publications/inv/p1_e.cfm.

- **Help our Lake develop a new balance:** With time, we can hope to see a better control on the nutrients that are feeding the cycles of weed growth, and we will see a better balance of the exotic or alien species. It's likely that the shallow areas of the lake will continue to have high growth, but we may see some improvement. What may be needed is a phosphorus/fertilizer ban for residential cosmetic use. The Town of Georgina is now looking into this, and is already being done in Minnesota. Visit www.moea.state.mn.us

7

Indicator 7… There are new species in our lake and the water is clearer.

New species that do not originate from our Lake have unbalanced the natural ecosystem and are harming humans and the fish and wildlife species that have naturally inhabited the Lake for hundreds or thousands of years.

Exotic and invasive species are not new to Lake Simcoe. For more than 100 years, numerous exotic and invasive species have been introduced into the Lake Simcoe watershed as a result of various direct and indirect human activities. Due to its close proximity to major urban centres and its direct link to the Great Lakes via the Trent-Severn Waterway, Lake Simcoe is particularly vulnerable to additional species introductions (LSFAU 2004).

Exotic species are organisms that are native to other areas of the world, but have been introduced intentionally or accidentally outside of their normal distribution into local, non-native, "alien" habitats

Environment Canada

In the absence of natural predators, competitors, diseases and parasites, populations of exotic species can explode and out-compete native species for food and habitat. Once established, they are almost impossible to eliminate. The control of nuisance exotic species can cost millions of dollars and impose other serious threats to the local environment such as the release of non-native predators and competitors, or spraying toxic chemical substances to control outbreaks.

The issue of Invasive Species is being reviewed by asking the following questions:

I. What Do We Know About Invasive Species?

II. Why is the Water More Clear?

III. What Can Be Done – The Starter Action List

I. WHAT DO WE KNOW ABOUT INVASIVE SPECIES?

Currently, there are nine aquatic invasive species with established populations within Lake Simcoe (Figure 15).

Figure 15 – Exotic Species in Lake Simcoe and Potential Impact on Aquatic Communities

Species	Potential Impacts	Year Found
Common Carp	Disruption of aquatic vegetation, excessive disturbance of bottom substrate causes eggs of other species to be silted over and not viable.	1896
Eurasian Water-milfoil	Excessive plant growth in nearshore areas.	1961-84
Rainbow Smelt	Potential predator of lake trout and whitefish fry; food source for lake trout and piscivores.	1962
Zebra Mussel	Covers docks, rocks, and water intakes; increased water clarity; diversion of energy to benthos which are aquatic organisms which live on, in, or near the bottom (substratum) of water bodies.	1992
Bluegill	Competes with native nearshore fish species.	1990's
Black Crappie	Competes with native nearshore fish species.	1987
Spiny Water Flea	Competitor and predator of native zooplankton.	1993
Bangia atropurpourae	Toxic red algae can cause nuisance smell.	1980
Curly Leaf Pondweed	Displace native species, reduce biodiversity, impede recreational activities, and reduce property values.	by 1894

Source: LSEMS 2003

The two most prolific invaders in recent decades, which have caused noticeable changes to the aquatic community have been the zebra mussel and eurasian milfoil. Two additional exotics (round goby and rusty crayfish), with the potential to shift food webs, have been captured in Lake Simcoe tributaries, but so far efforts to prevent their spread into the lake have been successful.

The impacts of several invading species are often greater than the sum of their individual affects on a system. The introduction of invading species can cause widespread and unpredictable changes to habitats and is a worldwide problem. In some cases these exotic and invasive aquatic species may have profound effects on fish community structure and health of the ecosystem and fish community.

The four invasive species that are profiled in this section are: zebra mussels, eurasian milfoil, round gobies, and purple loosestrife.

1. About Zebra Mussels

How do they get here?

- *Ships travelling into the Great lakes release ballast*
- *Alien species used in research that escape;*
- *Unauthorized stocking;*
- *Accidental releases from aquari ums, bait harvesters, anglers and the live fish for food trade;*
- *Deliberate introductions (e.g., purple loosestrife as an ornamental plant)*

Zebra mussels are small (average one inch in size) and prolific creatures which attach themselves to any hard surface, including rocks, human-made structures and shells of other larger native molluscs and clams, inhibiting the ability of these to feed. As many as 10,000 zebra mussels have attached to a single native mussel.

Zebra mussels, are native to Eastern Europe and western Asia. They are assumed to have come in the ballast of a ship, and were first found in Lake St. Clair in 1987. They quickly spread throughout the Great Lakes and other rivers and lakes across southern Ontario, Quebec, and the Great Lakes states. First found in Lake Simcoe in water samples in 1992, they were then seen on rocks and docks by 1994, and within a year they became common around the Lake.

Lake Simcoe is a nutrient rich lake, underlain by limestone based bedrock. This means that Lake Simcoe has hard, basic water with a high concentration of calcium, and an alkalinity which supports the growth of zebra mussels (calcium is needed to construct shells).

Zebra Mussels spread very quickly because they attach to the hulls of boats, and if the boat is taken to another lake without the hulls being cleaned, zebra mussels can be introduced into that lake.

Zebra mussels have done extremely well in Lake Simcoe as a result of their early sexual maturation, high reproduction rates, quick growth rates, and tolerance towards a wide range of climate conditions. The zebra mussel has no native predators in Lake Simcoe; however, it has been documented that diving ducks and several species of fish, including lake whitefish and rainbow smelt, have been feeding on these little mussels. (LSFAU 2004).

The effects of Zebra Mussels include:

- Water has become more clear;
- Smothering of spawning beds has contributed to the decline in fish reproduction;
- Smothering of native mussels making it impossible for them to function; and
- Plugging water intake pipes and fouling rocks and docks with their razor-sharp bodies.

2. About Eurasian Milfoil:

Eurasian milfoil is a submerged aquatic plant that forms a dense growth of floating mats along the surface of the water. This plant crowds out native species, clogs waterways, as well as recycles nutrients from the sediments into the water column to degrade water quality and fish habitat.

Eurasian milfoil is native to Europe, Asia and northern Africa. It was introduced to the United States (U.S.) in the 1940s and was first observed in Lake Simcoe in 1984 (McMurtry et al. 1997). However, the source of the original introduction is unclear. Now Eurasian milfoil occurs in nearly every state in the U.S. and several Canadian

provinces. Spread is mostly attributed to boating activity, although, unfortunately there have been some deliberate introductions (OFAH 2006).

The likely cause of the success of Eurasian Milfoil in Lake Simcoe is:

- Increasing water clarity;
- Lots of nutrients (phosphorous and nitrogen) from the sediment and the surrounding landscape;
- A warming climate – higher water temperatures allow multiple flowering and more growth;
- The absence of natural predators; and
- The presence of motorboats, which break up the plants and transport branches to new areas of the lake.

Not all Milfoil are invasive

The native northern milfoil and coontail are similar in appearance to the Eurasian milfoil, but do not form dense mats or long tangled strands along the waters surface. The seeds and plant material of the native northern milfoil are an important food source for waterfowl and marsh birds and moose. (Newmaster et al. 1997)

While it will be difficult for us to remove it from our lake, it is our responsibility to ensure that we are not responsible for spreading it to other lakes.

Fragments can easily be spread by water currents or inadvertently by boaters.

3. About Round Gobies:

The round goby is a particularly obnoxious, invasive fish. In the fall of 2005, 33 round gobies were found within a 100 m stretch of the Pefferlaw Brook, as well as six other non-native fish species native to Lake Erie, including white crappie, green sunfish and yellow bullhead (LSRCA 2006). Despite drastic eradication measures they seem to have reappeared in spring 2006.

The round goby is a bottom-dwelling fish similar in appearance to and with similar habitat needs as our native sculpin species. They are aggressive and voracious feeders, capable of feeding in the dark and breeding more than once a year.

The round goby takes over prime spawning sites traditionally used by native species, competing with native fish for habitat and changing the balance of the ecosystem. The round goby is already causing problems for other bottom-dwelling Great Lakes native fish like mottled sculpin, logperch and darters. Goby can survive in degraded water conditions, and spawn more often and over a longer period than native fish. Unfortunately, they have shown a rapid range of expansion through the Great Lakes (GLIN 2006.)

The round goby was found in Pefferlaw Brook, and in order to keep the fish from entering Lake Simcoe, biologists from MNR and LSRCA eradicated them from the creek. In the fall of 2005, Pefferlaw Brook was "cleansed" with a pesticide (Rotinone) to destroy any undetected larvae or adult round goby within the tributary. More than 4,000 native fish were captured and transported to the mouth of the brook prior, in order to avoid unnecessary death. If round goby were to establish a population in Lake Simcoe, the impact would be devastating to the fish community, especially the littoral/shoreline zone communities. Unfortunately the round goby has already been sited this spring.

4. About Purple Loosestrife:

Purple loosestrife is a plant native to Europe and Asia that has had a serious impact on wetland habitats since its introduction to North America, as an ornamental plant, in the 1800s. There are several plant species that

mimic or look similar to the loosestrife such as fireweed, blue vervain and water-willow or swamp loosestrife but, unlike the purple loosestrife, these plants are native.

Purple loosestrife reproduces at an alarming rate, spreading along roads, canals and drainage ditches, and has invaded marshes and lakeshores choking out the natural wetland vegetation that occurs around it. Most watersheds across Ontario have been invaded with purple loosestrife.

II. SO WHY IS THE WATER MORE CLEAR?

The primary reason for this is the zebra mussel.

Mussels, in general, are filter feeders, which mean they capture food by literally sucking or breathing in the water through specialized valves that absorb the small plant and animal material or free floating plankton in the water column, and spit out the remaining water. They are in essence, filtering the suspended material out of the water column, which improves the clarity of the water. They feed by filtering the water through a siphon, up to a litre per day.

