

Musselman's Lake Subwatershed Assessment and Stewardship Opportunities Report

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Lake Simcoe
Region
Conservation
Authority



TOWN OF
WHITCHURCH-
STOUFFVILLE

FINAL DRAFT

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Executive Summary

The objective of the Musselman’s Lake Subwatershed Assessment and Stewardship Opportunities Report (Stewardship Opportunities Report) is to describe the environmental issues facing Musselman’s Lake and its subwatershed and put forward recommendations to remedy or control these environmental issues. The Stewardship Opportunities Report was prepared by the Lake Simcoe Region Conservation Authority (LSRCA) in consultation with the Town of Whitchurch-Stouffville, landowners, resident associations, business operators, interested members of the public, appropriate government agencies and non-government environmental groups.

Background

Musselman’s Lake, in the Town of Whitchurch-Stouffville, is a small kettle lake situated on the Oak Ridges Moraine. In recent years, the lake has experienced increased water temperatures, excessive aquatic vegetation growth and a blue-green algae bloom in the late summer and fall of 2007.

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The Musselman’s Lake subwatershed has been extensively developed for residential, recreation and agricultural uses. A study completed by the LSRCA in 1989 confirmed that water quality in the lake was degraded. Increased development has resulted in the direct input of stormwater runoff into the lake without treatment. This is compounded by the limited and intermittent outflow from Musselman’s Lake, as well as septic systems that require re-inspections or upgrading.

The first step towards developing the Musselman’s Lake Stewardship Opportunities Report was to establish the Project Steering Team (PST), responsible for the overall management of the project. The PST consists of representatives from the LSRCA and the Town of Whitchurch-Stouffville. The PST created an advisory Technical Working Group (TWG) to assist with the development of the Stewardship Opportunities Report. The TWG includes local residents, as well as representatives from the LSRCA, the Town of Whitchurch-Stouffville, the aggregate sector, the agricultural sector and the business sector.

Creating Partnerships in Planning and Stewardship

Land use planning in the Musselman's Lake subwatershed is affected by legislation and policy enacted at the federal, provincial, regional and local levels. Given the unique character and environmental sensitivity of the area, extra care must be given in land use planning decisions. Together with the residential and business community members, the LSRCA, the Town of Whitchurch-Stouffville, the Region of York, as well as the provincial and the federal governments all have a role to play in improving and restoring the ecological function of Musselman's Lake.

Community Input

The Musselman's Lake Stewardship Opportunities Report is the result of extensive public consultation. Community workshops were held on August 23rd and November 17th of 2007, where community members identified several environmental concerns, the majority of which focused on water quality. Community members also helped guide the formation of the TWG (see Appendix A and B).

In August of 2008, a survey was conducted to ascertain local residents' opinions regarding land use, water quality, recreation, resource management and educational opportunities (see Appendix C).

State of the Subwatershed, Resource Goals and Recommendations

In taking a detailed look at the natural heritage system in the Musselman's Lake Subwatershed, the Stewardship Opportunities Report is divided into four main areas of focus: groundwater, surface water, aquatic habitat and terrestrial habitat.

Groundwater

Musselman's Lake depends on a constant supply of groundwater throughout the year as its primary source of water. Throughout the Musselman's Lake subwatershed, humans are extremely dependent on a reliable supply of groundwater for many purposes.

Specialists in the Source Water Protection program are tracking and accounting for groundwater in the Musselman's Lake subwatershed. This is essential in order to effectively manage water resources into the future. Under the Clean Water Act (2006), the local Source Protection Committee will develop plans for protecting municipal well water. They will look at potential sources of groundwater contamination in the area and determine the best method of managing existing and future land and water uses.

The Musselman's Lake subwatershed has several groundwater recharge areas (areas where rain and melting snow seep into the ground and add to the groundwater supply). During low water periods, groundwater flowing to the surface, known as discharge, helps maintain consistent surface water levels in Musselman's Lake.

In rural areas of the subwatershed, levels of bacteria, phosphorus, nitrates and road salt can become elevated where groundwater exceeds the capacity of the natural filtration capabilities of the soil. Sources of contaminants in these areas are fertilizers, improperly functioning septic systems, manure storage facilities and road salt application. In urban areas of the subwatershed, sources of groundwater contamination include road salt, hydrocarbons, metals, phosphorus and other nutrients.

Groundwater Resource Goal

Goal – To protect, restore and enhance groundwater quality and quantity and ensure sustainable groundwater use for a continuous supply of clean water to support environmental functions and human needs.

Because contaminants on the surface can reach groundwater through infiltration, contaminants should be kept away from vulnerable areas. These vulnerable features are being identified through the Drinking Water Source Protection program, which is currently being undertaken through the Clean Water Act. Proper storage and disposal of potential contaminants by all subwatershed residents will also protect groundwater quality.

Recommendations for addressing groundwater concerns include public outreach and education about their water supply and proper fertilizer, pesticide and chemical storage and use. Wherever possible, impervious surfaces (hard surfaces like asphalt) should be restricted and/or replaced with pervious surfaces.

Surface Water

Surface water is comprised of groundwater discharge, overland flow of precipitation, as well as precipitation that falls directly onto waterbodies. In the East Holland River and the Musselman's Lake subwatershed, spring flow is typically high due to a March or April snowmelt, as well as the onset of spring rains in April or May. Intense rainstorms throughout the year can also raise water levels and velocities. It is under these conditions that flooding and shoreline erosion occur. This natural variation in flow, which can range from spring flooding to very low or zero flow in summer, plays an important role in the health of an ecosystem.

Water quality can be diminished through municipal and industrial wastewater discharges, ruptured underground storage tanks, landfills, agricultural drainage, urban runoff, land clearing and construction activity. Vegetated areas improve water quality. Water is filtered as it flows through the vegetation and soil, into the groundwater supply.

Stormwater runoff in urban areas of the Musselman's Lake subwatershed can carry pollutants into the lake. These pollutants include nutrients and pesticides from lawns, parks and golf courses; road salts; tire residue; oil and gas; sediment; and nutrients and bacteria from pet and wild animal feces. In rural areas of the subwatershed, runoff from pasture and cropland can bring high levels of nutrients, sediment and bacteria into the lake. Certain agriculture activities that place stress on groundwater resources include the pumping of surface water for irrigation and creation of ponds to intercept surface flow. Tile drains also alter drainage characteristics.

A water quality report for Musselman's Lake, compiled in 1989, indicates increases in aquatic plants and algae. Significant plant growth was observed by sampling staff in 2006 and a toxic blue-green algae bloom occurred in the fall of 2007. These are clear indicators that water quality in Musselman's Lake is impaired.

Adding phosphorus from outside sources, such as fertilizers or industrial processes, can have a serious impact on the ecosystem and can cause increased growth of aquatic plants and algae. Phosphorus levels in Musselman's Lake have declined since 1989, but levels are still too high, as indicated by excess plant and algae growth. Phosphorus is the nutrient that regulates plant and algae growth. Over the last 25 years chloride concentrations in Musselman's Lake have increased. Higher levels of chloride typically correspond with improper and excessive use of road salts.

Surface Water Resource Goals

Goal – To ensure that surface waters are of sufficient quality to support healthy aquatic communities and enable sustainable human uses including recreation and commercial uses.

Goal

- Protect aquatic and terrestrial life and ecological functions;
- Protect human life and property from risks due to flooding;
- Contribute to the protection of Musselman's Lake, East Holland River subwatershed and Lake Simcoe as a drinking water source; and
- Support sustainable agricultural, industrial and commercial water supply needs.

Recommendations for addressing surface water concerns include implementing an in-depth lake-based monitoring plan. A community outreach and education program should be developed to inform residents about natural alternatives to the pesticides, herbicides and fertilizers. Phosphorus levels should be addressed by developing a stormwater management plan for the Musselman's Lake subwatershed and other non-conventional phosphorus reducing methods like precipitants that remove phosphorus from the water.

Aquatic Habitat

Rural and urban development in the Musselman's Lake subwatershed can impact aquatic habitat by removing the filtration effect of natural vegetation and impacting water quality. Septic systems throughout the Musselman's Lake subwatershed can fail and add nutrients and bacteria into the lake. The construction of docks, boathouses and man-made beaches, as well as the unnecessary removal of aquatic vegetation can also alter or destroy fish habitat.

Musselman's Lake is known by local anglers for its northern pike, smallmouth bass and largemouth bass fishery. Recent electrofishing surveys have shown that Musselman's Lake has a diverse warm water fishery. All of the documented species are well-suited to a shallow warm water kettle lakes and one would therefore expect to find them in Musselman's Lake. Two new species reported were black crappie and golden shiner. Golden shiner is native to the East Holland River subwatershed, suggesting that there is a link to the East Holland River subwatershed for at least part of the year. Black crappie is not native to the subwatershed.

Invasive species such as common carp or round goby have not been noted in Musselman's Lake. This likely indicates that they have not yet been introduced into the lake and demonstrates that fish populations are healthy. In a stressed system, invasive species are able to outcompete the native species in the lake for habitat and food.

Aquatic Habitat Resource Goals

Goal – Musselman's Lake should support a sustainable fish population, including optimum habitat for its naturally reproducing native fish and maintain stability in the bio-diversity of wildlife species and their habitat. The introduction of "invading species" such as zebra mussels and purple loosestrife must be prevented.

Goal – To have a healthy and diverse warm water fish community.

To support this community it is important that a wide variety of habitats are available in order to ensure that the species comprising the community are able to carry out their life cycles. This includes habitat for feeding, spawning and evading predators.

Goal – To continue support of a viable sport fishery, it is also important to ensure that there is a healthy bait fish community.

The sport fish community is only sustainable if the minnow community of the lake is healthy. A diverse population would create more recreational angling opportunities on the lake.

Goal – To have a healthy and diverse benthic invertebrate population.

The benthic invertebrate community is the foundation of the aquatic ecosystem. A healthy benthic invertebrate population supported by a variety of habitats will take in nutrients from the water and provide food for the minnow population of the lake, which in turn supports the population of larger fish. Therefore, a healthy benthic invertebrate community is essential not only for the health of the aquatic community of Musselman's Lake, but also for supporting its recreational fishing activities.

Recommendations for addressing aquatic habitat concerns include continued fish and benthic invertebrate studies, shoreline naturalization projects and implementing community outreach and education programs to inform local residents about the spread of invasive species.

Terrestrial Habitat

Terrestrial habitat is the most likely component of the natural heritage system to be directly impacted by human activities. The LSRC in partnership with Beacon Environmental has developed a natural heritage system (NHS) to define and catalogue significant environmental features and land types in the Lake Simcoe Watershed. The NHS has identified that 40.2% of the total area within the Musselman's Lake subwatershed as provincially significant. The lake itself has been identified as significant at the watershed level.

Forested area is important as it provides environmental, social and economic benefits, such as protection of air, water and soil conditions, provision of habitat, recreation and the sustainable harvest of woodland products. Currently, the East Holland River subwatershed has a target forest cover percentage of 30%. The Musselman's Lake subwatershed currently has 24.5% forest coverage, which is relatively healthy.

Non-native terrestrial plant species are often introduced via horticulture or agricultural activities. Some examples of terrestrial invasive species that may be present in the Musselman's Lake subwatershed and surrounding areas are Scots Pine, Common Reed, Dog-strangling Vine, Norway and Manitoba Maple, European Buckthorn and Common Lilac. Preventing the spread of invasive species will be one of the keys to reducing their impacts. Enhanced communication and education programs would help to prevent the spread by visitors to the watersheds who are unaware of the impacts of their actions.

Local and regional tree planting programs have planted 3,550 native trees and shrubs in the Musselman's Lake subwatershed. Future planting and restoration projects should aim at connecting existing natural heritage features, in order to create wildlife habitat corridors.

Terrestrial Habitat Resource Goals

Goal – Protect, enhance and restore the natural features, to improve ecosystem function, enhance biodiversity and also mitigate the impacts of changing land uses.

Goal – The protection and rehabilitation of the shoreline (littoral, riparian and upland areas) should be promoted to increase the amount of natural shoreline. The shoreline can be described as the “ribbon of life” that supports a diverse range of fish and wildlife species.

It is clear that human activities are having a significant impact on the health and quality of the Musselman’s Lake ecosystem through population growth and land use changes. By measuring or quantifying the value to communities of ecosystem services, we can more accurately account for land use changes which thereby help to inform land use and other decisions related to altering the landscape.

Recommendations for addressing terrestrial habitat concerns include conducting local plant and wildlife surveys, implementing community outreach and education programs to inform local residents about species at risk and the spread of invasive species. It is also important that the municipality incorporate the NHS into its official plans to ensure environmental protection. Areas for environmental restoration and tree planting should be identified.

The Stewardship Opportunities Report also describes Best Management Practices (BMP’s) as stewardship practices that can be implemented within urban and rural settings. They are environmental projects that will improve ground and surface water quality and quantity or enhance terrestrial and aquatic wildlife habitat. The Stewardship Opportunities Report outlines BMP’s that cover:

- Determining accurate land ownership information to verify who is responsible for implementing possible stewardship projects;
- Proper management of septic systems and holding tanks ;
- Native tree and shrub planting;
- Erosion control along the shoreline and other waterbodies;
- Environmentally sustainable agricultural practices;
- Street sweeping to reduce sediment buildup;
- Rainwater harvesting;
- Proper maintenance and placement of ditches and grassed swales;
- Roof top storage and green roofs;
- The use of soakaway pits, infiltration galleries and permeable pavement;
- The use of oil grit/hydrodynamic separators; and
- The proper use of road salt.

Implementation Strategy

The Musselman's Lake implementation group will be made up of residents, the LSRCA and the Town of Whitchurch-Stouffville. The implementation group will create an implementation plan that will guide stewardship opportunities. The PST, upon completion of the Stewardship Opportunities Report, will establish an implementation group comprised of residents, LSRCA staff, Town of Whitchurch-Stouffville and other agencies as required. The implementation group will be responsible to confirm, prioritize and implement the recommendations in the Stewardship Opportunities Report that will promote and ensure a healthy subwatershed.

There are many organizations within the Musselman's Lake subwatershed that can assist technically or financially throughout the implementation phase:

- LSRCA- Landowner Environmental Assistance Program (LEAP);
- York Region – York Natural Planting Partnership (YNPP) and Water for Tomorrow;
- Oak Ridges Moraine Foundation – Caring for the Moraine;
- Windfall Ecology Centre; and
- Lake Simcoe Clean Up Fund (LSCUF).

There are many programs and organizations mentioned above that provide technical assistance to landowners. The Musselman's Lake residents need to take advantage of these programs and initiate a broader public awareness campaign through forums, workshops and community stewardship events.