Many people assume that this increased visibility in the water must mean the water is "cleaner". Not true. All they have done is filtered out all the algae which normally would be food for native organisms (zooplankton, insects and fish). Native zooplankton relies upon plankton for food and fish and invertebrate larvae rely upon the zooplankton. If a traditional food base is gone, other alternatives need to be found or else individuals or whole populations will start dying off.

As water clarity improves from the loss of suspended algae, sunlight penetrates deeper into the water column creating new habitat for plant growth, because sunlight is an important ingredient for building plant material. Zebra mussels directly impact the phosphorus cycle and the fish community because they enable more plant growth and distribution of plants into new areas; more plant surface area traps soluble phosphorus into their cells and when these cells decompose, decomposition consumes dissolved oxygen and releases soluble phosphorus (phosphates) from the plants and the sediments back into the water column, which enables more plant growth. Loss of dissolved oxygen within the bottom water habitat and an altered food web is directly impacting the survival of young cold water species within Lake Simcoe.

III. WHAT CAN BE DONE? – THE SOLUTIONS STARTER LIST

Once established, invasive aquatic plants are extremely difficult to eradicate. Numerous species have already been introduced to Lake Simcoe ecosystem, bringing about changes to habitat and fish community structure. The best way to control these species, or any aquatic invader, is to prevent it from being introduced in the first place.

- **Zebra Mussels:** Once zebra mussels get established in a lake, there is no known way to comprehensively control them. The only thing that can be done is to try to prevent them being spread to other lakes, by cleaning boat hulls and emptying ballast and bait buckets before going to another body of water.

- **Eurasian Milfoil:** Eventually Eurasion milfoil populations peak and populations decline so that this species ends up in a new ecological balance with native species (northern milfoil and coontail) without dominating the community; this is true of some of the lakes in the Kawarthas.

Several methods have been used to try to control it without much success. Unfortunately, these methods are either unsuccessful due to the further spread of plant fragments, high costs, or results in unacceptable impacts on other natural features. Eurasian milfoil can quickly re-establish itself after being cleared because of the viability of even small fragments, which can stay alive for weeks if kept moist.

A promising new approach involves the use of high intensity ultrasound to kill the plants in situ. While this alternative may create limited environmental disruption compared to many other methods, further research is necessary to confirm its success.

Methods of Control

- *Mechanical harvesters*
- *Underwater tilling and cultivating*
- *Water level manipulation*
- *Fragment or bottom barriers*
- *Quarantine programs*
- *Biological control programs*
- *High Intensity Ultrasound*

Bates et al., 1985; Newroth, 1985

Further information may be obtained at the Environment Canada – Canadian Wildlife Service website: www.cws-scf.ec.gc.ca/publications/inv/p1_e.cfm.

- **Round Gobies:** As with so many other invasive species, the key to control is "Don't let it get in!" People around the lake need to know what the goby looks like, and report any findings if caught (do not throw the goby back into the water). The most important action is to be very careful of bringing bait in that might contain round gobies. Bait suppliers and fishermen are the key to keeping the goby out of Lake Simcoe.

- **Purple Loosestrife**: Unfortunately, complete eradication of this plant is impossible, even though mechanical removal has been effective in controlling or slowing down the spread in some areas of Ontario. Some methods have included:

    - Use of pathogens and parasitic insects, from Europe—100 different insect species most commonly associated with purple loosestrife—and Asia, for their potential as biological control agents. At several release sites in Ontario, complete defoliation of large purple loosestrife stands (many hectares) has been reported with local reductions of more than 95% of the biomass.

    - Project Purple involves mechanical control, information seminars, public awareness talks, educational programs, and beetle releases. For more information about purple loosestrife or to participate in a Project Purple event in your community call the OFAH/MNR Invading Species Hotline at 1-800-563-7711.

- **Join the invading species watch:** A volunteer-based monitoring program for aquatic invasive species, which is part of the larger OFAH/MNR Invading Species Awareness Program. The invading species watch offers shoreline residents and cottage owners a chance to participate in the program. Using a monitoring kit provided by the OFAH, volunteers take water samples using a plankton tow net, and send the samples to the OFAH for analysis (2004).

8

Indicator 8… I am catching lots of lake trout, what's the problem?

The problem is that most of the lake trout we are catching were not born in this lake. They are stocked fish that were raised in a hatchery and planted in Lake Simcoe because lake trout are unable to reproduce naturally. Only 1% of all lakes in Ontario produce lake trout and we are blessed with this resource. The only problem is that few wild lake trout remain (< 1%) because there is very little reproduction going on in the lake. In fact all of our cold water species are being threatened and if we lose them it is a clear sign that the lake has changed its ecological balance for the worse.

Lake Simcoe is an ecologically complex and biologically diverse community of aquatic plants and animals with a variety of shallow near-shore and deep offshore habitats to house these animals. What that means is that there is a large variety of habitats and species interacting together, creating a complicated, inter-dependent mix of lifecycles. In recent decades new species have emerged in Lake Simcoe (pike, black crappie, bluegill, zebra mussel), which will add a new complexity to the evolving system.

The wild lake trout has become a canary in the coal mine – meaning it's decline is sending a clear message as to what happens when a natural ecosystem goes out of balance. This section reviews what is happening to the fishery through the following questions:

I. What Do We Know About the Lake Simcoe Fishery?

II. What is Causing the Decline in Our Cold Water Fish?

III. What Can Be Done? The Starter Solution List

I. WHAT DO WE KNOW THE LAKE SIMCOE FISHERY?

Lake Simcoe is blessed with an economically important cold, cool and warm water fishery, including lake trout, lake whitefish, yellow perch, walleye, pike, bass and black crappie. However, in recent decades the cold water fish (lake trout, lake whitefish, lake herring) have not been able to successfully reproduce, grow to adult size, and continue reproducing to increase natural abundance. The Lake's cold water fish have actually decreased in populations within the lake. Lake herring are virtually gone from the lake and lake trout and lake whitefish populations are being maintained solely through stocking (FAU 2001& 2005).

Prior to European settlement, Lake Simcoe provided ample habitat for cold water fish species and now these species are in danger.

What is happening to our cold water fish?

Cold water species such as lake trout, lake herring and lake whitefish are akin to the canary in the coal mine.

Lake trout are found in 2200 lakes in Ontario, which represent 1% of lakes in the province and 20 to 25% of all lake trout lakes in the world, so it is important to conserve this important world heritage resource from disappearing (LSEMS 2003).

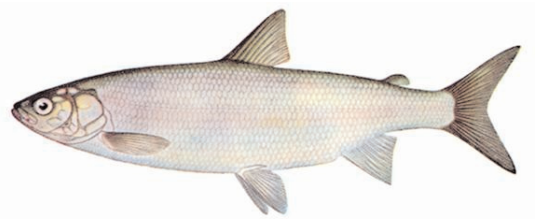
Lake trout are a sensitive cold water lake species and are an excellent indicator of ecological health because they are sensitive to changes in water temperatures and concentration of dissolved oxygen (LSFAU 2002), both of which are being alter by humans. Lake trout require high concentrations of dissolved oxygen and low temperatures to develop and reproduce. During the warm summer months, lake trout will escape to the lower levels of the lake where low temperatures and high dissolved oxygen content exist. As more phosphorus enters the lake, more weeds and algae grow, and when they die they sink to the bottom of the lake. As the plants decompose, bacteria utilizes the dissolved oxygen and as the oxygen supply diminishes in the lower

colder layers of the lake the lake trout must move to the warmer sections of the lake.

Poor bottom water habitat forces young and adult lake trout up the water column exposing them to lethal water temperatures (>21 °C) and the young lake trout to the cannibalistic adults and other dangers (predators, anglers, competitors, pollution, etc). As the lake trout live under poorer life conditions, there is less energy available for reproduction.

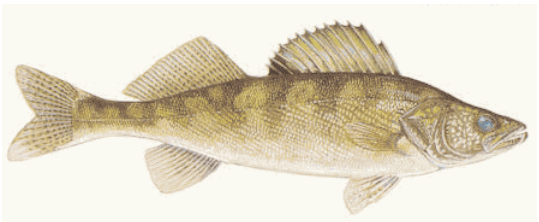
Since the early 1980s, wild lake trout are virtually absent from the population and nearly all lake trout caught (99.9%) in Lake Simcoe have been of hatchery origin, identified by clipped fins. The estimated catch by anglers of lake trout has continued to increase since the late 1970s, which can be attributed to the stocking efforts by MNR.

In July 2001, the Lake Simcoe Fisheries Assessment Unit (LSFAU) discovered two naturally reproduced young-of-year (YOY), 3 to 4 month old, lake trout during a bottom trawling survey, and in July 2002 four YOY and an age one and two lake trout. This indicates that lake trout reproduction has occurred to a very limited degree in Lake Simcoe. Although the presence of naturally reproduced juvenile lake trout is encouraging, the true significance of these fish is unknown (LSFAU 2002 & 2006). This does not mean that the lake trout fishery is bouncing back, but it provides a small hope that continued reduction in nutrient and toxic loading will improve habitat conditions.



Lake herring, native to Lake Simcoe, were once abundant in Lake Simcoe and an important part of the recreational fishery. They serve an important ecological role as the principal source of food for lake trout. As lake herring populations decline, the non-native rainbow smelt replaces them as lake trout's primary food. In January 1, 2001 the objective of MNR's Fisheries Assessment Unit - the lake herring fishery – was closed to protect the remaining stock (LSFAU 2004).

Lake whitefish are the most sought after species in Lake Simcoe and are a genetically distinct stock (Ihssen et al. 1981), having been separated from nearby stocks in the Great Lakes region for approximately 7,000 to 10,000 years (Evans et al. 1988). They are currently listed as a Threatened Species at Risk in Ontario.