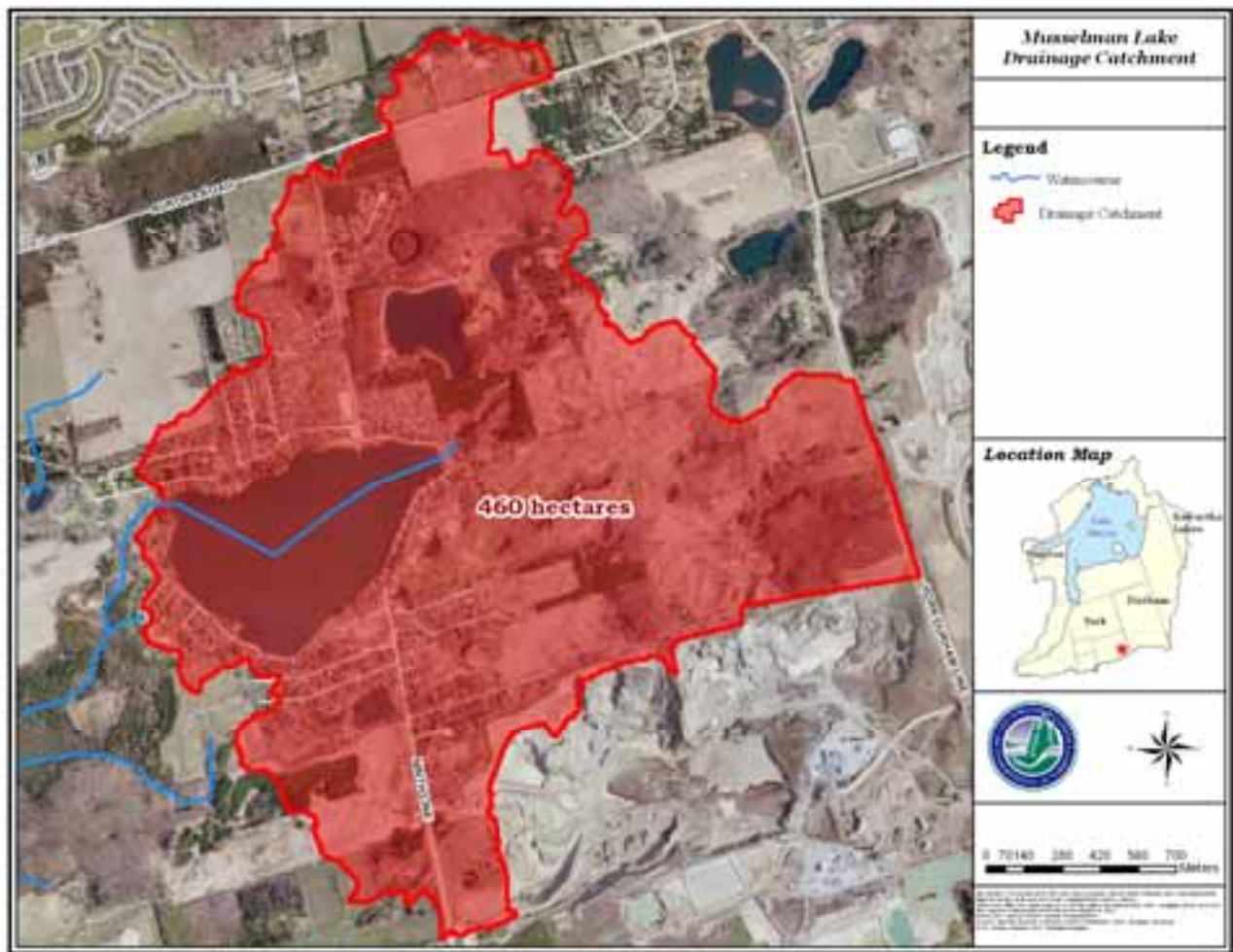
Through the Musselman's Lake resident survey, there were examples of residents lacking environmental awareness on specific subjects (see Appendix C). The implementation group should prioritize the educational gaps and work towards ensuring the residents have all the available resources they require.

1.0 Background

1.1 Description of Musselman's Lake Subwatershed

Musselman's Lake is a small, shallow kettle lake with a surface area of 46 hectares, a subwatershed area of 460 hectares (4.6 km²) and a maximum depth of approximately 8 metres. Located in the south-east corner of the Lake Simcoe watershed it lies in the ecologically significant and sensitive geological landform of the Oak Ridges Moraine and is one of the headwaters for the East Holland River.

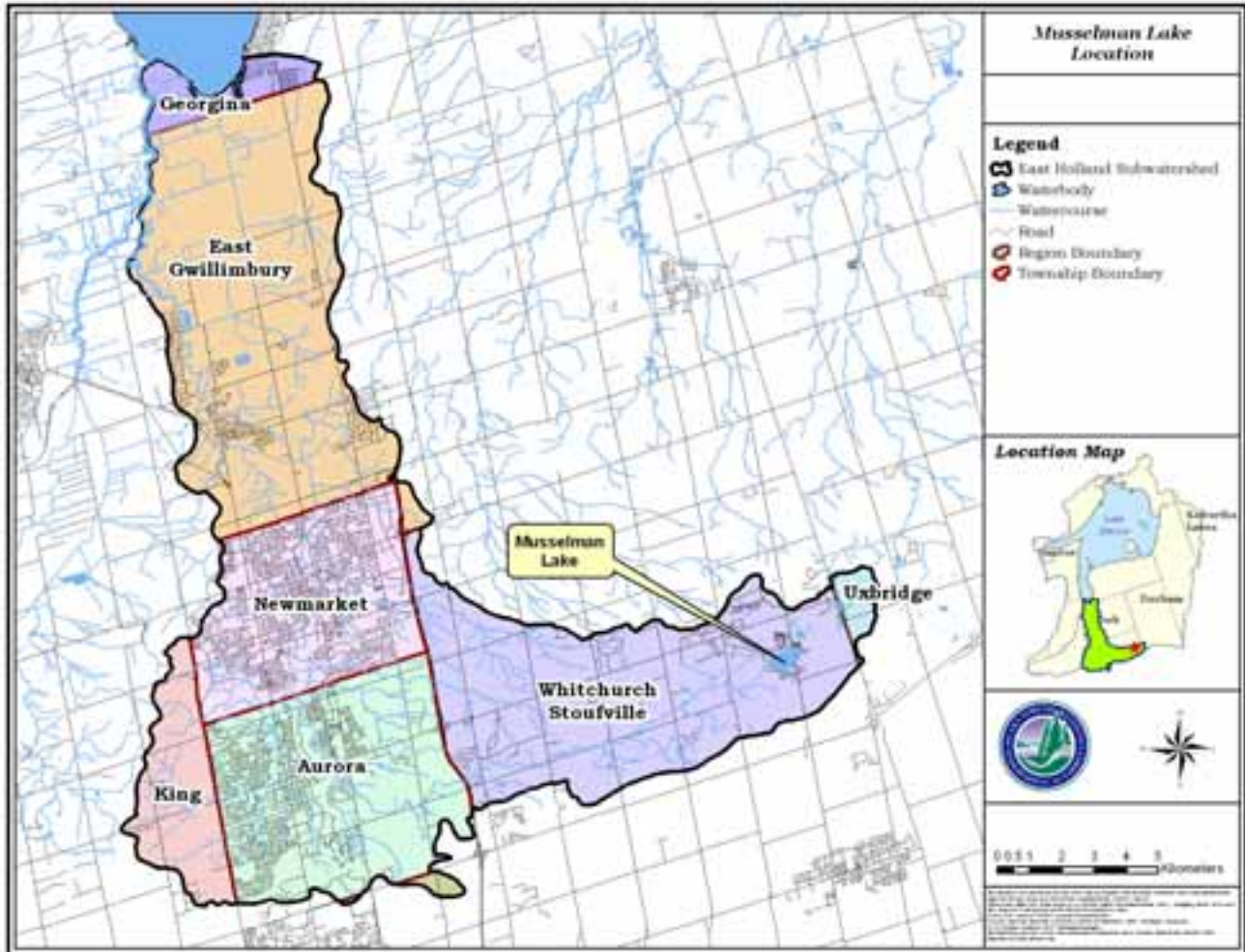
Figure 1: Map outlining the Musselman's Lake subwatershed drainage area.



Like other kettle lakes, Musselman's Lake has no significant streams or tributaries that provide inflow and only has intermittent outflow, through a small culvert at the northwest end. Precipitation, surface runoff and groundwater are the sources of inflow into Musselman's Lake with the outflow draining into an adjacent wetland area. This area eventually drains into the East Holland River, which flows to the west and then north through

Newmarket and East Gwillimbury where it joins with the West Holland River to become the Holland River, which flows into Cook Bay at the south end of Lake Simcoe. (Figure 2 - map of watershed, map of Musselman's)

Figure 2: Musselman's Lake location within the East Holland subwatershed.



The community of Musselman's Lake is located in southern Ontario in the Town of Whitchurch-Stouffville, approximately 45 minutes north east of Toronto. Musselman's Lake is one of the many kettle lakes located along the Oak Ridges Moraine, a 160 kilometre long geological landform that is known as southern Ontario's rain barrel. The landscape mosaic consists of agricultural lands (23.8%), residential development (17.8%), forests (20.1%), wetlands (9.3%) and grasslands (11.6%). (See Table 1).

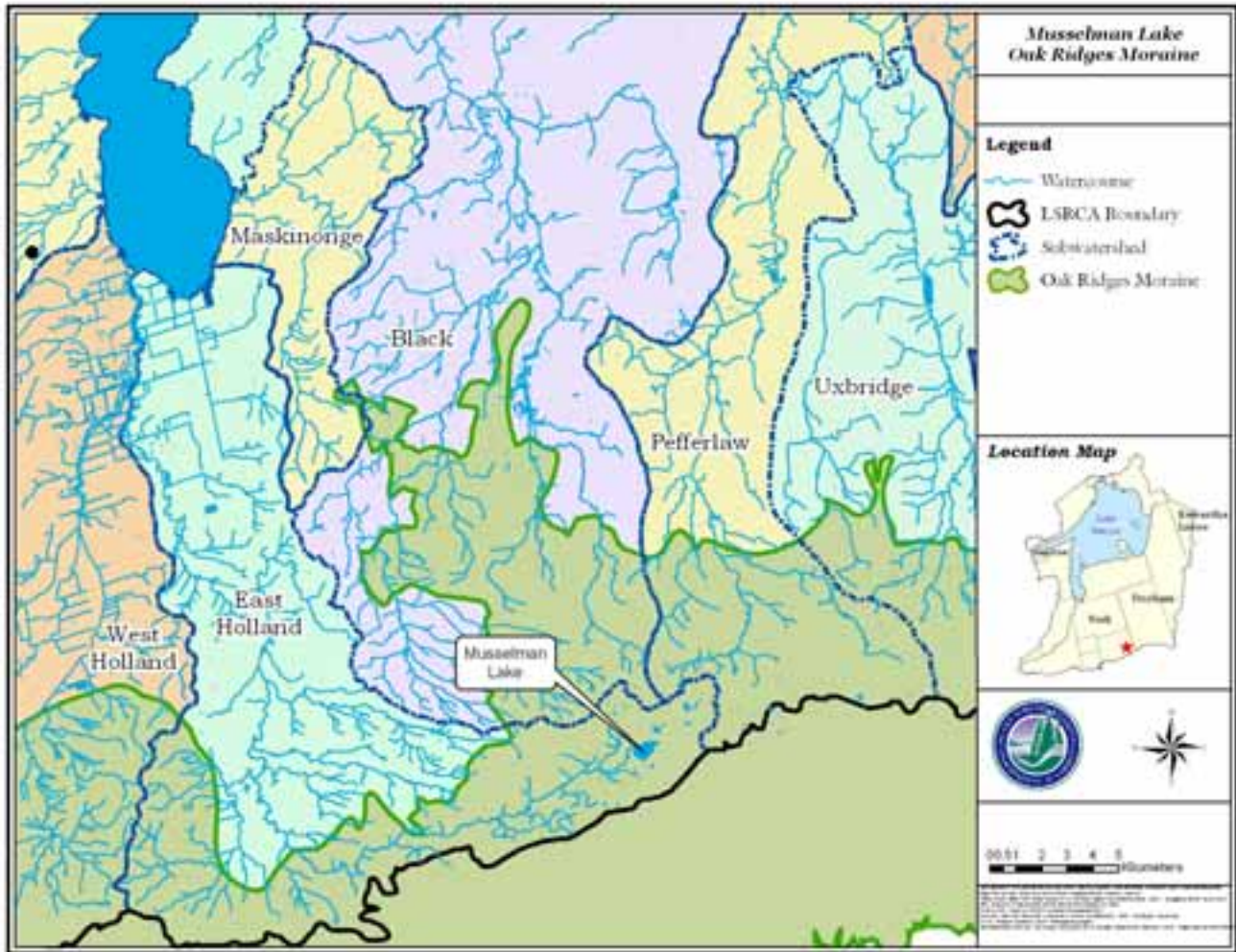
Table 1: Land use in the Musselman’s Lake subwatershed.

Land Use / Cover	Hectares	% of subwatershed
Active aggregate	13.4	2.7
Residential	89.9	17.8
Rural development	11.4	2.3
Hay, pasture, row crop	120.5	23.8
Grasslands	58.6	11.6
Woodland	101.9	20.1
Wetland	47.3	9.3
Lakes	50.8	10

The ecological significance and function of the Oak Ridges Moraine (ORM) and its associated subwatersheds has been studied extensively in recent years. Landscape analysis, geologic mapping, sedimentology, shallow geophysics and borehole data have been integrated to better understand the complex Moraine. A better understanding of the structure and function of the ORM provides a basis for land use planning and resource management both on and adjacent to the moraine.

The ORM is a prominent and sensitive feature in southern Ontario. It forms the drainage divide between Lake Simcoe and Lake Ontario. The Moraine parallels the shore of Lake Ontario and varies in width from approximately 3 km near Lake Scugog to 24 km at its widest point within York Region (see Figure 3). The crest has a general elevation of 305 Metres Above Sea Level (masl) (with some areas extending above 335 masl) and stands 229 m above the mean elevation of Lake Ontario (Chapman and Putnam, 1984).

Figure 3: Musselman's Lake location within the Oak Ridges Moraine.



The ORM consists of sand, gravel and silt deposited as a ridge between two retreating glacial ice lobes. The surface of the ORM is distinguished as “kame and kettle” relief, where the hummocky hills are composed of sand and gravel with underlying till or boulder clay occasionally protruding to form high ridges (Chapman and Putnam, 1984).

Aquifer - an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted.

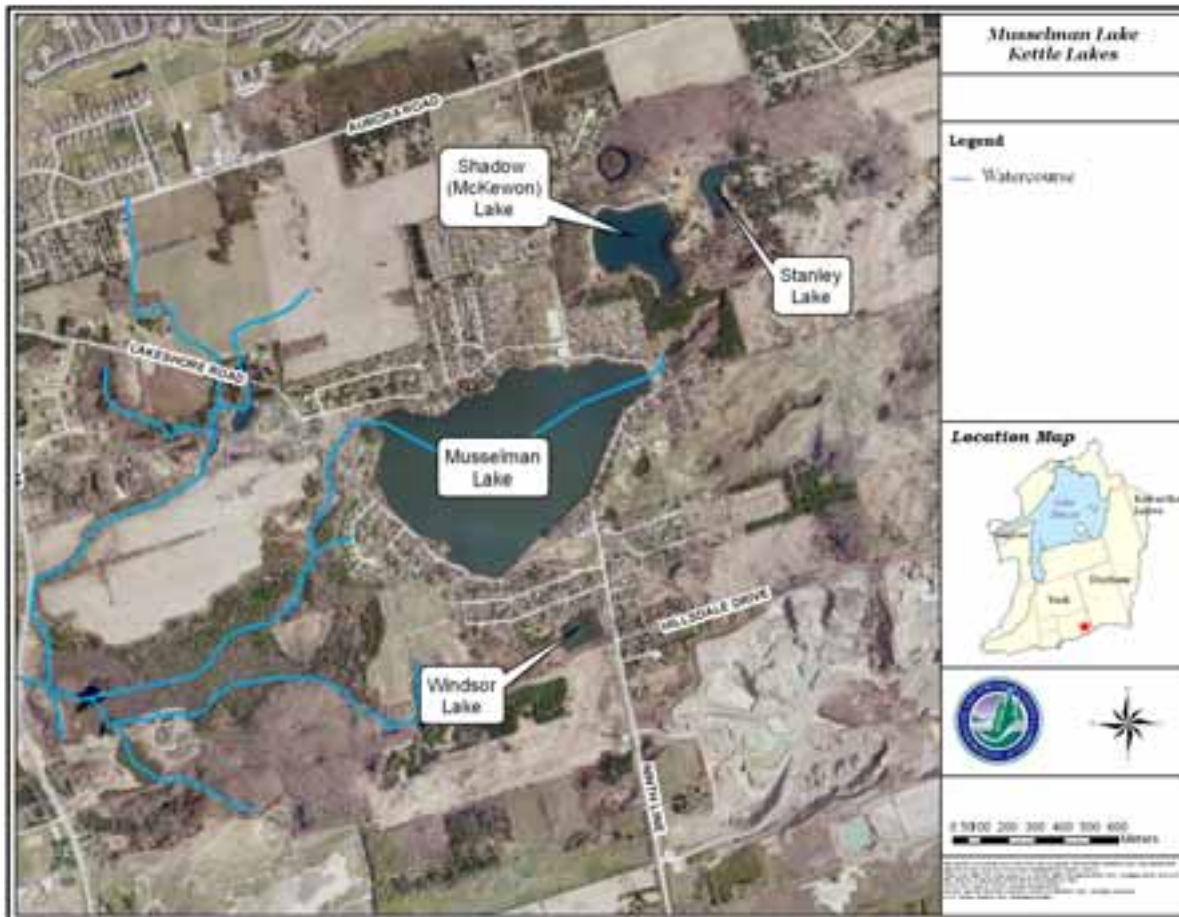
Due to the high permeability of the soil and hummocky topography, the ORM provides excellent conditions for surface water to infiltrate. This groundwater recharge function is very important as it not only replenishes aquifers which are being used to provide drinking water, but it also contributes baseflow to watercourses as they flow off of the ORM north

toward Lake Simcoe and south toward Lake Ontario.