Walleye, although really a cool water fish, is one of the most highly sought fish in Ontario. While walleye are native to Lake Simcoe, they only constitute a relatively small component of the fish community and recreational fishery (LSFAU 2001). The Holland River, prior to the loss of its marshland and the channelization of its lower reaches, is the area where significant walleye spawning used to occur. By the 1950s, the river's habitat degradation forced the walleye to find suitable habitat within the Talbot River. Today, angling clubs continue to rehabilitate spawning sites in other tributaries (McMurtry et al. 1997).

II. WHAT IS CAUSING THE DECLINE IN COLD WATER FISH?

Lake Simcoe's cold water fish are in danger and when the cold water fish are gone from a lake, it is a clear sign that the lake has changed it ecological balance. Coldwater species such as lake trout are highly susceptible to many interacting pressures from the natural environment and human induced changes to the watershed. Therefore, there are a number of reasons for their reproductive failure:

> *Human settlement and development in the Lake Simcoe watershed has created intense pressure on the lake's ecosystem.*
>
> *(McMurtry et al. 1997)*

- **Nutrient Loading:** The main culprit appears to be excessive nutrient loading, which has degraded spawning grounds and deep, cold water habitat. (LSFAU 2005; LSEMS 2003). Deposition of silt and organic matter on spawning shoals may also have impaired survival of eggs and young fish. Excessive nutrient loading from various sources, increasing fishing pressure, habitat destruction (siltation, pollutants, toxic chemicals, deforestation, wetland drainage, aquatic algae), and invasion of non-native plants and animals have transformed the lake and its assemblage of fishes over the past 150 years (McMurtry et al. 1997). Clearing of land and intensification of land use and discharge have contributed to point source and non-point source loadings of phosphorus into the lake causing eutrophication of an historically, nutrient poor lake. Deforestation and dyking and dredging marshland have also diminished available habitat for all fish species type.

- **Harvesting of Lake Simcoe's Fish Population:** The commercial fishery, present from 1868 to the early 1900s, had a significant impact on the lake's fishes; this was partly due to intensive fishing pressure as well as the absence of restrictions on gear and sale of game fish (McMurtry et al. 1997). Many species populations declined due to over-harvesting by the commercial industry or because of competition from invasive species. Muskellunge, in decline by the 1930s due to the invasion of northern pike and lake sturgeon, disappeared from Lake Simcoe because of over-fishing. A growing recreational fishery gradually replaced the commercial harvest and angling harvest is now greater than the commercial fishery was in the 1800s (LSEMS 2003).

- **Loss of deep cold water habitat:** There is a direct link between phosphorus loading and reduced concentrations of oxygen in the bottom levels of the lake. Microbial break down of algae and plant material has caused the depletion of oxygen, which is particularly critical for late summer lake trout habitat. Although stocked yearling lake trout are surviving, the dissolved oxygen concentration in parts of the lake is near lethal limits for adults in the late summer, which may begin to limit the adult lake trout population if further degradation occurs.

- **Increased competition for limited food supplies:** A major change in the composition of the fish community has increased competition for food, since the appearance of several introduced species, such as common carp (1880s), northern pike (1920s), and more recently black crappie and bluegill. Lake trout prey on lake herring and rainbow smelt, but as their populations decline, lake trout have shifted their efforts towards other species, including sculpin species found near the bottom of the lake.

- **Invasive Species:** Invasive species like zebra mussels may alter aquatic ecosystems through a number of mechanisms including diversion of energy flow, alteration of the benthic community, increased water clarity and promotion of aquatic plants (Griffiths 1993). Recent invasion and population explosion by black crappie, which is a native species to Ontario but not to Lake Simcoe, may also have implications, such as increasing competition and predation to near shore fish communities such as pumpkinseeds, bass, rock bass, walleye, yellow perch and lake trout. The implications of invasive species into an already complex community can only be revealed over time.

- **Loss of Spawning Habitat:** Lake Simcoe once provided extensive shoal spawning habitat, with approximately 50% of the shoreline being suitable for lake trout spawning (MacCrimmon 1958). As early as the late 1970s, spawning shoal degradation was confirmed, but lake trout continued to spawn at some of these locations during an early 1980s observation. Shoal investigations indicated that 95-100% of shoals were covered in silt and amorphous material.Siltation and plant material, such as the red algae and Cladophora (filamentous algae which is non-digestible by zooplankton) and zebra mussels can accumulate or grow on spawning shoals, burying and suffocating the incubating eggs.

III. WHAT CAN BE DONE? – THE SOLUTIONS STARTER LIST

The Wild Trout is acting as a canary by signalling where key changes are needed in order to increase their ability to live and reproduce. The good news is that many of the causes that are hindering their reproduction are issues that have been raised in other sections of the Report. Reducing phosphorus, renaturalizing the shorelines, and creating strategies to deal with invasive species will all have a positive impact on the cold water fishery. Below is a starter list of solutions.

Governments

- **Continue learning and current monitoring:** Ministry of Natural Resources's Fisheries Assessment Unit should continue long-term monitoring and assessment of Lake Simcoe fish populations, through studying:
    - Factors that pertain to young fish populations such as habitat use, diet and mortality rates of juvenile lake trout and other fish;
    - Current status of spawning shoals and the extent of natural reproduction with attention to the impact of zebra mussels; and
    - The post stocking survival of yearling lake trout in Lake Simcoe (LSFAU 2005).
- **Focus on Phosphorus Reduction:** One of the primary objectives of the Lake Simcoe Environmental Management Strategy (LSEMS) is to restore a self sustaining cold-water fishery through a reduction in phosphorous loading. Phosphorous loading must be reduced to improve critical habitat for cold water fish species such as lake trout, lake whitefish and lake herring.

Individuals

- **Improve fish habitats:**
    - Plant trees and shrubs along the shoreline;
    - Don't mow the lawn to the water's edge;
    - Place a small row of large boulders along the front of the shoreline to protect in-water banks from wave erosion;
- **Education:** Educate yourself regarding protecting habitat and preventing the invasion of exotics;
- **Lifestyle Change:** Adopt a Green Lifestyle by reducing your phosphorus dumping through the use of lawn fertilizers and high phosphorus household cleaning products, maintain your septic system by having it pumped out every 3-5 years; and
- **Obey regulations:** Don't over harvest, obey the provincial fisheries regulations.

9

Indicator 9…There seems to be fewer turtles and frogs.

The turtles and frogs are telling us something. If the trout are the "canaries" for the lake, the frogs and turtles are the "canaries" for our wetlands. These are the animals that need healthy areas of both dry land and water to live their lives, and as our wetlands are drained for agriculture, peat extraction, or housing development, the frogs and the turtles are usually the first to disappear. They are the first to feel the stress of a lost or damaged natural area.

Losing natural areas means losing pieces of our community. From a very practical point of view, losing our natural areas means that the lake suffers. Whether it's the forests and wetlands away from the Lake, where the Lake's streams and rivers begin, or right on the shoreline of the Lake, if they are lost or degraded, there will be an effect on the Lake.

This Section looks at the cause and impact of the decline of the 'canaries of the wetlands' through two questions:

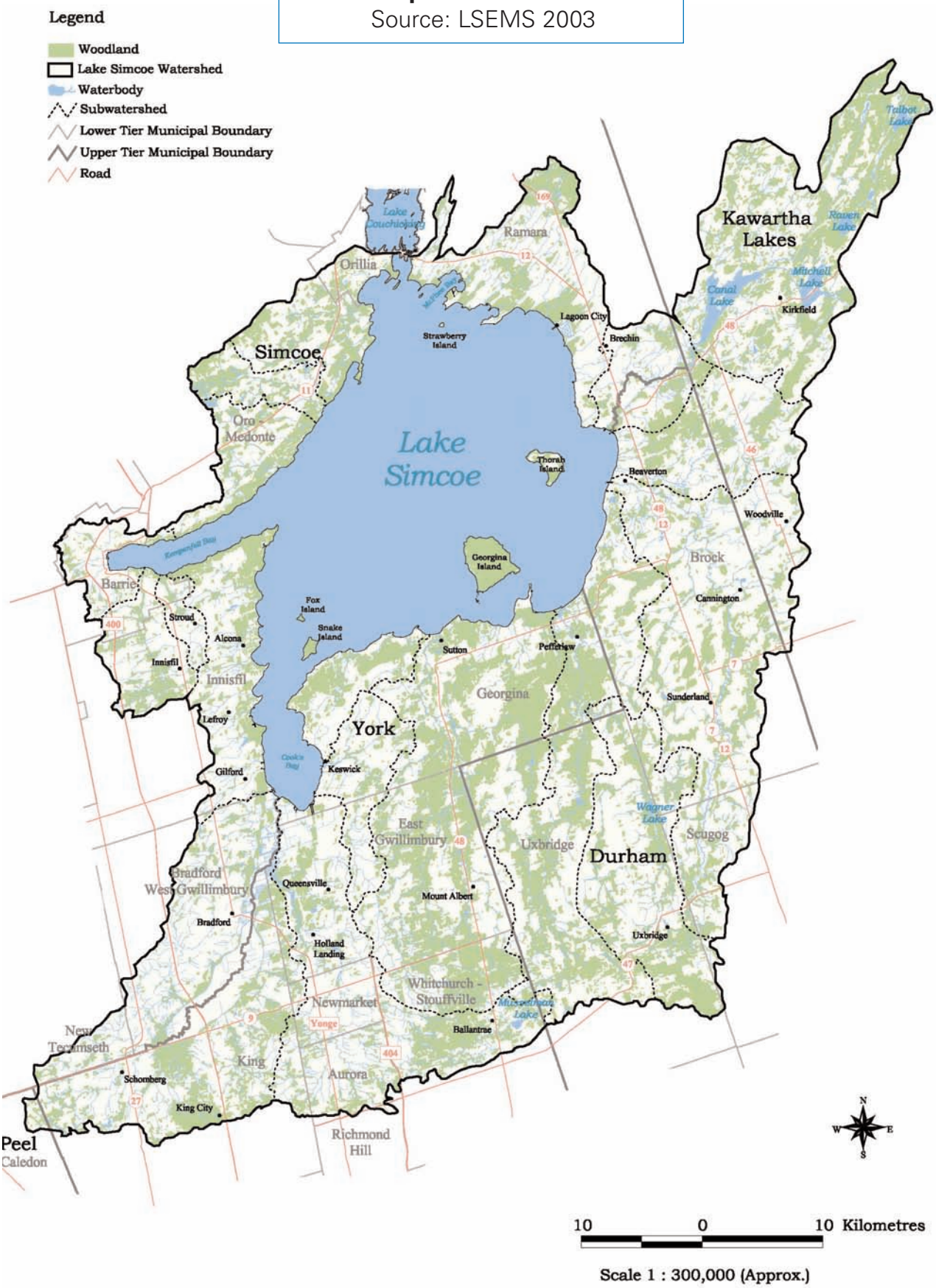
I. What Do We Know about the Canaries of the Wetlands?

II. What Can Be Done? The Starter Solution List

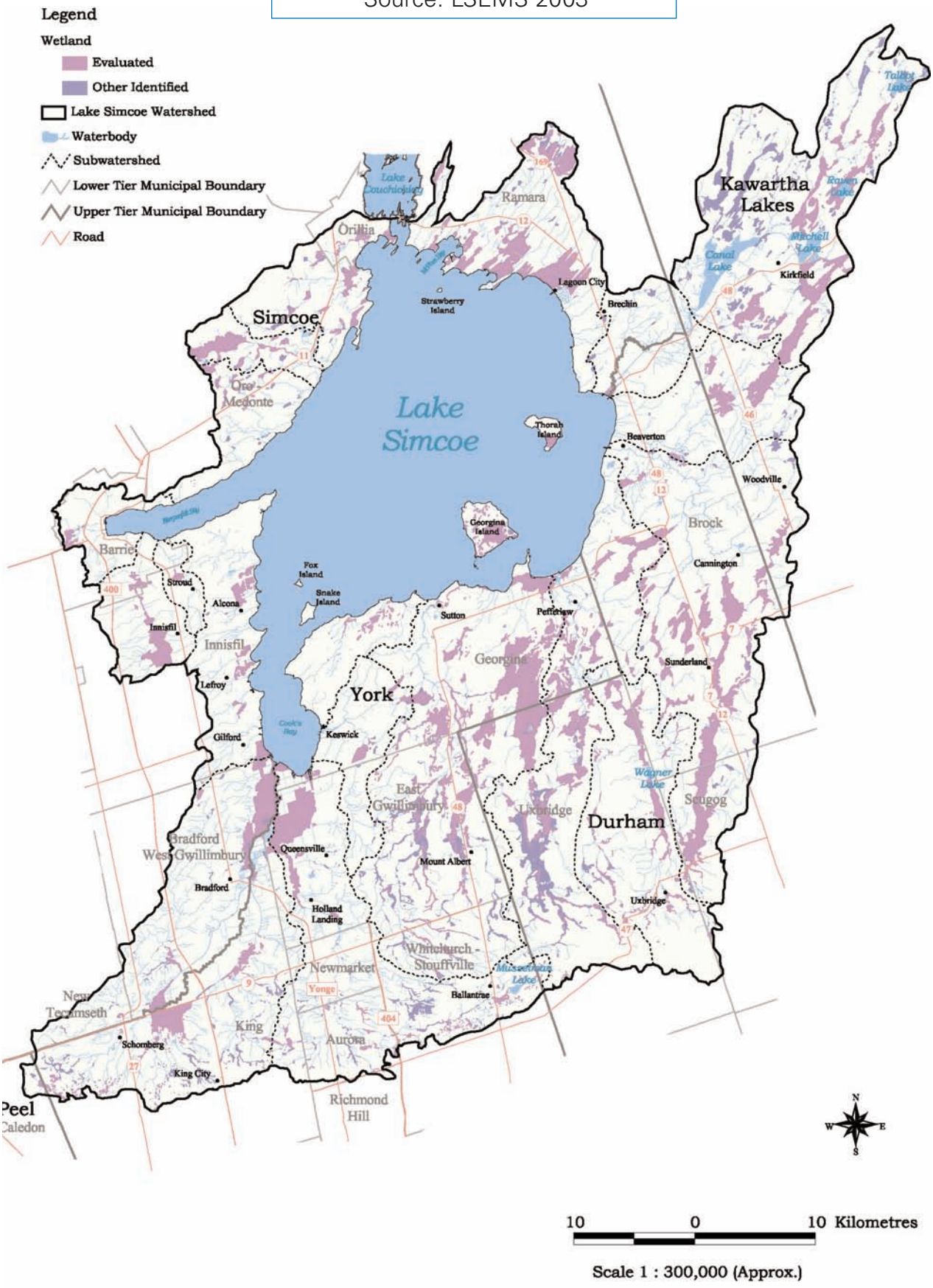
I. WHAT DO WE KNOW ABOUT THE CANARIES OF THE WETLANDS?

The Lake Simcoe watershed is an incredibly diverse natural ecosystem, but not to the extent it was 200 years ago. Before European settlement of the area around Lake Simcoe, the watershed consisted completely of natural forests and wetlands, with few relatively small areas cleared for agriculture by some of the cultures of the First Nations people. Maps 7 and 8 show the location of the remaining forests and wetlands in the lake's watershed (29% is forested and 9% is wetlands.) These maps show that some parts of the watershed still have a lot of forests and wetlands (Pefferlaw Creek and Black River watersheds, in the south, and in some parts of the northeast watersheds). The most important aspect of these areas is that the 'greenspaces' tend to connect to one another – they form a corridor that allows animals to travel longer distances without having to cross a field, giving them a substantial boost in their habitat.

Map 7 – Woodlands
Source: LSEMS 2003



Map 8 – Wetlands
Source: LSEMS 2003



Over the past 100 years, the following has occurred:

- Clearing the forest for farmland changed things dramatically as early as 1900, by which time about 87% of the forests had been converted to farmland.
- In the 1920s, the first of the Holland Marsh projects began, and today more than 30 square kilometres of land has been drained and is being used for intensive vegetable farming.
- Peat extraction is also chipping away at wetlands around the lake.
- Development of urban areas continues as the most serious threat to the remaining forests and wetlands, especially in the fast-growing areas of Newmarket, Aurora, Bradford, and Barrie.

The East Holland River watershed, with less than 60% "greenspace" (forest and wetland) sent more than 3 times as much phosphorous into Lake Simcoe as did the Black River watershed, which is about 80% "greenspace."

(Nicholls 2001)

- We are seeing fewer red-shouldered hawks in the watershed, birds of prey who use large tracts of forested areas for their habitat. This bird is another "canary", since its decline signals that large networks of treed habitat are dwindling. (Pers. Comm., Mike McMurtry and Emma Followes).
- The Lake Simcoe watershed has 65 provincial and/or national species at risk, including amphibians (frogs and salamanders), reptiles (turtles and snakes), birds, plants, molluscs, invertebrates (butterflies, moths, dragonflies, damselflies, tiger beetles), mosses, fish, and mammals.
- Turtles are negatively impacted by the warming climate. They let the environment "choose" the gender of their offspring. Eggs incubated at high temperatures (>30 °C for map turtles) develop into females and those incubated at cooler temperatures (<30 °C) develop into males. Some scientist suggest that global warming has the potential of dramatically skewing the gender ratio (a 2 °C rise in global temperatures) or eliminating the production of male offspring (a 4 °C rise in global temperature). Turtles are therefore good indicators for monitoring biotic impacts of predicted global climate change.
- The remaining bits of undeveloped lakefront are continually under the threat of development. Since all the open, clear shorelines were developed many years ago, and what is left today is often shoreline wetland, much of that development is in areas not particularly desirable for human use, but extremely important for the animals.

The Loss of Biodiversity - "Everything is interconnected":

Biodiversity represents the interactive web of life. It is both local and global. The loss of one plant can disrupt the intimate balance of life in a single ecosystem, affecting other plants, animals and insects that live there, while damage to a habitat a continent away can render a local species at risk or even extinct. Biodiversity contributes something else to our quality of life that is more difficult to define. The variety of landscape and species is important to our cultural and artistic expression. For many Ontarians, getting outdoors and away from concrete and artificial light and noise is a way to renew the spirit. Seeing a butterfly or hearing a bird call in a city garden provides a moment of wonder and delight.

The real message of the turtles and frogs is twofold. One is a reminder to protect the corridors that the wetlands and woodlands that provide for the migration of the natural

inhabitants within the Lake Simcoe eco-system. The second is that we need to understand and respect the need to protect areas for their breeding, nesting and feeding.

II. WHAT CAN BE DONE – SOLUTIONS STARTER LIST

Governments

- **Understand the importance of the natural world.** While people may intrinsically understand the beauty and of a forest, sometimes it's not so easy to appreciate that a swamp or a bog is equally, if not more important in the world of nature. Perhaps it's hard to appreciate that the frogs and the turtles are telling us something important about their world. We must understand the importance of the natural ecosystems across the entire watershed – the forests, the wetlands, and the natural corridors that join the pieces together.

- **Respect even the small, seemingly unimportant wetlands and woodlands.** They provide habitat, ensure that they are not degraded or destroyed.

- **Protect what is left through legislation:** If we are going to keep "the canaries" healthy, we need to keep what is left of our forests and wetlands. For the most part, it's the municipal governments that will make decisions on land development, and it is development that will be reducing the forests and wetlands that remain. They operate within rules set by the province, rules that address protection of forests and wetlands, but the rules carry quite a bit of flexibility, and it's important for citizens' voices to be heard when decisions are being made.

    - There is currently an immediate opportunity for people to be heard through the Campaign Lake Simcoe. This is a concerted strategy to bring awareness to the issues facing Lake Simcoe and to address the concerns through legislation.www.campaignlakesimcoe.ca.