Kettle Lakes are a geo-fluvial formation wherein, thousands of years ago, glacial ice settled into a till depression within the ORM. The retreat of the glacier and subsequent melting of the ice and rising of the water table created a lake. Five identified kettle lakes are located on the Oak Ridges Moraine in the East Holland River subwatershed (see Figure 4) and include, in order of size, Musselman's (48.0 hectares), McKewon or Shadow (6.6 hectares), Stanley (1.2 hectares), Van Nostrand (2.1 hectares) and Windsor Lake (1.7 hectares). These lakes contribute flow to the East Holland River only during the spring freshet and periods of intense storm activity.

Geo-fluvial - refers to the deposits and land forms created by the action of rivers or streams (or in this case melting glaciers) and the processes associated with them.

Figure 4: Location of the 4 kettle lakes located within the Musselman's Lake subwatershed.



1.2 What is a Subwatershed Assessment and Stewardship Opportunities Report?

The subwatershed report provides background information about the lake and the state of the resources in the subwatershed, together with recommended options and activities to improve the overall ecological health of the lake. The stewardship recommendations provide a list of actions to guide stewardship opportunities, including education, communications, restoration and monitoring. Together, these documents join the science and community resources to identify and implement priority actions through the help of community and government stakeholders.

Ecosystem - natural unit consisting of all plants, animals and micro-organisms in an area functioning together with all of the non-living physical factors of the environment

The ecosystem approach to environmental management takes into consideration all of the components of the environment. These components include the movement of water through the system, the land use, climate, geology and all of the species that comprise the community living in the system. These ecosystem components are all intricately related and changes in any can have significant effects on the others.

Biophysical Boundaries - the physical boundaries of the natural system

To manage natural resources using an ecosystem approach it is essential to establish biophysical boundaries. In the Lake Simcoe watershed, the subwatersheds or river systems that drain into the lake have been identified as the best “fit” for the implementation of an ecosystem study because they are virtually self-contained water-based ecosystems (OMOE and OMNR, 1993c). Watersheds are defined as the area of land drained by a watercourse and, subsequently, the land draining to a tributary of the main watercourse is called a subwatershed. Watershed processes are controlled by the hydrologic cycle. The movement of water influences topography, climate and life cycles. It is due to this connectivity that any change within the watershed will impact other parts of the subwatershed.

Subwatershed planning is an integrated approach that takes all socioeconomic, physical and biological factors into consideration. This subwatershed report:

- Identifies the subwatershed location;
- Establishes the relationship of the subwatershed plan to other planning documents;
- Describes and analyzes the form, function and state of the natural systems contained within the subwatershed based on current information;
- Outlines resource management goals and objectives for the subwatershed;
- Recommends options for protection, rehabilitation and enhancement of conditions in the subwatershed; and
- This plan establishes a baseline of information and provides recommendations based on what we know today. As new information is collected we must adapt our management approaches.

An over-arching concept to keep in mind throughout the subwatershed planning process is that it is far more beneficial, both financially and ecologically, to protect resources from degradation, than to rehabilitate them once they have been damaged.

The stewardship recommendations were prepared by the residents and business operators within the subwatershed, with the help of the LSRCA and the Town of Whitchurch-Stouffville, to identify actions that community members can voluntarily undertake and options that could be initiated by municipal or conservation authority regulations or activities. The Stewardship Opportunities Report identifies the present condition of Musselman's Lake and its surrounding watershed along with the land use, water, recreation and resource management issues that need to be addressed. The Stewardship Opportunities Report will provide an action plan that guides stewardship opportunities, including education, communications, restoration and monitoring. It will also identify the tools and resources that are available and/or required to take timely actions to promote and ensure a health and sustainable lake and associated drainage basin for present and future generations.

An important principle in preparing this plan was to engage and consult with appropriate government agencies, landowners, non-government environmental groups, resident associations and interested members of the public.

This project was completed using a community-based planning process that encouraged community members and other key stakeholders to become actively involved from start to finish - **a plan that is developed by them and for them.**

The Stewardship Opportunities Report will be a living document which will be reviewed, updated and amended from time to time. By practicing the adaptive management principles, priorities and activities will change over time to address emerging issues and new science or community-based information.

2.0 Development of the Stewardship Opportunities Report

The first step in the process of the development of the Musselman's Lake Stewardship Opportunities Report was the establishment of the Project Steering Team (PST). The PST was responsible for the overall management of the project, consultation process, funding and the finalization of the Stewardship Opportunities Report. The PST consisted of Lake Simcoe Region Conservation Authority and the Town of Whitchurch-Stouffville. The project consultant (French Planning Services Inc.) and other government agencies supported the PST as needed. The PST held its meetings on a frequency as required to complete the project.

The PST also formed an advisory Technical Working Group (TWG) during the study process. The TWG consisted of a larger group of stakeholders who worked together to share data, information and provide the basis for the development of the Stewardship Opportunities Report.

The TWG members included:

- Dan Heron, chair and community resident;
- Paula Viola, co-chair and the Town of Whitchurch-Stouffville;
- Phil Davies, co-chair and LSRCA;
- Christa Sharp, LSRCA;
- Christine Laing, community member;
- Kelly Gibson, aggregate sector;
- Kyle Jenkin, business sector;
- Mark Carroll, community member;
- Ralph Toning, community member;
- Terry O'Connor, agriculture sector; and
- Brian Laing (alternate), community member.

The purpose of the TWG was to work with and advise the PST on the content, scope and issues to be addressed in the Musselman's Lake Stewardship Opportunities Report. The TWG also helped identify sources of data and shared scientific and local information that related to the project. The TWG worked with the consultant on a survey completed by residents of the area. This group also took the lead in formulating the stewardship recommendations and it is expected that the stakeholders in the TWG will take the lead in implementation. TWG meetings were held monthly and involved active participation of partner agencies and the public.

3.0 Community Input

Continual consultation and feedback from the community members is critical to the success of this project. The community consultation process involved four workshops, a survey and communication link and continual updates available on three websites; the Town of Whitchurch-Stouffville, Lake Simcoe Region Conservation Authority and the Musselman's Lake Residents Association.

The first public information session announced the project and obtained initial comments and concerns for the area residents. The second meeting was to provide an update on the background information collected to date in order to obtain feedback and ensure community priorities were addressed. The third workshop presented the draft Stewardship Opportunities Report prior to its release and the fourth meeting was held to obtain comments on the draft Stewardship Opportunities Report.

3.1 Workshop Summaries



The first workshop was held on August 23rd, 2007 and began with a welcome by the Town of Whitchurch-Stouffville and the Lake Simcoe Region Conservation Authority (LSRCA). LSRCA provided participants with background information on the Musselman's Lake Stewardship Opportunities Report. Randy French, from French Planning Services Inc., facilitated the workshops and asked participants to fill out two worksheets to help pinpoint values, special places and memories that they have of the lake and the surrounding community. Participants were also asked to identify issues that impact these values and places and then discuss possible solutions. The community identified

several important issues and actions and the majority of these concerns were around water quality. Other issues and actions were about recreation, natural areas, safety concerns and working together as a community. A workshop summary was prepared and released for public review to confirm that all issues and matters were included.(Please see Appendix A for further details)

The second workshop was held on November 17th, 2007 and Randy French once again facilitated the workshop and welcomed the participants. The timing of this workshop was selected to provide information and an opportunity to discuss and learn about a recent cyanobacteria algae bloom that occurred in October. David Lembcke, the LSRCA's Senior Environmental Monitoring Scientist gave a presentation on cyanobacteria and the ongoing monitoring activities. Rod Boudreau, a Preston Lake resident, then presented on the Preston Lake Management Plan. Randy French requested that interested residents submit applications to be a member of the TWG. During the community meeting it was suggested that the following sectors be represented on the working

group: Resident and community associations, Agriculture, Aggregate, Preston Lake Representative, Elected Council, Commercial, the Lake Simcoe Region Conservation Authority and Municipal Staff. Regional staff, York Regional Health Services, Ministry of Natural Resources and Ministry of Environment will be utilized for technical advice as needed. The community survey was discussed and the residents provided suggestions. (Please see Appendix B for further details)



The third open house was held on December 8th, 2008 at the Ballantrae Community Centre. Randy French facilitated the workshop and had an open discussion so the community could provide feedback on the preliminary document. The LSRCA and Town of Whitchurch-Stouffville staff presented on the scientific information contained within the Stewardship Opportunities Report.

The fourth workshop was held on March 5th, 2009 at the Ballantrae Community Centre for the community to provide their feedback on the draft Stewardship Opportunities Report. The draft Stewardship Opportunities Report was circulated to the community two weeks prior to the meeting to allow the residents time for review. Community members provided comments and suggestions on the draft Stewardship Opportunities Report and their recommendations were included in the final report.

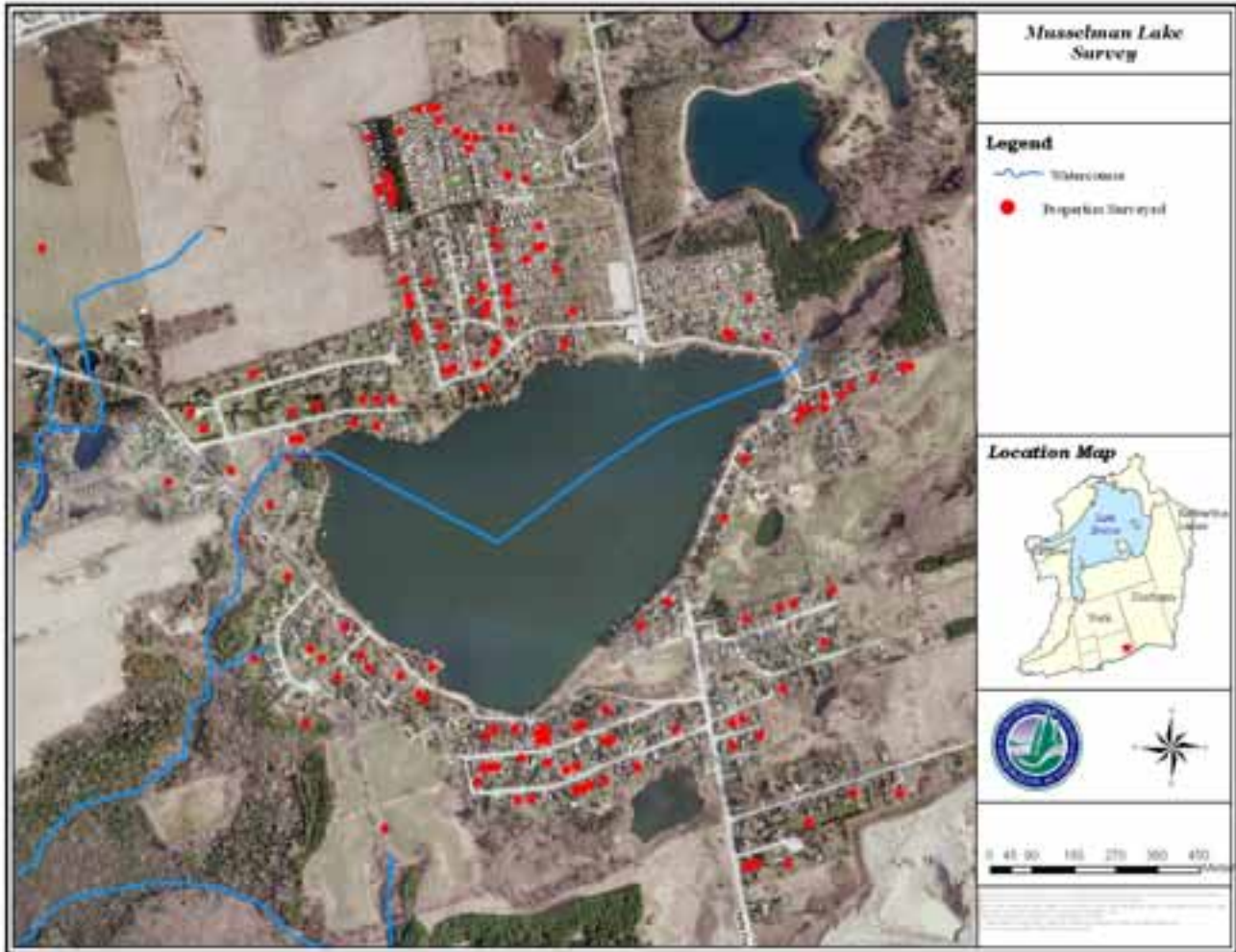
3.2 Resident Survey Summary

The Musselman's Lake TWG and PST undertook a community survey to gather information on the important values and features that make Musselman's Lake a special place.

The objective of the survey was to obtain the opinion of the residents in the Musselman's Lake subwatershed area regarding land use, water quality, recreation, resource management issues and educational opportunities. The results of the survey were used during the preparation of the Stewardship Opportunities Report to ensure that the community member's ideas and views were considered.

LSRCA staff distributed the survey to Musselman's Lake residents. The surveyors visited 517 homes during a two-week period in August 2008. The community was canvassed from Monday to Saturday, alternating between days and evenings. There was a "complete" survey with 16 questions for residents to complete. There was also a "no" survey with 3 questions allowing residents to complete a shorter version. Out of 517 homes, 178 residents were present at the time of the survey representing 32% of the Musselman's Lake population. There were 154 "complete" surveys, 10 "no" surveys and 14 residents did not wish to complete any survey. Of the residents present at the time of the survey (178 homes), 164 surveys (154 "complete" and 10 "no" surveys) were completed which translates to an 85 % return rate.

Figure 5: Location of the 158 completed surveys within the Musselman's Lake subwatershed.



In general, the residents were enthusiastic about participating in the Musselman's Lake Stewardship Opportunities Report by completing the survey. They wanted to provide their input into preserving and enhancing the lake. The residents are actively using the area for recreation. The community survey showed that the residents of Musselman's Lake were concerned with protecting and conserving the subwatershed.

Seventy-two percent of residents were concerned about the environmental health of Musselman's Lake and the surrounding community. Water quality was the main concern of residents which included water pollution, stormwater runoff, water clarity, bacteria, aquatic vegetation, septics and the smell.

All residents participate in some kind of recreational activity within the community and 51% are summer activities which include kayaking, canoeing, water skiing, boating, fishing, swimming and scuba diving.

Seventy-four percent of residents have a septic system, 22% have a holding tank and the remaining 4% don't know what kind of sewage treatment they have.

For full survey results, please refer to Appendix C.

4.0 State of the Subwatershed and Resource Goals

Various public interest groups have been working to highlight the environmental problems of Musselman's Lake. In the 2008 community survey, water quality issues were the number one environmental concern for 67% of lake residents.

However, despite the community interest in Musselman's Lake, there is very limited detailed environmental data available. There was a report completed by the LSRCA in 1989 on the Musselman's Lake Surface Water Quality.

To date, there have been no detailed studies to evaluate the biological diversity of this system, how water chemistry and quality change over a year, or even the bathymetry of this lake. Using new scientific data collected in 2008 and the ongoing monitoring program the LSRCA will be able to fill these gaps and continue to assess the current environmental condition of Musselman's Lake and understand how conditions have changed. From this information current management goals will be assessed, and new goals and recommendations created to restore the lake to a more natural condition. Through the adaptive management approach new information will be collected and continually reviewed to assess the current and evolving state of the watershed.

Ecosystems provide many services including carbon storage and sequestration, water storage, rainfall generation, climate buffering, biodiversity and soil stabilization. In fact, the forests, wetlands and rivers that make up watersheds are essentially giant utilities providing ecosystem services for local communities as well as regional and global processes that we all benefit from. Measuring the quantity, quality and distribution of natural heritage features within the subwatershed can tell us a great deal about its health. Recently, in a joint partnership between the LSRCA, the David Suzuki Foundation and the Greenbelt Foundation, the monetary value of the goods and services provided by the natural features in the subwatershed were calculated (i.e. natural capital).

Natural capital refers to our natural assets and the ecosystem goods and services that those assets provide. The benefits provided by natural capital include the storage of floodwaters by wetlands, water capture and filtration by forests, the absorption of air pollution by trees and climate regulation. The Musselman's Lake subwatershed goods and services were estimated to be worth \$1,355,727 annually, with forest, wetland and pasture providing the highest values. The high value for wetlands (\$280,469) reflects the many important services they provide, such as water regulation, water filtration, flood control, waste treatment, recreation and wildlife habitat.