- **Regulation enforcement:** Recently, a new regulation under the Conservation Authorities Act came into being, and this gives more power to the conservation authorities to protect shorelines and wetlands. They should be encouraged to use this power, and one area of potential is to reduce the amount of peat extraction that is going on in the watershed.

- **Forestry Stewardship:** Manage our forests to keep them healthy. If they are going to be logged, make sure it's done sustainably. Use the experts who are out there to help – the Conservation Authority, Stewardship Councils.

Individuals

- **Learn about the impact of development on the wetlands.** There are a growing number of reports and publications that have been written to profile the need for protection of plants and animals – specifically with respect to the Greenbelt for example - Report Card: Grading implementation and progress in Year 1. February 2006 and Waiting for the Ark: Endangered Species in the Golden Horseshoe Greenbelt November 2004. You can check these out at www.environmentaldefence.ca

- **Continue to observe:** Much of what we know about the wetlands and forests, and what lives in them, comes from studies done by or funded by governments (MNR, Conservation Authorities, and Environment Canada). And it should come as no surprise to anyone that this work is not being as well funded today as it was in the 1970s and 80s. Unless something changes, we are not going to be well-enough informed to know when our canaries are showing signs of weakness. So, what can we do?

- Encourage governments to continue or increase funding to monitor and evaluate our forest cover, our wetlands, species at risk, and other species across the watershed;
- Help (with your money and your time) non-government organizations with their work in this area (OFAH, Ontario Nature, Conservation Foundations, Couchiching Conservancy, and many others have programs using volunteers to monitor different parts of the natural world); and
- Keep an eye on your own property, and keep records of what you see from year to year.

- **Don't harm the amphibians and reptiles.** Leave them alone, especially in the spring when they are trying to reproduce. This goes for the snakes as well. Even though, for some people, it's hard to love a snake, they play a very important role in the ecosystem. Without the snakes, a balance is undone, and parts of the ecosystem get out of whack, especially the small rodents.
- **Restoring critical components:** The people who planted trees in the 1920s to try to improve a terrible situation in the watershed had a vision that was long term, and they acted on it. We are reaping the benefits of that "restoration" today. We have more knowledge today, and if we are wise we will use that knowledge to improve degraded wetlands and forests, and leave these as legacies to our grandchildren. LSEMS projects can help here, as can organizations like Ducks Unlimited and Wildlife Habitat Canada.

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Indicator 10… Weather Patterns are Changing…

Have you noticed that the winters seem to be getting shorter, extreme heat events are occurring more frequently, the duration of lake ice cover is decreasing, and that heavy precipitation events are becoming more common? Growing evidence suggests that the climate of the Lake Simcoe Region is changing rapidly. The main culprit for this and many other symptoms on our Lake is global warming, happening largely due to human activities. Climate change is nature's way of signalling that the planet is ailing and needs nursing back to health.

Nature is a delicate balance. All elements of the Earth act and interact in a complex and symbiotic way to maintain a climate system that fosters sustainable life for all organisms. When this climate system gets out of balance, such as through global warming, there are significant implications to our weather, which in turn have not only environmental, but also social and economic implications.

Climate change is one of the paramount challenges of our times. While this is a complex issue, please bear with us as Lake Simcoe could be a local lightning rod for a global problem. This section reviews the highlights of the complex topic of climate change and global warming by asking the following questions:

Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

Article 1.2 UNFCCC

I. What Do We Know About Climate Change?

II. What Does Climate Change Mean for the Lake Simcoe Region?

I. WHAT DO WE KNOW ABOUT CLIMATE CHANGE?

We are able to live on this planet because of a natural layer of heat-trapping gases, including water vapour, carbon dioxide and methane that surrounds the earth and keeps the earth warm enough to support life. These gases create a greenhouse effect. In essence, they are trapping excess heat in the Earth's atmosphere in much the same way that a windshield traps solar energy that enters a car.

Over the past 250 years, humans have been artificially raising the concentration of greenhouse gases in the atmosphere. Factories, power plants, and cars burn coal and gasoline and spew out a seemingly endless stream of carbon dioxide. We produce millions of pounds of methane by allowing our trash to decompose in landfills and by breeding large herds of methane-belching cattle. Nitrogen-based fertilizers, which we use on nearly all our crops, release unnatural amounts of nitrogen oxide into the atmosphere. When we clear vast tracts of land to make way for urban sprawl and agriculture we destroy forests that naturally remove carbon dioxide from the atmosphere.

According to the Intergovernmental Panel on Climate Change (IPCC), carbon dioxide levels have increased 31 percent and methane levels have increased 151 percent since the beginning of the industrial revolution.

Temperature data gathered from many different sources all across the globe show that the surface temperature of the Earth has risen dramatically over the same period. According to the IPCC, the surface temperature could rise by between 1.4°C and 5.8°C by the end of the century. Rarely in the Earth's history has the average surface temperature changed as dramatically as the changes that scientists are predicting for this century. During the last ice age 20,000 years ago, for instance, the Earth was roughly 5°C cooler than it is today. (NASA)

Even the minimum predicted shifts in climate for the 21st century are likely to be significant and disruptive.

II. WHAT DOES CLIMATE CHANGE MEAN FOR THE LAKE SIMCOE REGION?

Due to lack of studies done on Lake Simcoe watershed, a huge information gap exists which prevents us from making any definite conclusions on impacts of climate change. However, numerous studies are available on the Great Lakes region and it is safe to conclude that the climate change impacts on the Lake Simcoe watershed will be similar to the Great Lakes region.

One such study has been undertaken by the Union of Concerned Scientists, and the David Suzuki Foundation. In their report the authors have projected climate change impacts in the Great Lake region. (Figure 16).

Figure 16 – Projected Changes in Great Lakes from Climate Change
Source: www.ucsusa.org/greatlakes/glimpactover.html

WARMER TEMPERATURES	Average temperatures rise 5-20°F (3-11°C) in summer, 5-12°F (3-7°C) in winter
PRECIPITATION CHANGE	Little change in annual average precipitation but higher temperatures leads to more evaporation, which leads to drier conditions, especially in the summer and fall
EXTREME EVENTS	More extreme downpours, dramatic increases in extreme-heat days, more droughts
LAKE LEVELS	More evaporation and declining ice cover likely to lower lake levels
GROWING SEASON	Lengthening by several weeks, but varying across region

One of the key findings of this Report is the absence of research that has been conducted on the evidence and impact of climate change on Lake Simcoe and the watershed. This gap is of significance given the possible consequences outlined on the following pages.

III. WHAT ARE THE SYMPTOMS OF CLIMATE CHANGE ON LAKE SIMCOE?

The following are possible impacts of climate change in the Lake Simcoe watershed.

- **Whammy on the Fisheries:** The changing climate could make the fish population more vulnerable than ever before. The body temperature of a fish is essentially equal to the temperature of the water. Typically, each species has a preferred temperature to live in when given a choice. Rates of food consumption, metabolism, and growth rise slowly as the preferred temperature is reached, and drop rapidly after it is exceeded. Given the vital importance of water and temperature to fish, they will respond strongly to variations in climate that involve changes in water volume, water flow, and water temperatures. Responses to such environmental changes fall into two broad categories:
    - Changes in fish distributions, including shifts in the large-scale centres and boundaries of individual species and species groups, and shifts in the distributions of individual population members at local scales; and
    - Changes in the overall production of the entire fish community in a particular region and changes in the relative productivity of individual populations within a community (Kling et al. 2003).

Figure 17 explains the impacts and consequences of temperature change on fish in the Great Lakes region.

Figure 17 – Impacts and Consequences on Fish in Great Lakes Region

Impacts on Fish Ecology	Consequences for Fisheries
Change in overall fish production in a particular aquatic ecosystem	Change in sustainable harvests for all fish populations in the ecosystem
Change in relative productivity of individual fish populations in a particular aquatic ecosystem	Change in the relative levels of exploitation that can be sustainably directed against the fish populations of the ecosystem
Large scale shifts in geographic distribution of species	Change in mixture of species that can be sustainably harvested within a specific geographic area and location of profitable fishing grounds
Small scale shifts in the spatial distribution of members of a specific population	Change in sustainable harvest for the population and a change in efficiency of fishing gear, leading to change in sustainable levels of fishing effort

- **Water Water Everywhere**: The Lake Simcoe watershed holds an abundant supply of surface as well as ground water resources. So much so, that we have become used to having unlimited supply of water at our disposal. Not any more. Projected changes in rainfall, evaporation, and groundwater recharge rates will affect all freshwater users. The following are some of the changes that will occur in the water quantity:
    - Lake levels are expected to decline in both inland lakes and Ontario's four Great Lakes, as more moisture evaporates due to warmer temperatures and less ice cover.
    - Pressure to increase water extraction from the Great Lakes will grow, exacerbating an already contentious debate in the region.
    - Reduced summer water levels are likely to diminish the recharge of groundwater, cause small streams to dry up, and reduce the area of wetlands, resulting in poorer water quality and less wildlife habitat.
    - Development and climate change will degrade the flood absorbing capacities of wetlands and floodplains, resulting in increased erosion, flooding, and runoff polluted with nutrients, pesticides, and other toxins.
- **The Spread of Invasive Species:** A changing climate will likely favour invasive species with generalized habitat and feeding requirements over native species with more specialized needs. The spread of non-native species will likely compound the impacts of climate change on Ontario's aquatic ecosystems. Climate change will enable species, including warm water fish species, to expand their range northward. The introduction and spread of invasive species and climate change will increase competition for limited resources and will fundamentally change native fish communities.
- **An Increase in Summer Stratification:** Stratification of lakes occurs when a warm surface layer of water develops over cooler, deeper water. A warming climate increases the duration of summer stratification in the deep lakes, reducing the size and quality of cold water habitat. This, in turn, makes frequent and larger "dead zones"—areas of water depleted of oxygen and unable to support life—more likely to occur, a risk especially for Lakes Erie and Ontario. Persistent dead zones can result in toxic algal blooms; foul-smelling, musty-tasting drinking water; damage to fisheries; and massive fish kills—known as "summerkill".

- **Loss of Winter Ice**: Declines in the duration of winter ice on lakes are expected to continue. The loss of winter ice may be a mixed blessing for fish, reducing winterkill from oxygen deficits in shallow lakes but also jeopardizing reproduction of Lake Whitefish and lake trout in the Great Lakes' bays, where ice cover protects the eggs from freezing winter temperatures and winds.

- **The Release of Nutrients and Contaminants:** Lower oxygen and warmer temperatures promote greater microbial decomposition and subsequent release of nutrients and contaminants from bottom sediments. Phosphorus release would be enhanced, and mercury release and uptake by biota would also likely increase—exposing humans to higher mercury levels via fish consumption.

- **Human Health Impacts:** One of the most direct impacts of climate change will be felt on human health. Climate change will increase air pollution, severe weather events, especially extreme heat days, and increase infectious diseases, which proliferate with increasing heat and rainfall. All of these health-related risks may be prevented or at least mitigated through effective measures. The potential impacts of heat-related morbidity or mortality will rise significantly especially amongst the sick and elderly.

- **Loss of Sense of Place**: The rapid climate change of the magnitude recent climate models project will fundamentally alter the character of every region of the world. How is this sense of place eroded? The loss of winter for some people might not be a big deal, but our songs, our art and culture, and literature include winter as a strong influential element. Can we live without winters as we know it, without ice fishing, without opening our windows in summer? Yes we can, but not without feeling a sense of loss for our future generations.

Having read the section so far, one can get rather depressed. Climate change is however a major wake-up call. Many have not been conscious to the language of nature, or have avoided it. We cannot afford to do that any longer. With awareness, we have the tools we need to begin the process of restoration and the necessary shift in mindset that is needed to live sustainably.

The Starter List that follows has been written with these opportunities in mind.

IV. WHAT CAN BE DONE? – THE SOLUTION STARTER LIST

Global Climate Change is a massive topic that is difficult to problem solve with a few pointers. Below is a set of steps however that can get us moving down the road of recovery.

Meeting the challenge of global warming will require sustained effort over decades by governments, industry and the public.

Government

- Establish domestic policies, targets, and regulations that promote energy efficiency, energy conservation, and renewable energy.

- Strive to meet existing international agreements on Climate Change mitigation.

Industry

- Innovate, manufacture, and operate under a new paradigm where green house gas emissions are continuously minimised.

Individuals

- **Support politicians who understand and will act to minimize the risks of dangerous climate change:** – Vote for the candidate you believe will do more for the environment. Continue to hold your local representative accountable for the commitments made to your community. Come out and support that politician in both words and deeds.

- **Be the change we wish to see in the world:** The biggest change people can make is the change in their own mindset and beliefs. Changing lifestyle from consumerism to sustainability is not an easy one – unless you truly believe in the stewardship role we play for future generations.

- **Home improvements:** There is a lot you can do around the house to minimize waste and energy use like:

    - Carry out home energy evaluations.
    - Turn off the lights if not in the room.
    - Turn down the thermostat and air conditioning.
    - Clean your appliances and change filters to reduce energy use.
    - Line-dry your clothes instead of using dryers.
    - Use low flow shower heads and check for any leaks in the faucet.
    - Turn off computers when not using them.
    - Minimize your lawn watering.
    - Cut down on garbage and compost as much as you can.

- **Reinforce 3 Rs:** Remember the right steps to successful 3 Rs are to reduce first, then reuse and recycle, and not the other way round.

- **Rely on your feet:** The link between automobile emission and global warming has been clearly established. Each year, your car pumps about five or six tons of carbon dioxide out of its exhaust. That is around 11,000 pounds of greenhouse gases from just one vehicle (Spence 2005). Therefore, think before you go for a joy ride. If you can walk or run an errand then rely on your feet – our ancestors did so for centuries! Carpooling, taking public transit, and improving your car's fuel efficiency are some of the other things you can do to reduce emissions.

- **Buy fuel efficient cars:** If you need to drive – there are increasing number of choices of fuel efficient and hybrid vehicles coming onto the market.

- **Purchase locally grown food:** We are fortunate to live in an abundant area where fresh produce is available for a good part of the year. Stock up in the summer, freeze in the fall, and enjoy local produce all winter.

For more information on Global Warming/Climate change - visit the Windfall Ecology Centre: www.windfallcentre.ca.

CHAPTER 3 – ENCOURAGING STORIES

Lake Simcoe is not the only sick Lake in the world. Many communities throughout the world are undertaking lake-related studies and collaborative action. Local communities are working with governments and other key players to mobilize change. Here are some case studies that parallel what is occurring on Lake Simcoe. They provide "tried and tested" approaches that can be applied to Lake Simcoe.

STORY 1 – PAUDASH LAKE MANAGEMENT PLAN

Haliburton County / Hastings County, Ontario

The Paudash Lake Conservation Association undertook a 2 year community-based planning process that involved all seasonal and permanent residents, commercial operators and government agencies to develop a Lake Management Plan. The purpose of the plan was to identify the significant social, natural and physical features that make the lake and its surrounding area a desirable place for people to live, visit and earn a sustainable livelihood and to put in place land use policy and stewardship actions to deal with the issues.

The Lake Association led the process and they conducted many focused workshops. A survey was sent to all shoreline property owners. As well, they held many informal meetings with residents, commercial operators and government agencies (multiple municipal, provincial and federal jurisdictions) to gain a better understanding of the values that are important to the people of the lake and the issues that affect their quality of life.

The uniqueness of this process was that it was not led by a government agency. Instead it was coordinated and paid for by the residents of the lake together with limited financial assistance from the Ontario Trillium Foundation. The advantage of this approach was that the planned actions were generated by local community members and therefore promoted a vested interest in ensuring they were completed. The Plan was completed in 2005 and its implementation will be initiated in 2006.

Similar lake planning projects are being undertaken by at least 22 lake associations located across southern Ontario. More information can be obtained on the Paudash Lake Management Plan from the following sources:

Paudash Lake Conservation Association	www.paudashlake.info
French Planning Services Inc.	www.lakeplan.com

STORY 2 - LAKE ERIE (CANADA AND UNITED STATES)

In the 1960s, Lake Erie was declared "dead," though, ironically, it was full of life – just not the right kind. Eutrophication had claimed Lake Erie and excessive algae became the dominant plant species, covering beaches in slimy moss and killing off native aquatic species by soaking up all of the oxygen. The demise of Lake Erie even made it into a Dr. Seuss book, The Lorax.

> "You're glumping the pond where the Humming-Fish Hummed!
> No more can they hum, for their gills are gummed.
> So I'm sending them off. Oh, their future is dreary.
> They'll walk on their fins and get woefully weary
> in search of some water that isn't so smeary.
> **I hear things are just as bad up in Lake Erie."**
>
> *– The Lorax, by Dr. Seuss*

For decades, pollution filled Lake Erie with far more nutrients than the lake could handle. Phosphorus, found in many commercial detergents at the time, was the main culprit. Plants began growing, dying and decomposing in Lake Erie, creating anoxia (severe deficiency of oxygen) at the bottom of the lake and leaving the water's surface putrid and mossy. The lack of oxygen killed fish and other aquatic species, and the smelly surface repelled anglers, tourists and those living around Lake Erie. Heavy metals also had contaminated much of the fish population of Lake Erie.

In response to public concern and recommendations by the International Joint Commission, the Great Lakes Water Quality Agreement (GLWQA) was signed by the United States and Canada in 1972. The Agreement emphasized the reduction of phosphorus entering lakes Erie and Ontario, and in 1977 maximum levels for phosphorus were added to the Agreement. Also, phosphorus in detergents was finally controlled.

The GLWQA directed the preparation of Lakewide Management Plans (LaMPs) to identify critical pollutants that impair beneficial uses in the lake proper and to develop strategies, recommendations and policy options to restore these beneficial uses. The process for preparing the LaMPS was a top down approach that was coordinated by many municipal, regional, provincial, federal and international agencies and involved environmental interest and local community groups.

Today, phosphorus loads in Lake Erie are now below the maximum allowed in the GLWQA, and eutrophication has been controlled. Algae and excessive plant growth has been reduced, and native plants are once again growing in sections of the lake. Lake Erie still has many problems – such as non-native invasive species, contaminated sediments and closure of beaches due to sewage contamination. But, through international cooperation and public advocacy, the lake is no longer considered "dead," and, hopefully, people have a better understanding and concern for the effects of human activity on water quality in the Great Lakes and beyond.

This case study shows that the environmental integrity of Lake Erie is dependent not only on its various characteristics and stressors within the lake itself, but also on actions implemented through governmental agencies and individuals throughout the entire watershed and beyond. The future of the lake will also depend on the vigilance of government agencies and other stakeholders to identify new issues and deal with them in a cooperative and timely manner.

Further information may be found at:

www.great-lakes.net/teach/pollution/water/water5.html
www.epa.gov/glnpo/lakeerie/2004update/index.html
www.fish.state.pa.us/PA_Exec/Fish_Boat/anglerboater/1999/julaug99/lerieerr.hm
www.greatlakesdirectory.org/pa/092903_great_lakes.htm

STORY 3 – LAKE VICTORIA (AFRICA)

Lake Victoria is one of 3 lakes within the Rift Valley Lake system in Africa and is comparable in importance and issues to the Great Lakes. It is the world's second largest fresh water body after Lake Superior. About 30 million people live in the riparian countries and they are dependent upon the lake for food, energy, water, building materials and transportation, as well as a repository for human, agricultural and industrial waste. There are 8 major rivers that flow into the lake and extensive wetland ecosystems fringe the lake. Lake Victoria is rich in phytoplankton which is dominated by Blue Greens because of eutrophication. As a result, deoxygenated deep waters are causing fish deaths and migration.