Forests (\$484,121) provide high value because of their importance for water filtration, carbon storage and habitat for pollinators and recreation. Based on the average cost of carbon emissions, the carbon stored within the soil of the grasslands and pastures of the Musselman's Lake subwatershed together provide \$145,306 in services. It is therefore critical that the true value and the costs of potentially damaging these ecosystem services be taken into account.

Table 2: The estimated breakdown of goods and services within the Musselman’s Lake subwatershed.

Land Use	Value (\$)
Cropland	15,919
Forest	484,121
Forest / Wetlands	356,029
Grasslands	11,648
Hedgerows/Cultural Woodland	1,386
Pasture	133,657
Water	72,498
Wetlands	280,469
Total	1,355,727

4.1 Natural Heritage

4.1.1 Groundwater

For groundwater stewardship opportunities, please see section 5.1 and 5.5.

Groundwater - is water located beneath the ground surface in soil pore spaces

Groundwater is water that is present below the earth’s surface, in the spaces between rocks and soil particles and stored in aquifers.

Groundwater is vital to the proper functioning of a watershed, as it provides a constant source of clean, cold water to waterbodies. The

discharge of groundwater to lakes and streams remains relatively constant from season to season; it therefore forms an important part of the surface water flow system and is particularly important when surface runoff is at its lowest levels, when it can be the only source of water.

Musselman’s Lake depends on a constant supply of groundwater through the year and especially during the dry summer months. Throughout the Musselman’s Lake subwatershed, humans are extremely dependent on a reliable supply of groundwater for many purposes including irrigation of fields, industry and recreation. Human use of groundwater must be sustainable and within the natural needs of the lake for maintenance of water levels and flows.

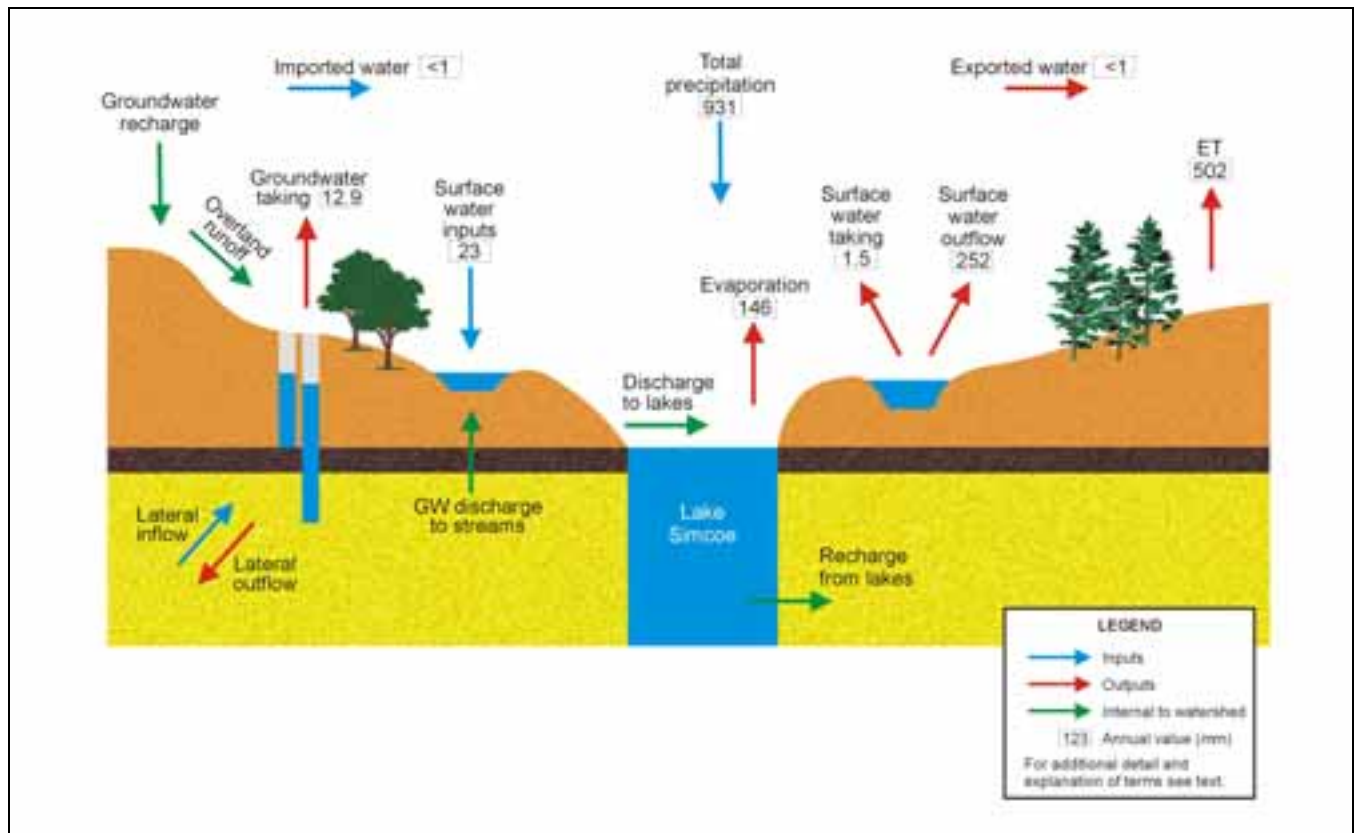
Water Budgets

To properly manage your family’s finances, you need to know how much money is coming in, how much you need to spend and how much you can put away. Not knowing could lead to overspending.

The same holds true for keeping track of our local water resources. For any individual watercourse (river, stream, creek, etc.), how much water is being added (inputs), how much is being subtracted (outputs) and how much is being stored. How much water do we get from rain and snow? How much is lost through evaporation and water taking? Where is the water and how does it travel through the watershed? How much is absorbed into storage by underground aquifers and how much is discharged out of the aquifers back into rivers and streams? What are the trends? Specialists in the Source Water Protection program are tracking and accounting for the water in the Musselman’s Lake subwatershed.

It’s just like the household budget. If more is going out (outputs) than coming in (inputs) then shortages will result. A water budget is not used to manage water levels, only to track them. It is one of the main tools needed to effectively manage our water resources into the future.

Figure 6: How a water budget is tracked.



Wellhead Protection Area

A wellhead is simply the above-ground physical structure of a well. The land surrounding the well will, to varying degrees depending on its slopes and drainage properties, allow contaminants spilled on the surface to find their way into the well water. A wellhead protection area is that area of land surrounding a wellhead that is particularly sensitive to certain land use activities that could contaminate drinking water.

Wellhead protection areas are defined by how long it would take surface water and possible contaminants to reach the well, based on the characteristics of the land. Where land slopes toward the well, or is composed of loose porous soils such as sand, or where underground water flows toward the well, it would take less time for a contaminant spilled on the surface to reach the well.

Therefore, wellhead protection areas are designated by the time it would take for contaminants to reach the well, a term known as 'time of travel'. This is determined by a variety of factors such as the way the land slopes, the draw on the water at the well, the type of aquifer, the type of soil surrounding the well and the direction and speed that groundwater travels. All of these factors help to determine how long it takes water to move underground to the well itself and how much land around the wellhead should be protected.

Wellhead protection is a good way to prevent municipal drinking water from becoming polluted because it requires landowners to manage activities that could become potential sources of contamination in the area supplying water to a public well. Much can be done to prevent groundwater contamination. Under the Clean Water Act (2006), the local Source Protection Committee will develop plans for protecting municipal well water. They will look at potential sources of groundwater contamination in the Musselman's Lake subwatershed, rank them based on their potential to contaminate groundwater and then determine the best method of managing existing and future land and water uses that pose a significant risk to drinking water. Protecting the area around a well helps protect a healthy supply of water now and in the future.

Figure 7: Wellhead protection areas within the Musselman's Lake subwatershed and surrounding area.

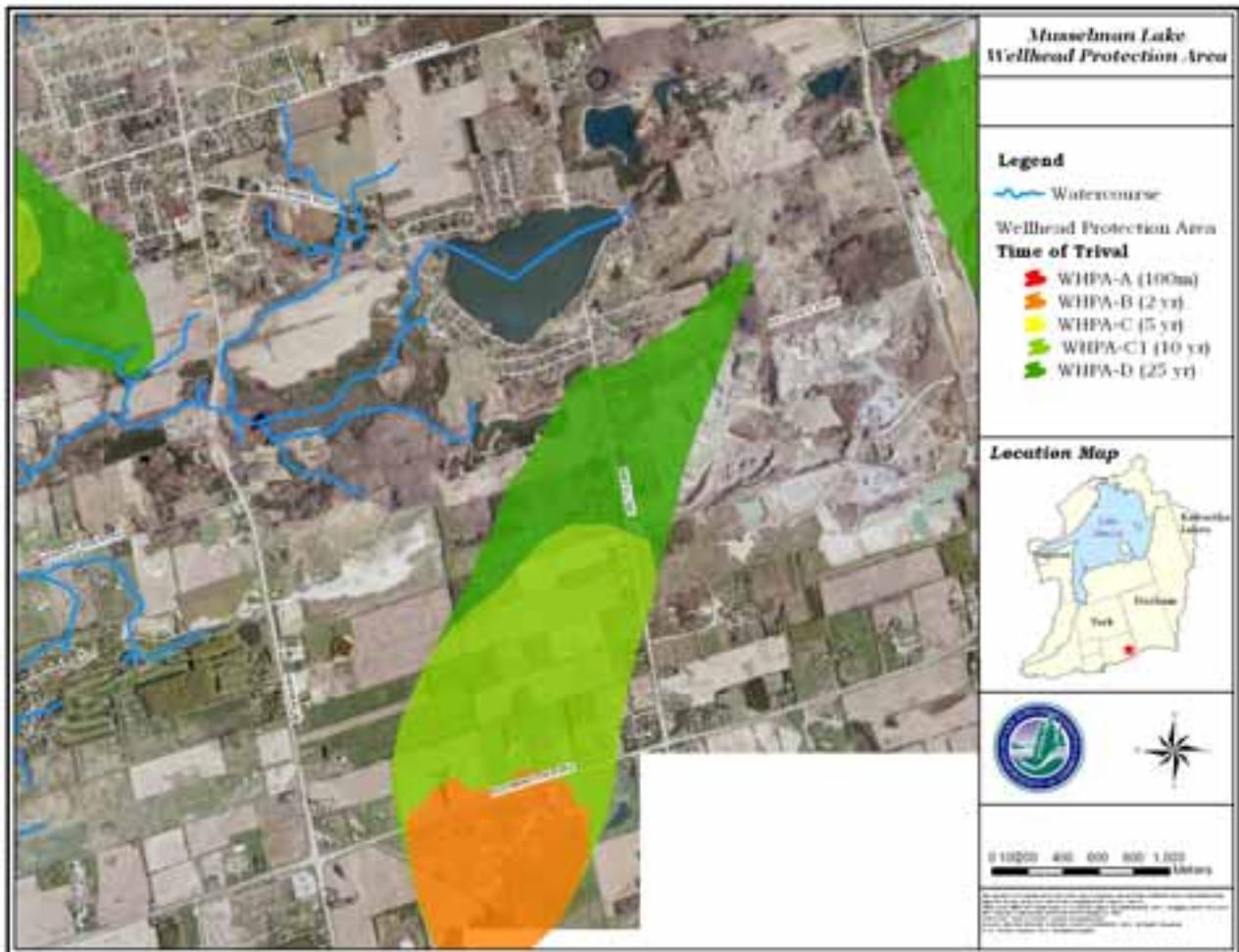
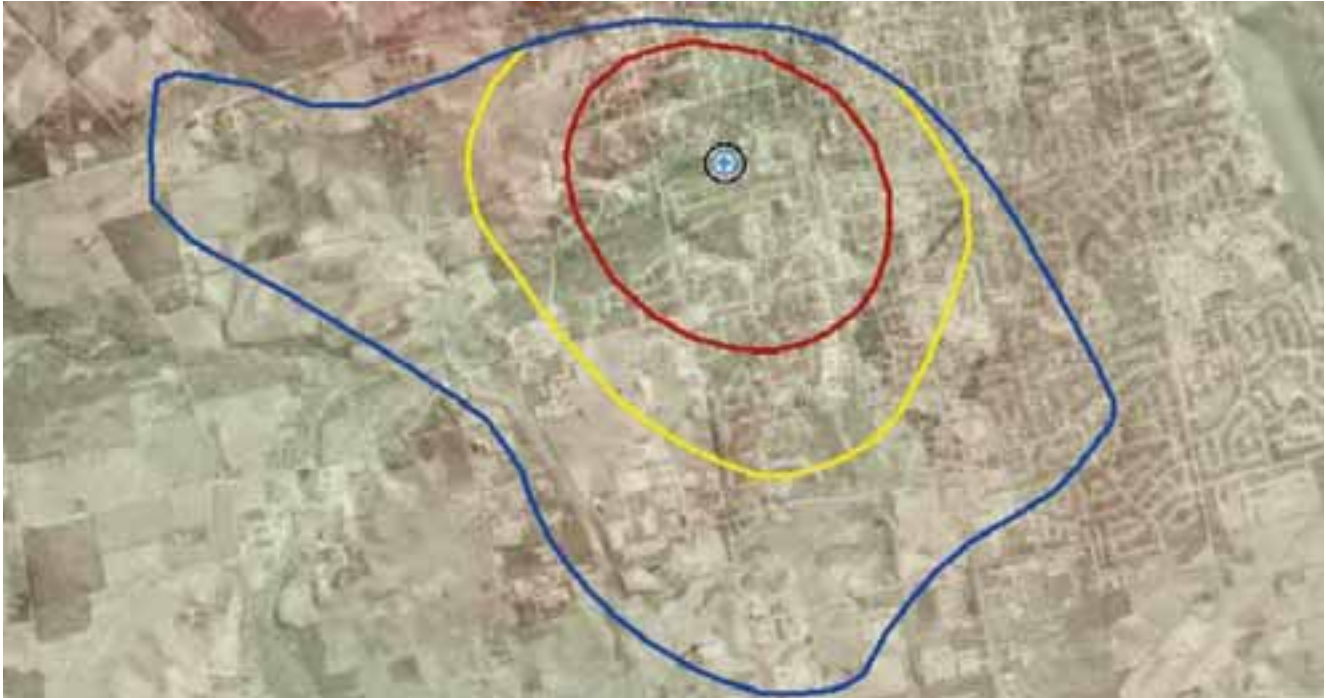


Figure 8: A typical wellhead protection area. The star at the centre of the diagram shows the location of a municipal well. The colored rings show the different amounts of time it takes for surface water to reach the well. The black circle is a 100 metre 'time of travel'; red is 2 years, yellow is 5 years and blue is 25 years.