There are greater than 500 species of fish, including 300 endemic (found no where else in the world) species of Haplochromis (cichlids) and several Tilapiines (tilapia). The introduction of Nile Perch and Nile Tilapia for a food source for the local population threatens this diversity and is blamed for the near extinction of 200 endemic species.

The increasing rate of human population growth and urbanization and abuse of the lakes resources (destruction of wetlands for agriculture, and mining contaminants and runoff) continue to threaten the elements of the lake that makes it important.

Local governments and citizen groups (schools in particular) are working with international organizations to educate locals on how to protect, conserve and manage their natural resources (American Zoo and Aquarium Association, AZAA, in particular the Toronto Zoo and the New England Aquarium have designed educational programs for both Canadian and Kenyan school children to learn more about their "great lakes"

and exchange ideas on how to protect them for the future generations).

This case study shows the importance of communication and education programs to help local people understand the importance of the lake, and embrace new approaches and life style choices to ensure the future sustainability of the lake.

Further information may be obtained at:

www.livinglakes.org/victoria/

STORY 4 – LAKE CHAMPLAIN, UNITED STATES AND QUEBEC

The Lake Champlain Basin is located in the High Peaks of New York's Adirondack Mountains to the west, Vermont's Green Mountains in the east, and Quebec's St. Lawrence Valley in the north.

In 1990, 607,788 people lived in the basin and the population has been growing at an average of 1.2% per year for the last 40 years. The population density of the basin is 61 persons per square mile. Approximately one third of the basin's residents use the lake as a source of drinking water. In 1992, 7.9 million non-resident visitors entered the basin through 14 crossing points along the Canadian border. In 1991, 167,874 fishing licenses were purchased. Besides humans, the lake's ecosystem includes about 81 species of fish, 318 species of birds, 56 species of mammals, 21 species of amphibians and 20 reptile species.

Non-point sources are estimated to account for about 71% of the total phosphorus load to Lake Champlain, with point sources contributing the remaining 29%. On a typical summer day in 1992 over 7,500 motor boats, more than 3,000 sail boats, at least 15 commercial vessels, and thousands of swimmers, windsurfers, kayakers, canoers, scuba divers and other recreationists were enjoying Lake Champlain. Lake Champlain has 43 marinas.

In 1996, the governors of New York and Vermont and the regional administrators of the USEPA endorsed Opportunities for Action: An Evolving Plan for the Lake Champlain Basin as a pollution prevention, control and restoration plan. The 1996 Plan called for periodic updates and a new version of the plan was signed in April 2003. The updated Plan was based on information from several public input meetings and comments from researchers, not-for-profits, local state, and federal agencies, and other groups interested in Lake Champlain's management.

More than 25 watershed, river and lake groups are active in the Lake Champlain Basin. These grassroots, citizen organizations help restore and protect the basin's waters and ultimately Lake Champlain. Activities include: monitoring water quality; inventorying natural resources; watershed planning; cleaning up rivers, streams, and lakes; restoring fish habitat; and working with landowners to improve water quality. Many of these groups rely on volunteer and member support.

Local involvement in planning and implementation is a cornerstone of the Lake Champlain Basin Program (LCBP). From 1993-2003, the LCBP awarded more than $2.6 million projects in New York and Vermont through several competitive grant programs. The LCBP also relies on citizen public meetings, written comments, and Citizen Advisory Committees.

More information can be obtained at:

www.lcbp.org/impofa.htm

STORY 5 – LAKE BAIKAL, RUSSIA

Lake Baikal is located in Russia and is the world's oldest (about 25 million years) and deepest (1700 m or 5577 ft) lake. It has a volume of water equal to all the Great Lakes combined and contains 20% of the world's unfrozen freshwater reserve. It has been declared a world heritage site because of its evolutionary and archeological implications. The lake also contains unusual freshwater fauna and flora, endemic to the lake, it has greater than 360 streams and rivers that flow into the lake and is surrounded by systems of protected areas that have high scenic and other natural values.

In 1957, a cellulose, pulp and paper plant was proposed for Baikalsh, much to the opposition by locals, scientists and academics. Following some 30 years of a community outcry the Soviet government (1987) issued a comprehensive decree (the Baikal Law) protecting the lake. This decree put in place a coordinating protection framework for numerous resource management agencies within the basin. The Baikal Law established:

Maximum allowable pollution within the ecological zone;
Hotspots for protection;
Federal regulations; and
General overview of problems.

However, many point and non-point sources are still dumping industrial waste and toxic effluent into the air and water 24 hours/day.

This case study is an excellent example of how long term community involvement eventually pays off to establish appropriate policy and that implementation of the policy is not a short term endeavour.

Of special interest is that a group of scientists and government officials from the Lake Baikal area came to Canada in 1999 (sponsored by the Canadian government) to view some of the techniques being used here to treat waste (household, sewage and stormwater), improve farm operations, and study ecological management and planning on a watershed basis. A key part of their visit was the Lake Simcoe watershed.

Further information can be found at:

www.livinglakes.org/baikal/

whc.unesco.org/pg.cfm?cid=31&id_site=754

Each of these is a powerful story about how people and nature can work together to begin to restore health to situations, like Lake Baikal, that took thousands of years to deteriorate. These stories show how human action caused significant stress on these Lake eco-systems, but also how local communities can work with the scientists and the governments to turn a situation around.

There is much to learn from those who have gone before us. Hopefully the future actions of the communities of Lake Simcoe and the watershed will be as helpful to others, as these stories will be to us.

CHAPTER 4 - A WAY FORWARD

You have now experienced the science behind the various indicators of change found in Lake Simcoe and the watershed, as well as read about success stories from around the world. Lake Simcoe and the watershed have its own unique challenges, but it is also a microcosm of the challenges being faced on a global level. Local and global issues meet on the shores of Lake Simcoe.

This document has tried to distill and simplify the science so that it can easily be shared. Key findings have also been transferred onto a set of Naked Truth Cards so people can quickly digest the issues and start to think about action. The Naked Truth Action Planning events are being conducted in mid July 2006 at four different locations around Lake Simcoe. Their purpose is to build on, expand and enrich this information and transform it into a vibrant Master Plan of Action for Saving Lake Simcoe.

We began this report by providing 4 lenses as subsets of the first chapter, hopefully, to be useful as background and as context for the research gathered. They were:

1. **The Natural Intelligence of Mother Earth. This alluded to the benefits of developing an ecosystem mindset.**

2. **The Power of Community. This looked at ways and means to engage everyone.**

3. **The Complexity of the Lake Simcoe Watershed. This hinted at ways to communicate complex information.**

4. **The Intricate Interconnectivity of Nature's Cycles. This suggested ways of understanding the world differently and renewing relationships with the natural world.**

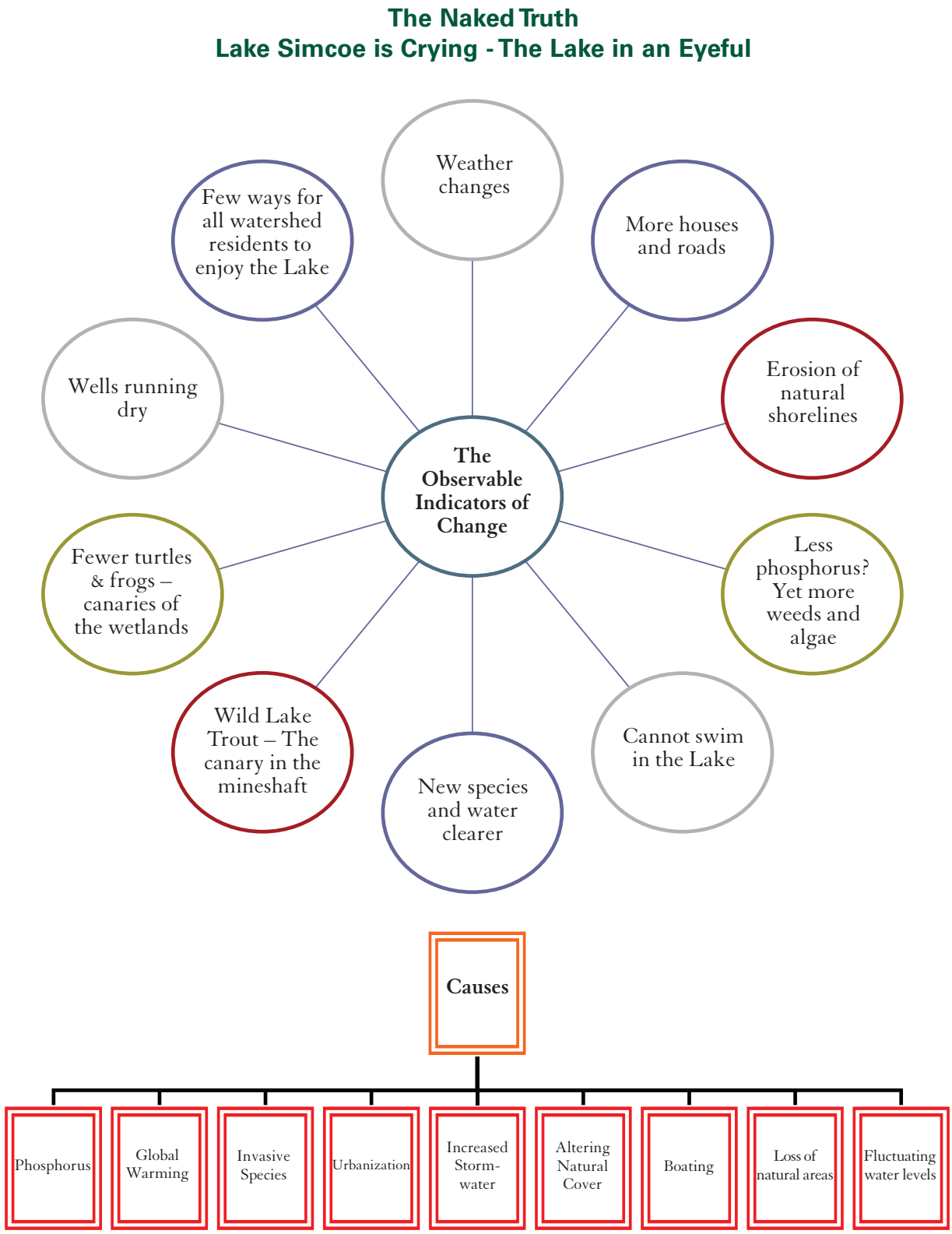
As it turns out, in the course of doing this research, we discovered that these four lenses could also be helpful if used as the basis for a simple but comprehensive framework for organizing ideas, thoughts and actions as we go forward from here. The road to the recovery and the protection of the Lake and the Watershed will undoubtedly be full of twists and turns .We believe, that with these four simple and clear organizing principles to guide us, we might be able to take steps together towards sustainable living for today and future generations.

Organizing Principle #1

Developing an Eco-System Mindset
(Building from The Natural Intelligence of Mother Earth)

The indicators of change outlined below are in the form of a wheel (Figure 18). This wheel emerged during the research. The indicators are mostly observations about science; however, one indicator has more to do with social science or public policy. Over and over we heard that there are not enough ways for residents of the watershed to enjoy the Lake, and so this too is included –as a symptom of the problems.

Figure 18 – The Observable Indicators of Change



Each of these indicators is connected to the others. This suggests that we might no longer afford, as we have done in the past, to isolate one indicator such as weeds, or one cause such as phosphorus, and only focus on this or that. The other extreme --to do a 'broad sweep-- will not open the doors to restoring the entire system either.

We need to start thinking as an eco-system. An ecosystem is a world of 'and' not 'either/or'. This can be confusing, but it can also help a clear sense of order emerge - it all depends on mindset. People can become a victim of their mindsets and be blinded to seeing new possibilities, or with a shift in mindset, can open up an entire range of alternatives.

The ecosystem mindset allows a diversity of knowledge, ideas and perspectives. This can be valuable in enlisting support of people on behalf of the Lake, in that different people approach problems, process information, and think and feel in different ways. The signature of the ecosystem mindset is the desire to find common ground – while at the same time using the tension between different perspectives to elevate thinking.

As more people who live in the watershed begin to develop eco-system mindsets, we all might have a better chance to see the possibilities for new solutions and innovative approaches.

Organizing Principle #2

Fresh Vision – Fresh Governance (To Harness the Power of Community)

As stated a number of times in this report, the issues facing Lake Simcoe and the watershed are interconnected and complex. The implications of the deterioration of the Lake and the watershed are significant. The research on success stories clearly shows that it is only when citizens and governments work together in true partnership can environmental issues – like the Lake Simcoe challenge – be tackled effectively.

There are many examples of innovative and progressive 'partnership' organizations, but one of the most inspiring is the Lake Champlain Basin Program that partners government agencies from New York, Vermont, and Quebec; private organizations; local communities; and individuals to coordinate and fund efforts which benefit the Lake Champlain Basin. They work together on a unified action plan with targets, objective and time lines on water quality, fisheries, wetlands, wildlife, recreation, and cultural resources.

Tapping into community power requires an infrastructure that joins and links the key players who are collectively working towards a common goal – each utilizing their own diverse knowledge and powerbases. In the textbox below is a 'starter vision' for this type of infrastructure to begin the dialogue.

A Starter Vision

'The new "Lake Simcoe Alliance" is a network of government agencies, private organizations, communities and individuals who recognize the value of working together to coordinate and fund efforts to restore and maintain the unique natural heritage of Lake Simcoe, its watershed and the quality of life it offers.
Mission:Combining science and stewardship, we seek to ensure that this important water system and its wildlife, native plants, and natural processes continues to function as an interconnected web of life, capable of supporting all of the natural and human communities that reside within it, for now and for future generations.
Vision: We are successful when all residents of the Lake Simcoe watershed take it for granted that their long-term personal, spiritual, and economic well-being is inextricably connected to the well-being of the Lake and its natural systems.'
(Thanks to Y2Y – Yellowstone to Yukon for their inspiring words which we have 'borrowed' as an example of action that can be mobilized.)

Organizing Principle # 3

Communicating inventively
(Arising from the fact that that the Watershed is Very Complex)

One of the most powerful tools that we have seen and used to describe the complexity of Lake Simcoe and the watershed are maps. A map helps to simplify and effectively show in one image key points of reference – the expanse of territory that feeds into the Lake Simcoe Basin, along with the names of 22 municipalities, 4 regions, 18 local communities, 18 subwatersheds, and 35 streams and rivers flowing into the Lake and one major outflow – through Lake Couchiching to the Severn River.

A map can tell many stories in one form. A map can also be a memory of what has been explored and what is known. To expand a map is to expand a story.

Communication is one of the most difficult challenges we as human beings face. Sharing, interpreting, and decoding complex information are all key functions of both action planning and mobilizing change. Engaging people in being part of change requires that they connect with all their senses and not just their intellect. Words, the use of pictures, photographs, maps, music all help people truly connect to a situation.

A picture tells a thousand words – and allows for interpretation by the viewer – a vital tool in mobilizing change. How to communicate well is one of the most serious challenges we have .

Organizing Principle # 4

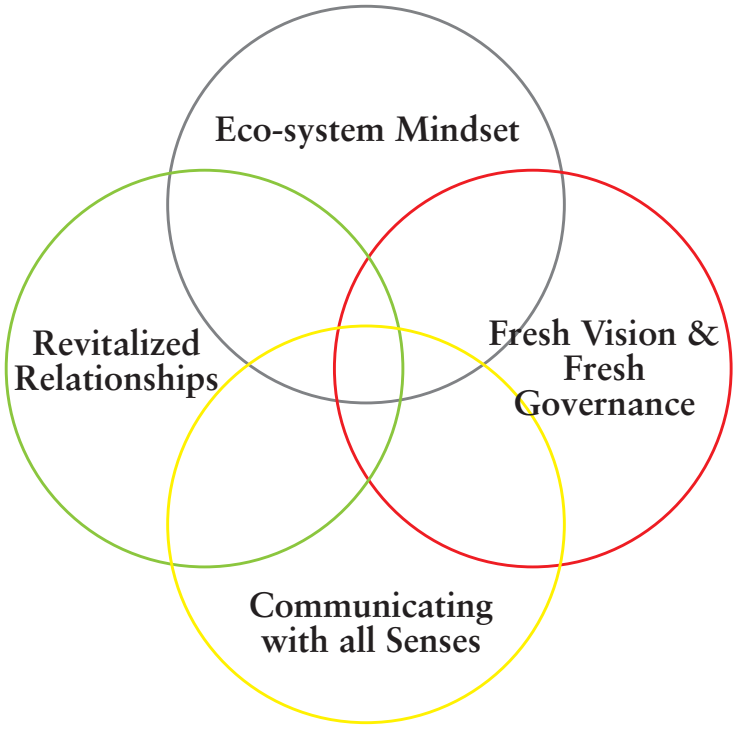
Revitalizing Relationships
(Reconnecting with and renewing Nature's Cycles)

One of the driving forces of the entire Naked Truth initiative is to help people reconnect to Lake Simcoe and the beauty and magic of the Lake. In our very busy lives, revitalizing our relationship with Nature offers many benefits. Connecting or reconnecting with Nature's cycles can let us see how various distinct activities relate to each other, as well as develop an appreciation of ongoing change. Understanding interconnection and interdependency is very important in understanding how Nature operates. The cycle works when each part undertakes its own responsibilities.

The same can be said for people. As has been stated many times in this report – the issues require diverse perspectives to join forces and unite in helping Lake Simcoe and the watershed. Of the greatest challenges we may have is to learn how governments, agencies, community groups, businesses, individuals…. people from many cultures and age groups can build relationships and work together using the same organizing principles.

A FINAL WORD

As this chapter closes, we are excited about what the future brings. While the issues and challenges are significant – so too is the power of people coming from throughout the watershed to create together ways to stop harming the Lake, start helping it and continue loving it so it can get on with healing itself.



The Possible Organizing Principles

Chapter 5 – Acknowledging Others

Consolidating wide ranging research can be a daunting task, and it took a core research team comprised of:

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Personal Communication

1. Jeff Anderson – Senior Fisheries Biologist, Lake Simcoe Region Conservation Authority
2. Jason Borwick – Area Biologist, York/Durham, Aurora District, Ontario Ministry of Natural Resources
3. Pamela Denis- Subwatershed Planner, Lake Simcoe Region Conservation Authority
4. Robert Eisenberg, Rescue Lake Simcoe Coalition
5. John Gilbank, Working Committee, Lake Simcoe Environmental Management Strategy
6. Emma Followes – Ecologist, Aurora District, Ontario Ministry of Natural Resources
7. Jamey Heath, Campaign Lake Simcoe, Environmental Defence
8. Jake LaRose – Assessment Biologist, Lake Simcoe Fisheries Assessment Unit
9. Mike McMurty – Natural Areas Ecologist, Natural Heritage Information Centre
10. Rob Regier- Acting Manager of Corporate Communications, Lake Simcoe Region Conservation Authority
11. Jack McDonald, Rescue Lake Simcoe Coalition
12. Brian Shuter- Research Scientist, Ontario Ministry of Natural Resources
13. Annabel Slaight, Rescue Lake Simcoe Coalition
14. Mike Walters – Director, Watershed Management, Lake Simcoe Region Conservation Authority
15. Peter Waring – Area Supervisor, York/Durham, Aurora District, Ontario Ministry of Natural Resources
16. Cam Willox – Fisheries Assessment Unit Coordinator, Lake Simcoe Fisheries Assessment Unit
17. Janet Wong- Senior Planner, Lake Simcoe Region Conservation Authority







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