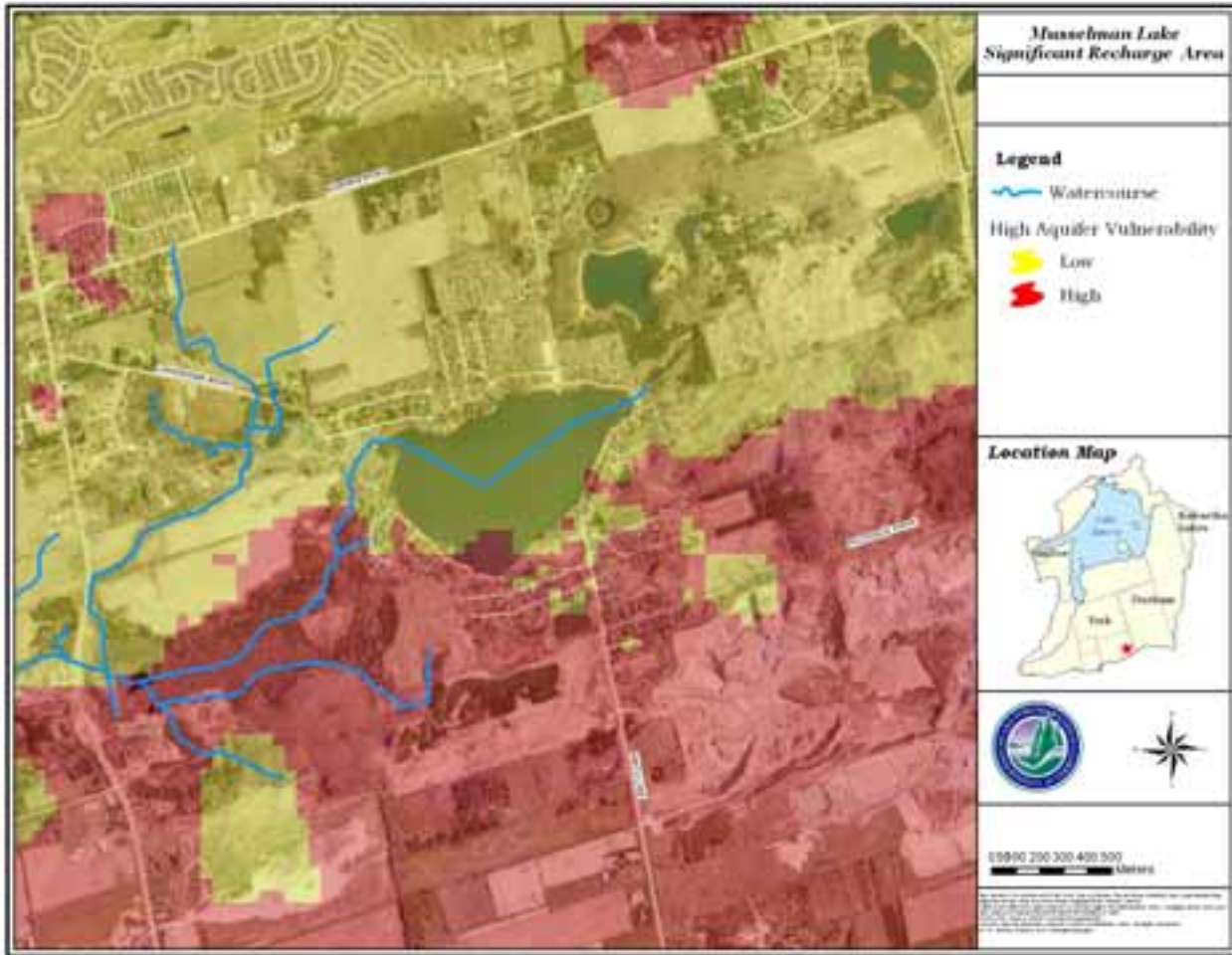
Highly Vulnerable Aquifers

Aquifers are areas of soil or rock under the ground where cracks and spaces allow water to pool. Their vulnerability to contamination is based on a number of factors including their depth underground, the sort of soil or rock between them and surface sources of pollution and the characteristics of the soil or rock surrounding them.

When the soil or rock above an aquifer is loose and composed of many large cracks and spaces, it is easier for water to flow into the aquifer. It also makes it more vulnerable to contaminants. In addition to rain and melting snow seeping into the ground to recharge the aquifer, pollutants can also seep into the ground, contaminate the groundwater and therefore contaminate the water in a drinking water well.

These highly vulnerable aquifers are of particular concern in the protection of drinking water. Protecting them is a good way to prevent municipal drinking water from becoming polluted.

Figure 9: High Aquifer Vulnerability within the Musselman's Lake subwatershed and the surrounding area.



Significant Recharge Areas

An aquifer is an area of soil or rock under the ground that has many cracks and spaces and has the ability to store water. During high water periods, water seeps into the aquifer and this is called recharge. Much of the natural recharge of an aquifer comes from rain and melting snow. During low water periods, water seeps out of the aquifer into creeks and streams and this is called discharge. This helps to keep surface water bodies flowing when they might otherwise dry up.

The land area where the rain and snowmelt seep down into an aquifer is called a recharge area. Recharge areas often have loose or permeable soil such as sand or gravel, or shallow fractured bedrock, which allows the water to seep easily into the ground. A recharge area is considered significant when it is needed to maintain the water level in an aquifer that supplies a community with drinking water.

Figure 10: A typical significant recharge area.

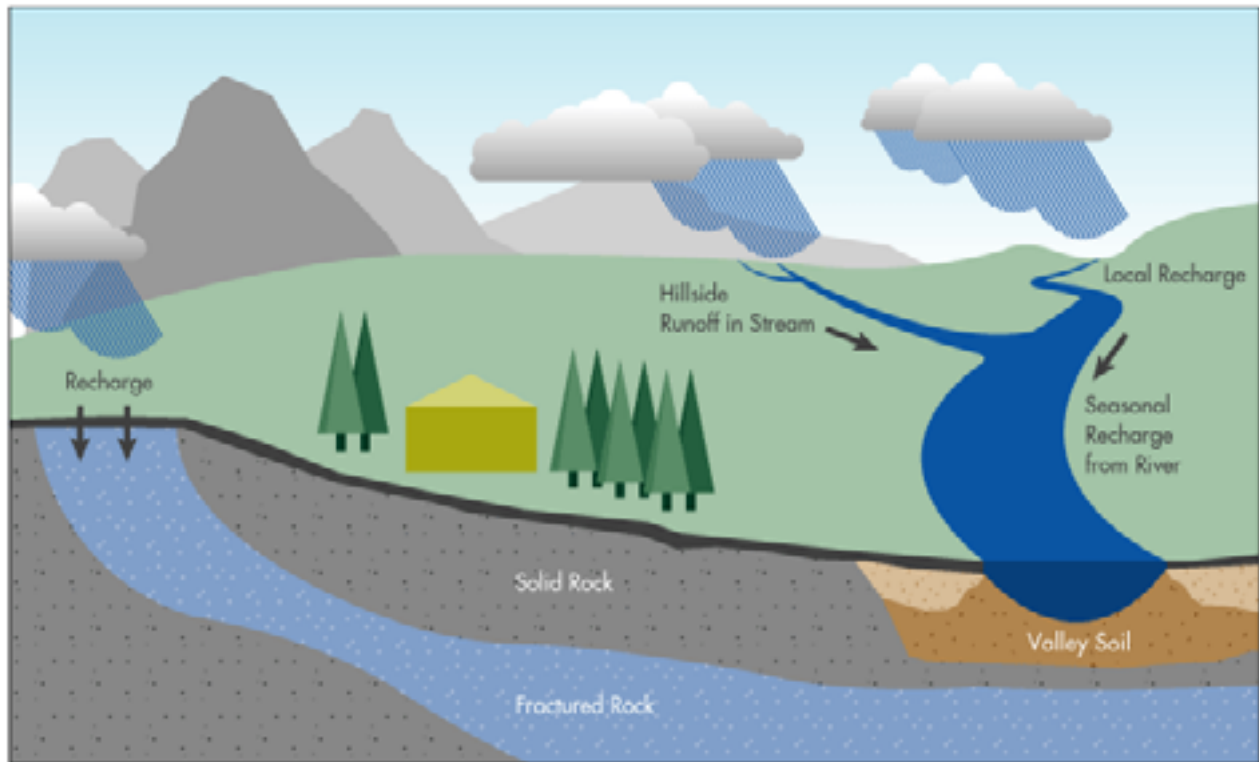
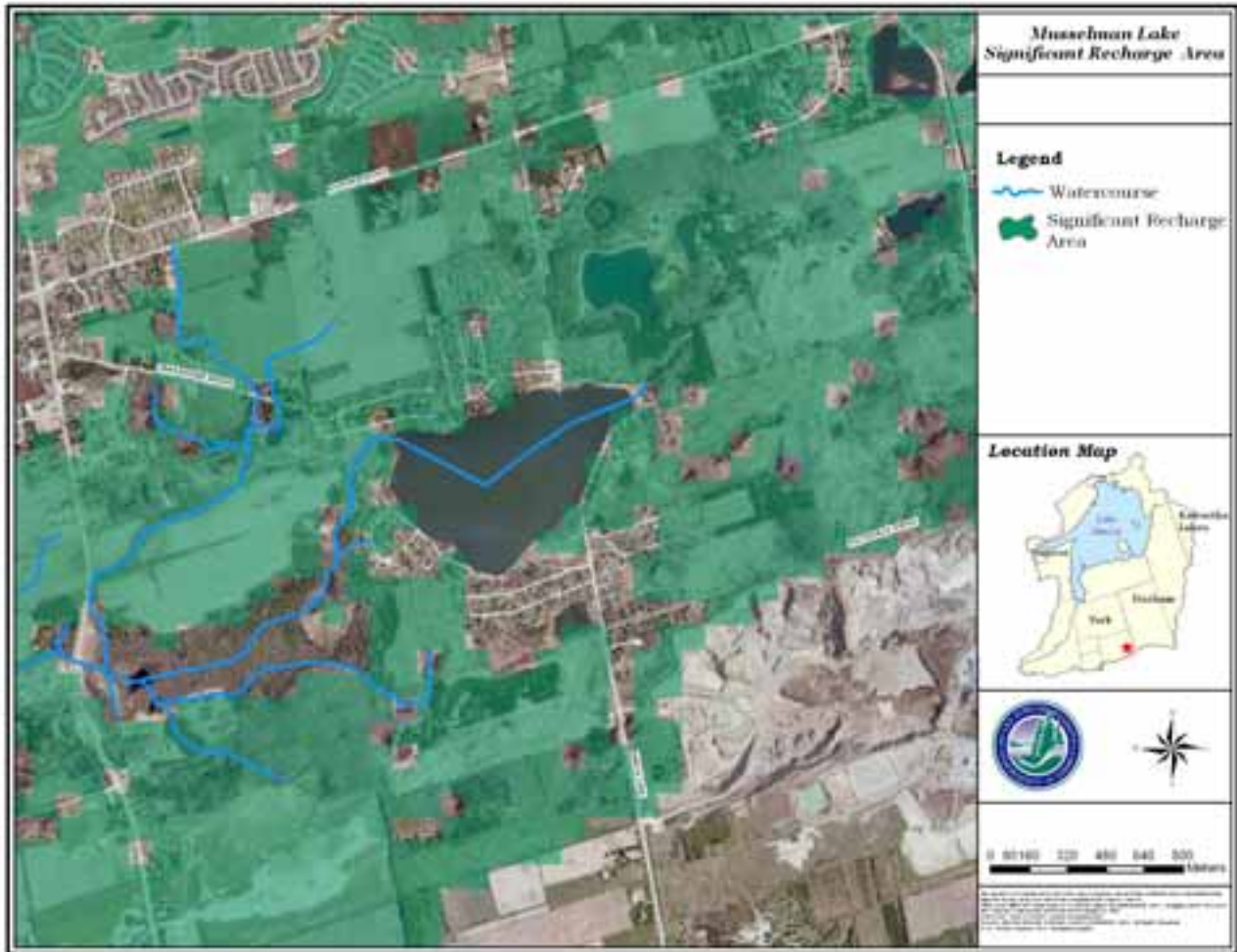


Figure 11: Significant recharge area in the Musselman's Lake subwatershed and the surrounding area.



Factors Affecting Groundwater Quantity

There are three main factors influencing the quantity of groundwater in an area. They are climate, geology and land use.

Precipitation is the main climate variable that influences groundwater quantity. The amount that falls, as well as how it falls, will have a significant influence on how much infiltrates into the soil.

The underlying geology, as well as the soils at the surface, will determine how groundwater is conducted. Musselman's Lake subwatershed is a highly permeable area which is made up of sand, gravel and silt. This soil type is normal for an area located on the ORM.

Land use can also influence groundwater recharge. Vegetation slows the overland flow of water by friction, enabling more water to infiltrate into the soil. The roots of plants play a role by loosening surface material to allow more water to permeate into the soil. Wetlands and other depressions serve as a storage area so that even in areas with less permeable soil, the water can be detained and can infiltrate slowly. Changes from natural land cover can have a negative influence on groundwater recharge, as the above-mentioned pathways are disturbed.

General Factors Affecting Groundwater Quality

The quality of groundwater is most often better than that of surface water because groundwater moves more slowly and is subject to natural filtering as it moves through the soil. As the water moves through the soil, contaminants are subject to the processes of adsorption, where they are bound to soil particles; precipitation; and degradation over time. These processes serve to improve the quality of the water.

There are some substances that can easily move through the groundwater system. The most notable of these is chloride from road salt. In rural areas, levels of contaminants including bacteria, phosphorus, nitrates and road salt can become elevated where the groundwater is beyond the capacity of the natural filtration capability of the soil. Sources of contaminants in these areas are fertilizers, improperly functioning septic systems, manure storage facilities and road salt application. In urban areas, groundwater can be subject to contamination by road salt, hydrocarbons, metals, phosphorus and other nutrients.

Groundwater Resource Goals

Goal – To protect, restore and enhance groundwater quality and quantity and ensure sustainable groundwater use such that there will be a continuous supply of clean water to support environmental functions and human needs.

Groundwater Observations

1. Musselman's Lake is dependent upon groundwater as a primary source of water.
2. Musselman's Lake residents rely on groundwater for agriculture, industry and recreation.
3. Musselman's Lake subwatershed is a highly permeable area which is made up of sand, gravel and silt.

4.1.2 Surface Water

For surface water stewardship opportunities please see section 5.2 and 5.5.

Surface Water Quantity

Analysis of surface water quantity involves looking at the water that moves over land or within wetlands, streams and lakes. Surface flow includes normal flow in rivers and streams and is comprised of groundwater discharge, overland flow of precipitation, as well as precipitation that falls directly onto waterbodies. The amount of water available in a system is influenced by the amount of evaporation and transpiration, how much infiltrates into the groundwater and how much runs overland to waterbodies.

How Water Moves Within a Watershed

The geology of a watershed and its climate are among the most important factors in determining the amount of water that flows to and within a watercourse. This is due to their effects on the amount and intensity of precipitation, evaporation and infiltration into subsurface flow. In the East Holland River and in turn the Musselman's Lake subwatershed, spring flow is typically high due to a March or April snowmelt as well as the onset of spring rains in April or May. Intense rainstorms throughout the year can also raise water levels and velocities. It is under these conditions that flooding and shoreline erosion could occur. During periods of little to no rain fall, flow is maintained by groundwater seeps, wetlands, ponds and, kettle lakes that release water over time.

Baseflow - is the portion of streamflow that comes from groundwater and not runoff. It is assumed that 50% of the water that percolates down to shallow ground water contributes to baseflow

This natural variation in flow, which can range from spring flooding to very low or zero flow in summer, plays an important role in the health of an ecosystem. Floodwaters serve to flush the system, maintain floodplain vegetation and provide spawning opportunities for fish. Low flow periods are critical for maintaining year-round fish populations. Even watercourses that may dry up in summer typically provide fish spawning opportunities during periods of higher flows.

Native vegetation has adapted to take advantage of these natural fluctuations in surface water flow and can also help to mitigate the effects of natural extremes in climate, including storms and droughts, on the surface flow regime. Naturally vegetated areas can help to slow the overland flow of precipitation, encouraging infiltration; while wetlands act as sponges, storing storm flows and releasing water slowly during periods of lower flows. This reduces the frequency and intensity of high flows during storm events and also helps to maintain flows during drought conditions.

Land use Influences on Surface Water

Changes in land use and water taking (both surface and groundwater takings) can dramatically alter flow characteristics. The land use changes associated with urbanization can have a significant impact on surface flows. This is due in large part to the increase in impervious surfaces, which include roads, parking lots and rooftops. The reduced infiltration of precipitation to groundwater aquifers due to the impervious surfaces can also result in lower groundwater levels and a reduction in the volume of water that is discharged as baseflow.

The activities associated with agriculture that place stress on groundwater resources include the pumping of surface water for irrigation and creation of ponds to intercept surface flow. Tile drains also alter drainage characteristics at the site due to the efficiency at which they remove water from the field. Factors such as soil moisture and type, precipitation amount and intensity, amount of area tile drained and the size of the subwatershed will influence whether the influence of tile drains on water quantity will be seen at the subwatershed scale.

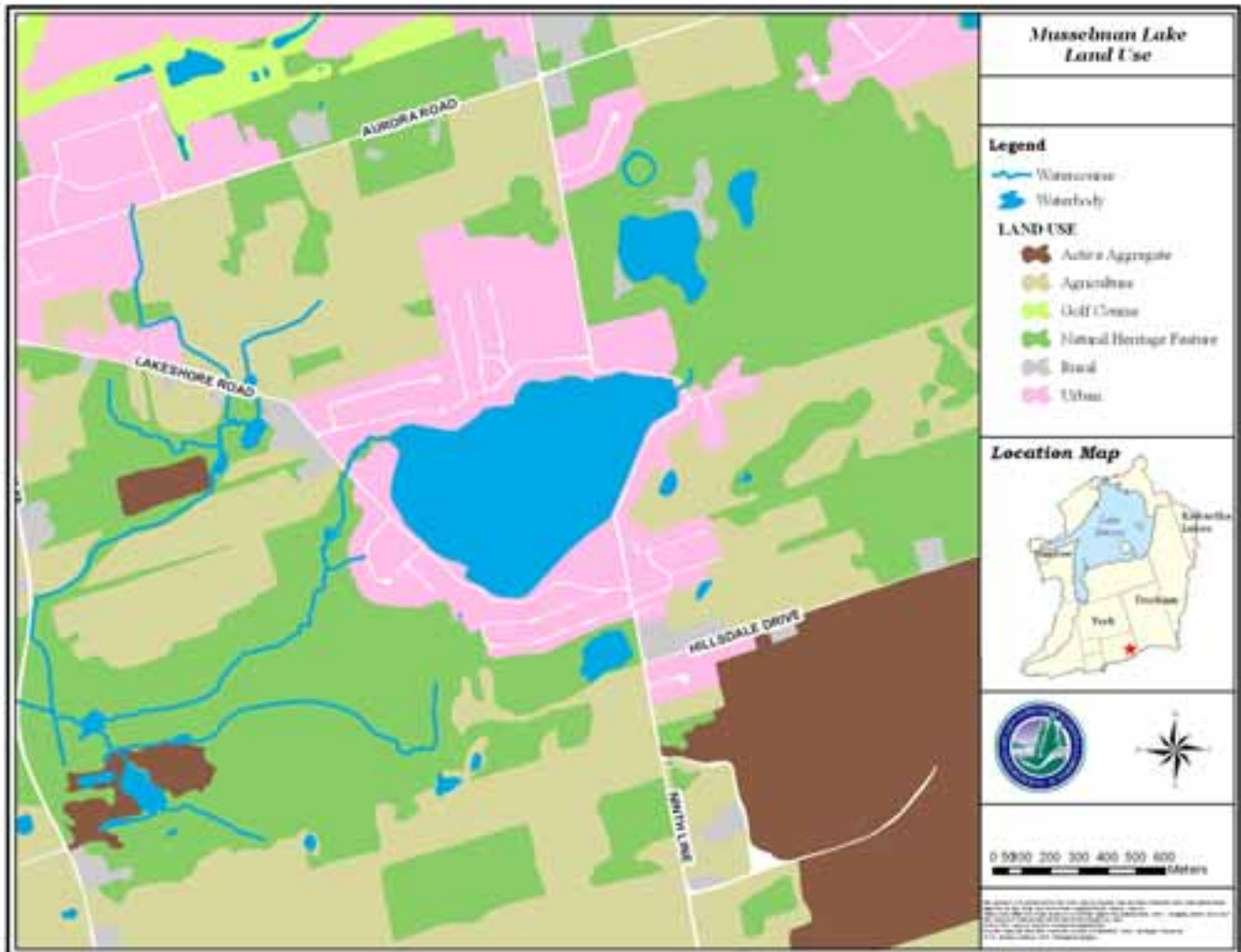
Surface Water Quantity Observations

4. Spring flow is typically high due to a March or April snowmelt, as well as the onset of spring rains in April and May.
5. During periods of little to no rain, flow is maintained by groundwater seeps, wetlands, ponds and kettle lakes that release water over time.

Surface Water Quality

The chemical, physical and microbiological characteristics of natural water make up an integrated index we define as “water quality”. Water quality is a function of natural processes, point sources and non-point sources. For example, natural processes such as weathering of minerals and various kinds of erosion are two actions that can affect the quality of groundwater and surface water. Point sources of pollution are direct inputs of contaminants to the surface water or groundwater system and include municipal and industrial wastewater discharges, ruptured underground storage tanks and landfills. Non-point sources include, but are not exclusive to, agricultural drainage, urban runoff, land clearing, construction activity and land application of waste that typically travel to waterways through surface runoff and infiltration (see Figure #12). Contaminants delivered by point and non-point sources can travel in suspension and/or solution and are characterized by routine sampling of surface water.

Figure 12: Land use within the Musselman's Lake subwatershed.



Natural Influences

Natural features in the environment generally serve to maintain water quality conditions. Naturally vegetated areas including grasslands, meadows and woodland areas tend to improve water quality as it flows over land. The stems and roots of the vegetation slow the flow of water, enabling soil particles and other contaminants to be deposited and increasing the amount of runoff that is infiltrated into the soil. Water is filtered as it flows through the soil to the groundwater. Wetlands slow the flow of water, provide storage and can absorb some contaminants, including nutrients such as phosphorus; and thus have a natural filtering ability. The inputs of clean, cool groundwater into lakes and streams also serves to improve water quality, by diluting the concentration of any pollutants in the portion of the flow coming from surface water.



Rural and Urban Influences

Rural and urban areas can have considerable impacts on surface water quality, particularly if the appropriate controls are not in place. Runoff in urban areas, particularly those built prior to the requirement for stormwater management, can carry a host of pollutants to local watercourses. These pollutants build up on roads, driveways and parking lots and even lawns and are washed to watercourses during precipitation events. The pollutants that can be carried by urban stormwater runoff include nutrients and pesticides from lawns, parks and golf courses; road salts; tire residue; oil and gas; sediment; and nutrients and bacteria from pet and wild animal feces. Paved surfaces increase the volume and velocity of surface runoff, which causes streambank erosion, contributing additional sediment. A further input of sediment and nutrients from urban and rural areas is the wind erosion of soils. Those areas without vegetation can be a significant source of windborne pollution.

There are a number of water quality issues that are associated with agriculture. Runoff from pasture and cropland can contain high levels of nutrients, sediment and bacteria; and wind can erode topsoil with its associated contaminants.

Surface Water Quality Observations

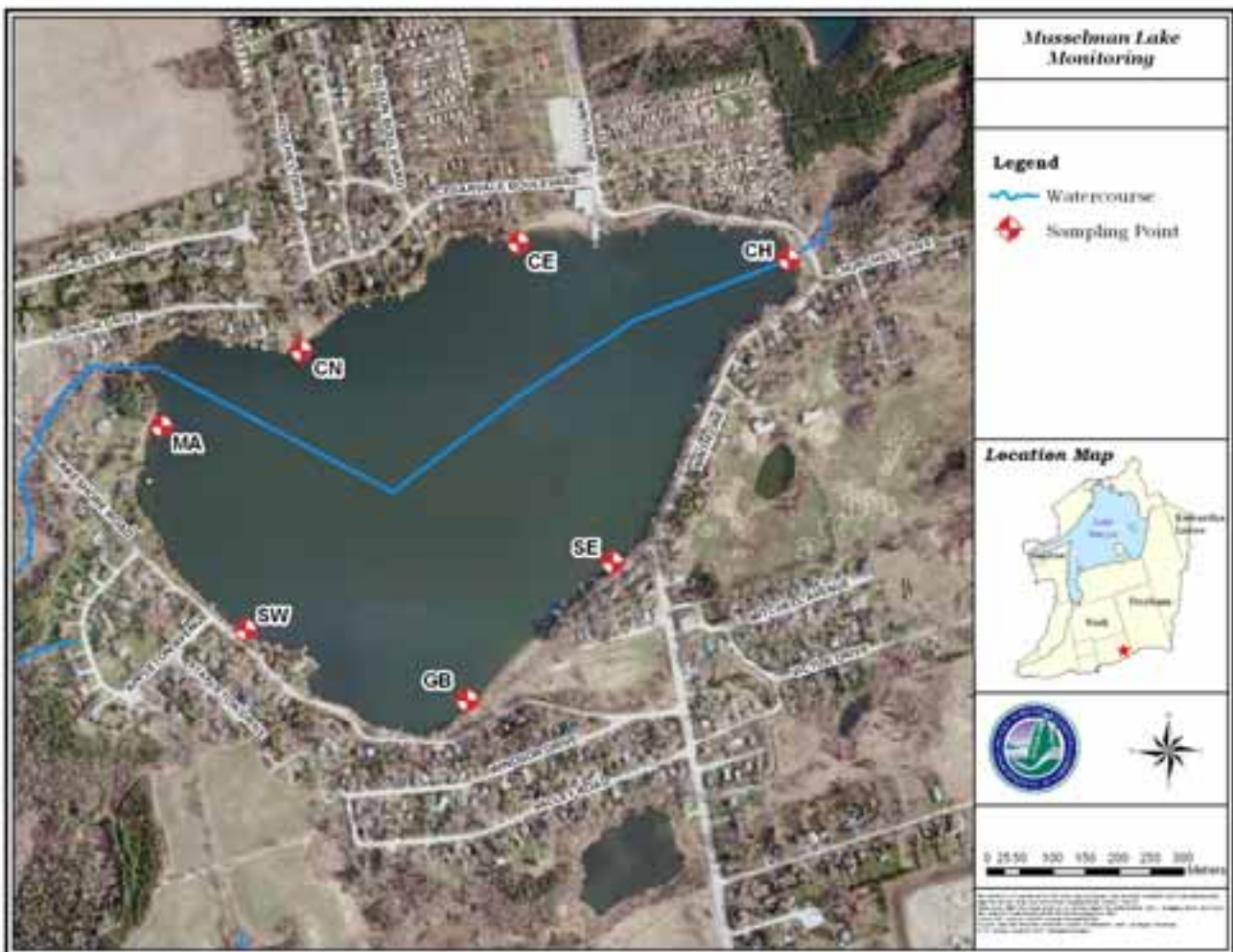
6. Contaminants delivered by point and non-point sources can travel in suspension and /or solution, and are characterized by routine sampling of surface waters in the Musselman's Lake subwatershed.

Musselman's Lake Nearshore Water Quality

Water Quality Background

The data in this report consists of data collected at a single monitoring site in 1982, data collected at seven stations in 1989 and data collected at the same seven sites on a monthly basis from 2006 to 2008. The 1982 data set was collected from the middle of the lake, while the 1989 and 2006 to 2008 data sets were collected from shore sites around the lake. (See Figure 13)

Figure 13: The Musselman's Lake monitoring locations from 1989, 2006 and 2008.



The water quality report compiled for the 1989 data indicates that increases in aquatic plants and algae were one of the reasons for the sampling work conducted. Declining water quality along with plant and algae growth was

also a reason for the implementation of the most recent sampling initiative. Significant plant growth was observed by sampling staff in 2006 and a blue-green algae (cyanobacteria) bloom occurred in the fall of 2007. While plants and algae may impair the recreational and aesthetic value of a water body, blue-green algae can be toxic and pose a health risk to all lake users. Analysis of the algae confirmed that it was a toxic form and beach closures were implemented. The excess plant and algae growth experienced by the lake, coupled with the occurrence of a blue-green algae bloom, are clear indicators that water quality is impaired. This is caused by excessive nutrient inputs. Musselman's Lake is a kettle lake without an outflow except in high water conditions, the water remains in the lake for long periods of time. This long residence time leads to the accumulation of the nutrient inputs to the lake, which results in some of the issues now being seen.

Table 3: Parameters sampled and results for all monitoring sites combined for the 1982, 1989 and 2006 to 2008 data sets. The 1989 and 2006 – 2008 data represents the summary of seven stations around the lake while the 1982 data is a summary of one station.

	Total Ammonia-N	Total Kjeldahl Nitrogen (TKN)	Ortho-phosphate (P)	Total Phosphorus	Total Suspended Solids	Chloride (Cl)	Nitrite (N)	Nitrate (N)	Pseudomonas aeruginosa	Escherichia coli
1982										
min	0.002	0.57	0.001	0.015		22.1	0.001	0.005	0	
max	0.21	0.81	0.006	0.032		23	0.049	0.56	14	
median	0.102	0.67	0.0025	0.024		22.55	0.002	0.0125	0	
1989										
min	0.002	0.059	0.0005	0.013	1.1	38.9	0.001	0.005	2	3
max	0.17	357	0.085	0.14	201	42.9	0.011	0.025	10	164
median	0.018	0.83	0.0015	0.036	6	39.5	0.003	0.005	2	17
2006 – 2008										
min	0.05	0.4	0.01	0.006	1	9	0.01	0.1	10	10
max	0.32	55	0.15	3.9	560	88	0.01	26	10	1300
median	0.09	0.8	0.01	0.018	1	82	0.01	0.2	10	40

An analysis of the data from the above table indicates that total phosphorus (which includes all of its forms found in the environment) has decreased significantly. The median value in the current data set is half that of the 1989 Total Phosphorus median. Total Kjeldahl Nitrogen (TKN), a commonly used measure of nitrogen and Total Suspended Solids (TSS) has remained relatively stable. It is difficult to directly compare some of the other parameters (Orthophosphate, Nitrate, Nitrite and Pseudomonas aeruginosa) due to differing sampling techniques, but their levels also appear to be relatively stable. The majority of samples for these parameters remain at or below the levels at which they can be detected in the laboratory and are therefore not having adverse impacts on

water quality. The parameters that have seen increases are Total Ammonia (1989 to present), Chloride (discussed below) and E. Coli.

Also of note in the above table are the maximum values in the 2006 – 2008 set. Maximum values for TKN, Orthophosphate, Total Phosphorus, TSS, Chloride and Nitrate all occurred on October 15, 2007 during the blue-green algae bloom. While the chloride value was only slightly elevated the values for the other parameters were orders of magnitude higher than typical values. This is in part due to the fact that it was not possible to collect samples without algae because it was found throughout the water column and was therefore analyzed along with the sample. This demonstrates that a high level of nutrient is taken up by in the aquatic plants and algae of the lake.

In general, there is little difference in the water quality across the lake monitoring stations when comparing the 1989 and 2006 – 2008 data sets. The only real exception is station CH with the most notable parameter being E. Coli. The elevated E. Coli values recorded at CH are likely due to the goose population that resides there through much of the ice free season. Geese and their faeces are frequently witnessed at this site. Nutrients such as TKN and Total Phosphorus were also found to be slightly elevated at CH when compared to the other stations for both the historic and current data sets. The blue-green algae bloom in 2007 centered on station CH. Presumably this was largely due to the prevailing winds; however, further investigations around station CH to look for point sources of nutrients may be warranted.

Phosphorus



Blue-Green Algae Bloom (2007)

In the natural environment, phosphorus moves through the ecosystem in a unique cycle. The availability of phosphorus for plants and algae depends on both the amount of the chemical in the system and the rate at which it is cycled. Adding phosphorus from outside sources, such as fertilizers or industrial processes, can have a serious impact on the ecosystem.

While Total Phosphorus has declined since the 1989 data set and the majority of Orthophosphorus samples are below the level at which they can be detected, it is obvious that Musselman's Lake is still suffering from excess plant growth. Generally phosphorus is the nutrient that regulates plant and algae growth. High levels correspond to an increase in growth, indicating that levels in Musselman's Lake are still a concern. The dissolved form of phosphorus (orthophosphorus) is the type that can be used by plants and algae. It is quite likely that the lack of detection of orthophosphorus in the samples is due to the efficient uptake of the nutrient by the plants and algae. This is supported in that the highest orthophosphorus value was recorded during the blue-green algae bloom.

The Total Phosphorus guideline for water bodies to limit excess growth of plants and algae is 0.02 mg/L. For all stations except CH the median value is below 0.02 mg/L. Of the entire 2006 – 2008 data set 37.5% of the samples exceed the guideline as compared to 83% exceedance in the 1989 data set. This again suggests that water quality has seen some improvement in terms of nearshore nutrient concentrations. This takes into account precipitation which was similar across the study years with the exception of 2007 which was unusually dry. The persistence of plant and algae growth in the face of this improvement suggests that continued improvement is necessary. Further it suggests that nearshore sampling does not adequately capture nutrient sources and sinks in the lake and a more comprehensive lake-wide monitoring program should be adopted.

Chloride

Throughout North American lakes, chloride concentrations have been found to be steadily increasing (Wetzel: 2001) with Musselman's Lake being no exception. Chloride is easily dissolved in water and once in water tends to stay there. A major source of chloride in Canada is its use for road salting. Nearly all road salt applied will make its way into surface waters. Due to the volume of road salt used in Canada, the Canadian Environmental Protection Agency (CEPA) has defined road salt as toxic and set a chloride guideline of 210mg/L. Additional sources of chloride include waste water treatment discharge, industrial discharge and potash used for fertilizers.

While chloride concentrations in Musselman's Lake are not yet near the CEPA guideline, an examination of the data over the last 25 years has shown a 72.5% increase in concentrations. In each of the three data sets chloride concentrations are found to be stable and uniform throughout the lake; however, each data set shows higher concentrations than the last. The only exception is a sample taken through the ice in 2008 (minimum value of 9mg/L as in Table 3) where it is likely that melt water diluted the sample. Because it is dissolved in the water, traditional runoff treatment does not remove chloride from stormwater runoff. The most effective way to address the increasing chloride trend is to apply, store and manage road salt in a more efficient manner. To this end Environment Canada has produced a document entitled Code of Practice for the Environmental Management of Road Salts (Environment Canada, 2004) that can help guide municipalities and highway authorities in the better management of road salt use.

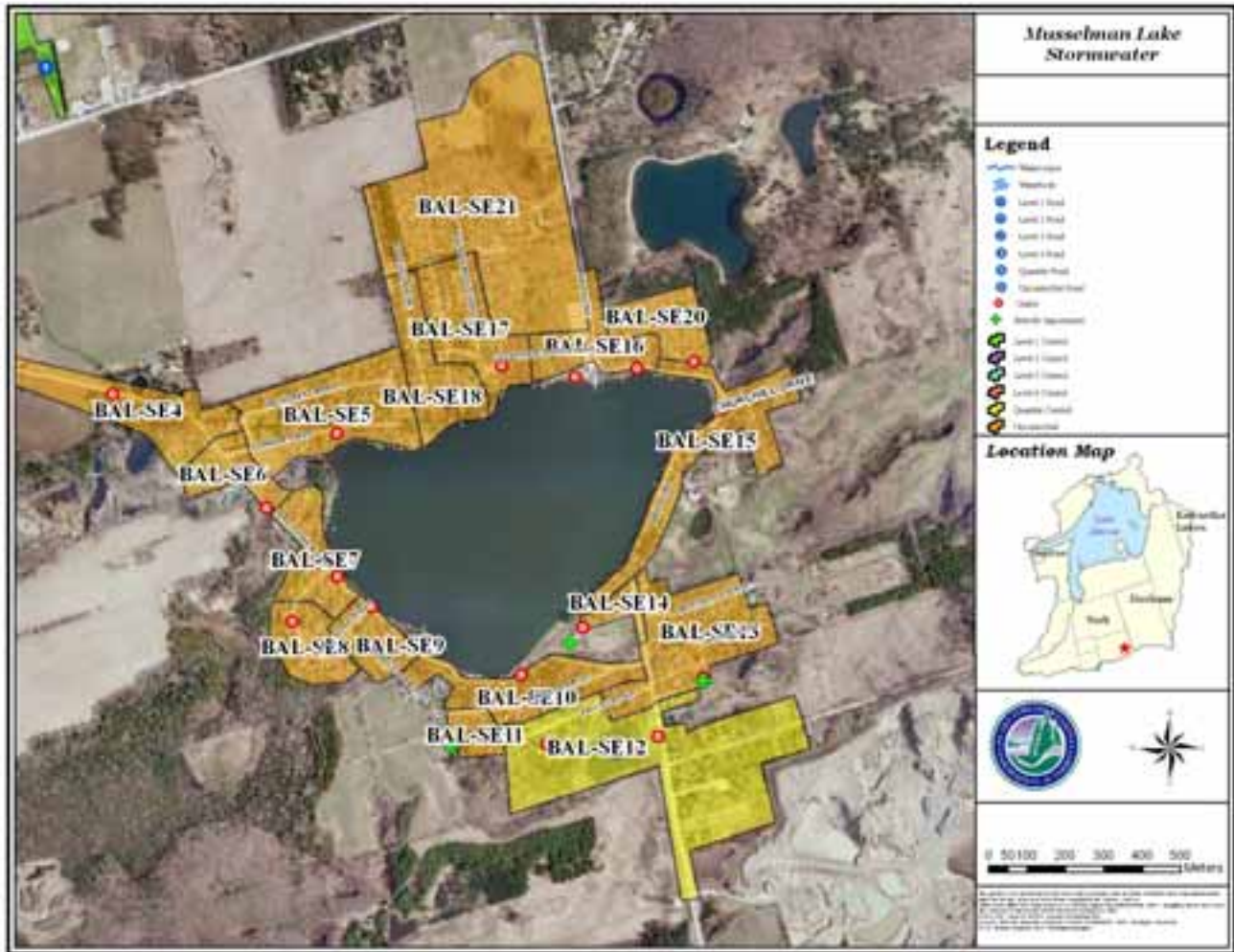
Water Quality Observations

7. 1989 data indicates increases in aquatic plants and algae.
8. Significant plant growth was observed by sampling staff in 2006 and a blue-green algae bloom occurred in the fall of 2007.
9. The algae bloom was likely caused by excessive nutrient inputs. Musselman's Lake is a kettle lake without an outflow except in high water condition, the water remains in the lake for long periods of time.
10. Total phosphorus has decreased but the lake is still suffering from excess plant growth.
11. Total nitrogen has remained relatively stable.
12. In general, there is little difference in the water quality across the lake monitoring stations when comparing the 1989 and 2006-2008 data sets.
13. Chloride concentrations have increased in the lake.

Stormwater Runoff

Figure 14 shows the urban drainage catchments around Musselman's Lake. Currently, of the 11 catchments that drain directly into the lake, none have stormwater controls. This uncontrolled area is estimated to contribute 98 kg of phosphorus per year to the lake. There is only sufficient space in two of these catchments to treat runoff with a conventional pond. The pond would reduce an estimated 7.39 kg of phosphorus per year from entering the lake. To achieve greater stormwater reduction lot level controls and unconventional treatments will need to be investigated.

Figure 14: Urban drainage catchments within the Musselman's Lake subwatershed.



Urban stormwater runoff occurs as rain or melting snow washes streets, parking lots and rooftops of dirt and debris, minor spills and landscaping chemicals and fertilizers. In the past it was common practice to route stormwater directly to streams, rivers or lakes in the most efficient manner possible. This practice typically has negative impacts on the receiving water body including nutrient enrichment. Over the last two decades this has changed and efforts are now made to intercept and treat stormwater prior to its entering watercourses or waterbodies. However, in many older urban areas stormwater typically still reaches watercourses untreated.

Urban stormwater runoff is also greatly affected by land use type. Commercial and industrial areas typically have more impervious area (e.g. paved parking lots, sidewalks, roof tops) than any other type of land use and consequently, generate more urban runoff and pollution. In sharp contrast are open areas that have little if any paved surfaces. In these areas, the natural hydrologic cycle occurs whereby water can infiltrate into the ground to be filtered by the soil before entering local streams and watercourses or continue deeper to recharge the ground water aquifer.

There are various methods of controlling stormwater runoff, from small-scale single lot controls to larger scale end-of-pipe stormwater management ponds. The most common types of ponds include wet ponds, dry ponds and artificial wetlands. By intercepting runoff and typically retaining the water for 24 hours, the ponds allow for settling of particulate material and reduce flooding potential. The ability of the pond to trap particulate matter is important as many pollutants, including nutrients, will be attached to these particles and therefore be trapped in the pond as well. Monitoring data has shown that a stormwater pond can remove more than 80% of phosphorus from stormwater runoff.

Existing water quality guidelines such as the Provincial Water Quality Objectives (PWQO) cite a total phosphorus value of 0.02mg/L to limit excess plant growth in water bodies. This guideline may not be as applicable to Musselman's Lake as it is a kettle lake with a long residence time. Current monitoring data found this guideline to be exceeded in 37.5% of the samples, down from 83% in 1989. However, by most residents' accounts the aquatic plant problem has not shown any significant reduction.

Phosphorus is generally recognized as the limiting nutrient to aquatic plant growth and, while there are few guidelines for other nutrients, they would arguably be of little relevance if excess phosphorus is available. Dissolved phosphorus (orthophosphorus) does not have a guideline but is relevant to plant growth as it is the form of phosphorus most available to the plants. In the current data set the majority of orthophosphorus samples were below laboratory detection limits. It is likely that the lack of detection of orthophosphorus in the samples is due to the efficient uptake of the nutrient by the plants and algae which utilized the nutrient before they could be sampled. A better understanding of this relationship through an aquatic plant survey could assist in setting an orthophosphorus target. Integrated with the overall lake-based study the total phosphorus guideline could be reviewed and a guideline specific to Musselman's Lake could be developed.

Stormwater Observations

14. There are 11 catchments that drain directly into the lake and none have stormwater controls. This uncontrolled area is estimated to contribute 98 kg of phosphorus per year to the lake.
15. There is only sufficient space in two of these catchments to treat runoff with a conventional pond. The pond would reduce an estimated 7.39 kg of phosphorus per year from entering the lake.
16. To achieve greater stormwater reduction, lot level controls and unconventional treatments will need to be investigated.

Surface Water Resource Goals

Goal – To ensure that surface waters are of sufficient quality to support healthy aquatic communities and enable sustainable human uses including recreation and commercial uses.

Goal – To ensure surface waters to:

- Protect aquatic and terrestrial life and ecological functions;
- Protect human life and property from risks due to flooding;
- Contribute to the protection of Musselman's Lake, East Holland River subwatershed and Lake Simcoe as a drinking water source; and
- Support sustainable agricultural, industrial and commercial water supply needs.

4.1.3 Aquatic Habitat

For aquatic habitat stewardship opportunities please see section 5.3 and 5.5.

Habitat - is an environmental area that is inhabited by a particular animal or plant species.

Habitat can be described as a place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristic. All living things have a number of basic requirements in their habitats including space, shelter, food and reproduction. In an aquatic system, good water quality is an additional requirement. In an aquatic system, water affects all of these habitat factors; its movement and quantity affects the usability of the space.

Rural and Urban Stresses on Aquatic Habitat

Rural and urban land uses in the subwatershed can impact aquatic habitat in several ways. The conversion of natural land uses such as woodland and wetland to agriculture or development removes the functions that these features perform, such as improvement of water quality, water storage and increasing the amount of infiltration to groundwater. This can result in impacts to water quality and a reduction in baseflow. Surfaces that are stripped and left exposed for construction can erode in precipitation events and pollute streams if the proper controls are not in place and can also be subject to wind erosion, resulting in inputs of sediment and nutrients to watercourses. The excessive sediment can cover necessary spawning substrate, clog the gills of fish and impede feeding ability; while the increased nutrients can lead to excessive plant growth and decreased oxygen content. Stormwater flow over paved surfaces carries with it sediment and other contaminants that can impact aquatic life. Stormwater runoff flows quickly and can contribute to streambank erosion, increasing the amount of suspended sediment in the lake. The impervious surfaces associated with urban areas reduce the amount of water infiltrating into the soil, which could impact groundwater levels and thus the amount available for baseflow and sustenance of ecological

function. The increased water use associated with the expansion of urban areas can draw down groundwater aquifers, leaving less water available to be discharged as baseflow. The removal of vegetated buffers along the Musselman's Lake shoreline contributes to bank erosion, which is an additional source of sediment to the system. Septic systems throughout the Musselman's Lake subwatershed can fail and provide a source of nutrients and bacteria. The construction of docks and boathouses, the placement of sand for man-made beaches and the unnecessary removal of aquatic vegetation can also harmfully alter or destroy fish habitat.

Aquatic Habitat Observations:

- 17. Removal of vegetated buffers along shorelines contributes to bank erosion which is a source of excess sediment entering the water.
- 18. Septic systems can fail and provide a source of nutrients and bacteria.

4.1.3.1 Fisheries

Musselman's Lake is known by local anglers for its northern pike, smallmouth bass and largemouth bass fishery. Ice fishing surveys were completed by the Friends of Musselman's Lake community group in 2006, 2007, 2008 and 2009. This data shows that most people are catching northern pike (*Esox lucius*) through the ice. Other species angled through the ice were pumpkinseed (*Lepomis gibbosus*), black crappie (*Pomoxis nigromaculatus*) and yellow perch (*Perca flavescens*). The anglers surveyed all came from the Greater Toronto Area (GTA) and use minnows as bait. All of the species above with the exception of smallmouth bass were captured in the electrofishing surveys completed in 2007, discussed below.

Biomass - The total mass of living matter within a given unit of environmental area.

Electrofishing - A world wide accepted fish sampling technique using electric currents to control fish movement and/or immobilize fish, allowing capture.

Recent electrofishing surveys have shown that Musselman's Lake has a diverse warm water top level predator fishery. The Friends of Musselman's lake and the Toronto and Region Conservation Authority (TRCA) conducted two boat electrofishing surveys in 2007. Nine species of fish were caught in three standard boat electrofishing runs on June 25, 2007 and four standard runs on November 15, 2007. Figure 15 denotes locations of boat electrofishing transects. Table's 4 and 5 denote results from both surveys. The results have been sorted from the most biomass to the least. The reduction of biomass and change in species composition from the June sample to the November sample could be due to the differences in season and time of day that the samples were collected. Warm water species tend to move from shallow waters in the late spring and summer to the deeper areas in the late fall and winter. The electrofishing boat is only effective in shallow (approximately 0-1.5m) water and this may have limited the number of warm water species caught in November. The June sample was conducted as darkness approached (19:46 – 22:02 hrs.) and the November sample was conducted during daylight hours (14:49 to 16:26 hrs.). Electrofishing by boat is more effective when

conducted at night with lights to attract fish. This could explain the higher biomass totals for June. Also included are the number captured, shortest, longest, heaviest and lightest fish to give an idea of the size ranges of species within the lake.

Figure 15: Locations of boat electrofishing transects in 2007.



Table 4: Electrofishing results from June 25, 2007

Species	Number Captured	Longest Fish (mm)	Shortest Fish (mm)	Heaviest Fish (g)	Lightest Fish (g)	Total Biomass (g)
largemouth bass (<i>Micropterus salmoides</i>)	48	445	80	1425	7	9613
brown bullhead (<i>Ictalurus nebulosus</i>)	18	320	150	695	69	5186
pumpkinseed (<i>Lepomis gibbosus</i>)	132	170	53	117	2	4296
northern pike (<i>Esox lucius</i>)	8	550	335	750	222	3499
black crappie (<i>Pomoxis nigromaculatus</i>)	22	230	136	191	35	1827
rock bass (<i>Ambloplites rupestris</i>)	4	271	135	473	54	1155
white sucker (<i>Catostomus commersoni</i>)	2	460	325	600	389	989
yellow perch (<i>Perca flavescens</i>)	11	205	150	96	36	737
golden shiner (<i>Notemigonus crysoleucas</i>)	4	143	96	28	11	70
Totals	249					27372

Table 5: Electrofishing results from November 15, 2007

Species	Number Captured	Longest Fish (mm)	Shortest Fish (mm)	Heaviest Fish (g)	Lightest Fish (g)	Total Biomass
northern pike (<i>Esox lucius</i>)	10	550	230	840	74	3818
largemouth bass (<i>Micropterus salmoides</i>)	9	400	65	771	5	1105
brown bullhead (<i>Ictalurus nebulosus</i>)	12	290	120	370	23	1073
yellow perch (<i>Perca flavescens</i>)	11	230	160	143	45	1015
golden shiner (<i>Notemigonus crysoleucas</i>)	16	200	115	92	11	619
rock bass (<i>Ambloplites rupestris</i>)	5	190	140	139	60	509
pumpkinseed (<i>Lepomis gibbosus</i>)	8	175	90	120	15	498
white sucker (<i>Catostomus commersoni</i>)	1	415	415	306	306	306
black crappie (<i>Pomoxis nigromaculatus</i>)	4	175	150	77	42	249
Totals	76					9192

All of the captured species are well-suited to a shallow warm water kettle lakes and one would therefore expect to find them in Musselman’s Lake. Two new species that have not been reported in previous surveys were black crappie (*Pomoxis nigromaculatus*) and golden shiner (*Notemigonus crysoleucas*). Golden shiner is native to the East Holland River subwatershed and is common. Black crappie are not native to this subwatershed. White sucker (*Catostomus commersoni*) are present in the lake suggesting that there is a link to the East Holland River subwatershed for at least part of the year. White sucker are a migratory fish that move to gravelly streams in the spring to spawn.

Notably absent from the survey were Cyprinid (minnow) species. The golden shiner was the only minnow species noted in this survey. Almost an entire trophic level is absent from this ecosystem as reported. It is highly unlikely that Cyprinids are absent in the lake but they were not captured in these surveys. Boat electrofishing is efficient at

catching larger fish but does not capture many of the smaller species of fish. Using trap and seine nets along with minnow traps would provide a much better representation of the fish species that inhabit Musselman's Lake.

Trophic Level - a level in the food chain (e.g. larger fish require smaller fish to feed on)

Invasive species such as common carp or round goby were not captured in the electrofishing runs and were not noted in the ice fishing surveys. This likely indicates that they have not yet been introduced into the lake and demonstrates that fish populations are healthy. In a stressed system, invasive species are better able to out-compete the native species in the lake for habitat and food.

Only one non-native species has been caught in Musselman's Lake, the black crappie (*Pomoxis nigromaculatus*). Black crappie is not native to the Lake Simcoe watershed and has been found in the tributaries to Lake Simcoe since 1984. It is most likely that a well-meaning angler introduced them into Lake Simcoe and now into Musselman's Lake.

To prevent further introduction of non-native fish species a ban of all live baitfish could be put in place to stop the accidental dumping of live non-native baitfish into the lake. An annual black crappie fishing derby could be organized to remove crappie each year from the lake. When transferring boats from other water bodies they should be scrubbed down to prevent the transfer of spiny water flea and zebra mussels. For more information, visit www.invadingspecies.com

Fisheries Resource Goals

Goal – Musselman's Lake should support a sustainable fish population including optimum habitat for its naturally reproducing native fish and maintain stability in the bio-diversity of wildlife species and their habitat. The introduction of "invading species" such as zebra mussels and purple loosestrife must be prevented.

Goal – To have a healthy and diverse warm water fish community.

To support this community it is important that a wide variety of habitats are available in order to ensure that the species comprising the community are able to carry out their life cycles. This includes habitat for feeding, spawning and evading predators.

Goal – to continue support a viable sport fishery, it is also important to ensure that there is a healthy bait fish community.

The sport fish community is only sustainable if the minnow community of the lake is healthy. A diverse population would create more recreational angling opportunities on the lake.

Fisheries Observations:

- 19. Recent electrofishing surveys have shown that Musselman's Lake has a diverse warm water top level predator fishery.
- 20. Two new species were found, black crappie and golden shiner.
- 21. White sucker are present suggesting there is a link to the East Holland River subwatershed.

4.1.3.2 Benthic Invertebrates

Benthic Invertebrate - are aquatic insects that are ideal indicators of water quality

To date, no benthic surveys have been completed on Musselman's Lake. Aquatic insects, or benthic invertebrates, are an ideal indicator of water quality as different species have varying tolerances to factors such as nutrient enrichment, dissolved solids, oxygen and temperature. The presence or absence of certain species is used to determine water quality at a given site. For example, some species of insects can only survive in cold, clear, nutrient free water where others can survive in warm, turbid nutrient rich water. Benthic surveys have not been completed on Musselman's Lake.

Benthic Invertebrates Resource Goals

Goal – To have a healthy and diverse benthic invertebrate population.

The benthic invertebrate community is the foundation of the aquatic ecosystem. A healthy benthic invertebrate population supported by a variety of habitats will take in nutrients from the water and provide food for the minnow population of the lake, which in turn supports the population of larger fish. Therefore a healthy benthic invertebrate community is essential not only for the health of the aquatic community of Musselman's Lake, but also for supporting its recreational fishing activities.

Benthic Invertebrate Observations:

- 22. The presence or absence of certain benthic invertebrates is an indicator of water quality.
- 23. No information is currently available about the presence of benthic invertebrates.

4.1.4 Terrestrial habitat

For terrestrial habitat stewardship opportunities please see sections 5.4 and 5.5.

Terrestrial natural heritage features are extremely important components of subwatershed health, as they not only provide habitat for many of the species residing in the subwatershed, but also influence subwatershed hydrology. They are among the most important parts of the ecosystem and are the most likely to be directly impacted by human activities.

A terrestrial natural heritage system is composed of natural cover (features), natural processes (functions) and the linkages between them. The matrix of agricultural, rural, urban and natural areas within the subwatershed's terrestrial system interacts with other hydrological and human systems and serves as habitat for flora and fauna throughout the subwatershed. The system includes not only large tracts of natural features, but also the small features that can be found within urban and agricultural areas.

Terrestrial Natural Heritage System

Due to the fact that the Province has placed the responsibility of defining significant features to the Municipalities and in an effort to assist our municipal partners, the LSRCA in partnership with Beacon Environmental, has developed a Natural Heritage System (NHS) for the Lake Simcoe watershed. Founded on the Provincial Policy Statement (2005) and supported by recent scientific concepts, the NHS Phase 1 identifies the existing natural heritage components and provides suggested policy templates. The Natural Heritage System for the Lake Simcoe Watershed Phase 1: Components and Policy Templates was approved by the LSRCA Board of Directors in July 2007 and is used by LSRCA staff to guide plan review, though the main intent is for adoption through municipal Official Plans. Science is the support structure of the NHS and supporting documentation provides comprehensive criteria based on recent scientific concepts in order to identify lands of ecological value within the watershed. A four-tiered policy approach was developed to direct the protection of the natural features of the Natural Heritage System (see table 6). The first two levels of this policy approach are assigned a "provincially significant" designation and are considered to be those features that would be identified if following the guidelines and intent

Big Woods Policy are those areas where there is a high percentage of woodland cover and large woodland patches. These areas are considered most likely at the landscape scale to represent high ecological function, diversity, connectivity and are priority natural areas.

of the PPS. Level 3 of this approach represents significance at the watershed level, while Level 4-supporting features are those that are considered to be supporting the natural heritage system of the watershed. Finally, Big Woods Policy Areas are target areas for replacement, restoration and stewardship priorities (Beacon and LSRCA, 2007). The Natural Heritage System for the Lake Simcoe Watershed (Beacon and LSRCA, 2007) provides an important tool for reducing the impact of human influences by ensuring that the functions of natural systems can be preserved and/or restored.

Table 6: Four-tiered policy for the protection of natural features of the Natural Heritage System.

Significance	Policy Level	NHS Intent	Implications for Replacement
Provincially Significant	Level 1	Retain No Development	Can be considered for impacts from non- <i>Planning Act</i> (e.g., EA)
	Level 2	Retain No Negative Impact	Where there is ‘no negative impact’
Watershed Significant	Level 3	Generally Retain, some flexibility No Net Negative Impact	Retention preferred but replacement acceptable; no net loss of area
Supporting	Level 4	Supporting Features	Retention encouraged, not necessarily a constraint to development

Quantity and Distribution of Cover

The Natural Heritage System for the Lake Simcoe Watershed (2007) has identified that 80% of the natural heritage features, or 40.2% of the total area within the Musselman’s Lake subwatershed are Level 1 policy features. The lake itself has been identified as a Level 3 feature.

Woodlands

With a diverse multi-dimensional structure and strong influence on their environments, woodlands form complex vegetative communities. The upland wooded areas of the Musselman’s Lake subwatershed (which has an area of 460 ha) are found in two large concentrations, one being at the north-east and the other at the south-west corner. The majority are linked to other natural heritage features, such as other forest community types, riparian areas and/or wetland communities and by Musselman’s Lake itself. The upland forests consist mainly of Deciduous Forest, with smaller areas consisting of Mixed, Coniferous and Coniferous Plantation (see Table 7). The deciduous forests typically are Sugar Maple Forest (*Acer saccharum*) communities that include Trembling Aspen (*Populus tremuloides*), Black Cherry (*Prunus serotina*), Red Maple (*Acer rubrum*) and Largetooth Aspen (*Populus grandidentata*).

Table 7: Breakdown of upland forests within the Musselman’s Lake subwatershed.

Upland Woodland Cover	Hectares	Percentage
Mixed forest	12.2	2.4
Coniferous	6.7	1.3
Deciduous	52.6	10.4
Cultural woodland	1	0.2
Plantation	29.4	5.8

Forested area is important as it provides environmental, social and economic benefits, such as protection of air, water and soil conditions, provision of habitat, recreation and the sustainable harvest of woodland products. Currently, the East Holland River subwatershed has a target forest cover percentage of 30%, a target that is generally accepted in southern Ontario (Refs). The Musselman’s Lake subwatershed currently has a treed cover (including wetland and upland) of 24.5% or 124 ha; upland forest cover specifically is at 20.1% or 101.9 ha, 29.4 ha of which is plantation. The tree cover within the Musselman’s Lake subwatershed is therefore at a relatively healthy level and is adding to the relative cover goal for the East Holland River subwatershed. Together with the adjacent wetland habitats, the forest system is suitable for successful populations of at least seven types of frog species, two turtles (including Bull Frog and Snapping Turtles), as well as habitat for migratory and breeding birds, including Loon, King Fisher and Osprey (Marsh Monitoring Program, 2002, 2003; pers. comm. Obs. Mark Carroll, 2008).

Wetlands

Wetlands are defined as lands that are seasonally or permanently flooded by shallow water, as well as lands where the water table is close to the surface (OMNR, 1994). Wetlands are critical to the ecological function of the watershed and the ecological health of Musselman’s Lake and its streams. Wetlands perform a variety of functions including:

- Recharging and discharging groundwater;
- Reducing flood damage by controlling and storing surface water;
- Acting as corridors for the movement of species between habitats;
- Providing recreational and tourism opportunities;
- Providing habitat for a wide variety of plant and animal species;
- Stabilizing shorelines and reducing erosion damage; and
- Improving water quality by trapping sediments, removing excess nutrients and bacteria.

The majority of the wetlands within the Musselman’s Lake subwatershed are considered to be Provincially Significant, either as a component of the East Musselman Wetland Complex or as a part of the Musselman Lake Wetland (see Figure 16). The Musselman Lake Wetland PSW was evaluated by the OMNR in 1985. It is a

Palustrine - Wetlands within this category include inland marshes and swamps as well as bogs, fens, tundra and floodplains

palustrine system 49.4 ha in size consisting of swamp, fen and marsh wetland community types. Palustrine systems are defined as having permanent or intermittent outflow, but no inflow. This area has been documented as being an active feeding area of blue heron, is home to muskrat, beaver and mink as well as to Provincially and Regionally significant plant species, namely cream violet (*Viola striata*), bog laurel (*Kalmia polifolia*) and hobblebush (*Viburnum alnifolia*). The most dominant wetland types within the Musselman's Lake subwatershed are Mixed Swamp, submerged shallow aquatic and Deciduous Swamp, with a total 3.7 ha of the rarer open fen wetland type.

Figure 16: Wetlands within the Musselman's Lake subwatershed.

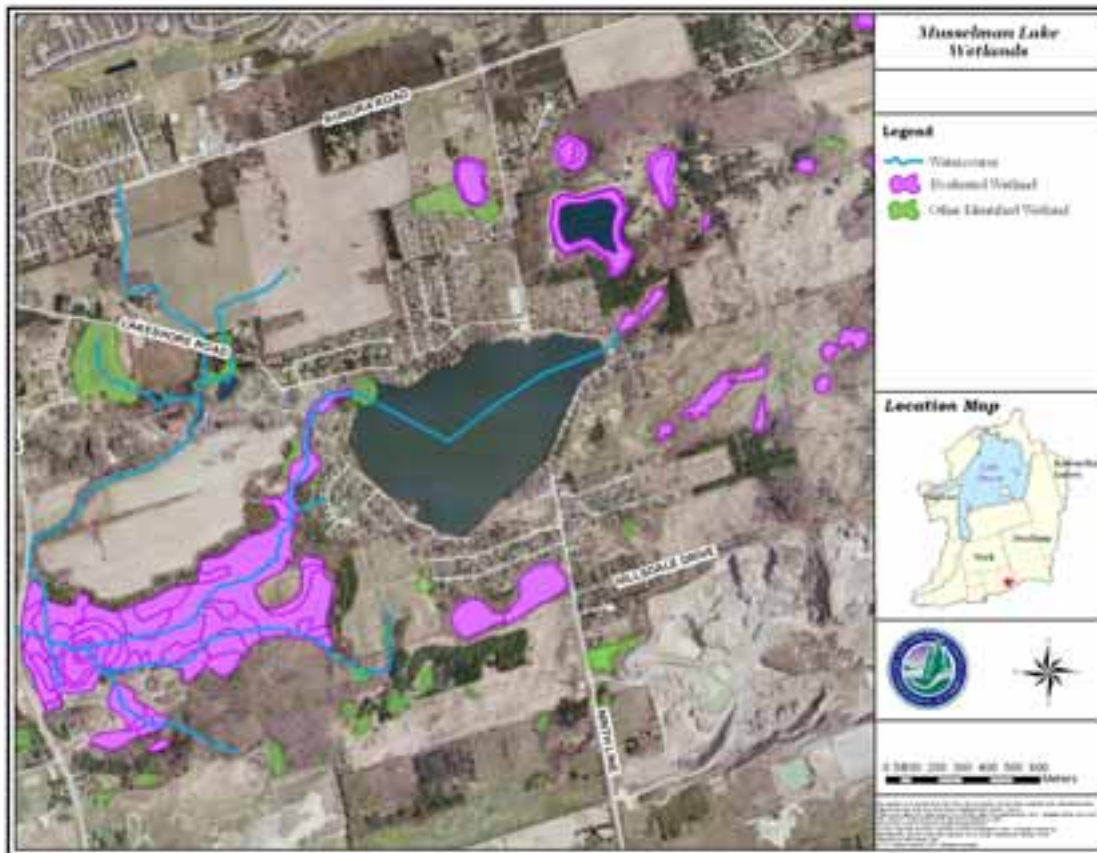


Table 8: Breakdown of wetland types within the Musselman’s Lake subwatershed.

Wetland Type (ELC)	Hectares	Percentage
Thicket swamp	1.9	0.4
Mixed swamp	17.6	3.5
Deciduous swamp	4.1	0.8
Coniferous swamp	0.5	0.1
Shallow aquatic	13.6	2.7
Shallow marsh	3.3	0.6
Meadow marsh	2.7	0.5
Open fen	3.7	0.7

Riparian Vegetation

Watercourses, if sufficiently buffered by riparian vegetation not only provide shade, shelter and food to the aquatic ecosystem but can become important linkages between natural heritage features. This is important because a well connected landscape is more likely to have a more highly functioning ecosystem. The watercourse reaches within the Musselman’s Lake subwatershed, for the majority, run through natural heritage features (3018 m) rather than along roads (22 m) or through urban areas (119 m). For cold water fisheries, the LSRCA’s policy requires a minimum 30 m vegetated buffer. Only 1.7 ha or 14% of the 30 m riparian buffer area of the entire

watercourse system within the catchment consists of impervious surfaces (13%) or intensive agriculture. Mixed swamp provides the greatest buffer area of 5.5 ha or 46%.

Riparian Vegetation - Plant communities along the land between land and water

Invasive Species

Non-native terrestrial plant species are often introduced via horticulture or agricultural activities. These species are planted, either intentionally or unintentionally (through contaminated seed mixtures) into gardens or crops. They then go to seed and are dispersed to surrounding areas where they may become established and disperse further provided the appropriate environmental conditions exist. Some examples of terrestrial invasive species that may be present in the Musselman’s Lake subwatershed, or are present in the surrounding areas, are Scots Pine (*Pinus sylvestris*), Common Reed (*Phragmites australis*), Dog-strangling Vine (*Vincetoxicum rossicum*), Norway and Manitoba Maple (*Acer platanoides* and *A. negundo*), European Buckthorn (*Rhamnus cathartica*) and Common Lilac (*Syringa vulgaris*).

Preventing the spread of invasive species will be one of the keys to reducing their impacts. Enhanced communication and education programs would help to prevent the spread by those users of the watersheds who are unaware of the impacts of their actions. Awareness of common actions that can potentially lead to the spread of terrestrial invasive species is a helpful start; these include, cleaning shoes of mud and seeds before going from one natural area to another, planting only native, non-invasive species on your property, removing invasives from their roots when observed and keeping the natural areas as robust as possible so that they can resist invasion.

Habitat Inventories

To the best of our knowledge, very little terrestrial inventories have taken place in this subwatershed and it would therefore be recommended that more be done. However, some marsh monitoring was conducted in the spring of 2002 and 2003.

Habitat Creation

While greater connectivity is generally strived for, restoration in landscapes that are not currently 'connected' should be undertaken in a deliberate manner to ensure that connecting features does not result in deleterious ecological effects. For example, a newly created corridor should not provide a pathway for an invasive species or a disease to become established in a previously unaffected area. However, planting in areas that will further enhance a forest edge, a riparian area, or add to an upland buffer adjacent to a wetland are all ways to add benefit to the natural heritage system.

Some tree planting has occurred to date, whereby 3,550 native trees and shrubs were planted in the Musselman's Lake subwatershed.

Terrestrial habitat Resource Goals

Goal – Protect, enhance and restore the natural features, to improve ecosystem function, enhance biodiversity and then to mitigate the impacts of changing land uses.

Goal – The protection and rehabilitation of the shoreline (littoral, riparian and upland areas) should be promoted to increase the amount of natural shoreline. The shoreline can be described as the “ribbon of life” that supports a diverse range of fish and wildlife species.

Terrestrial Habitat Observations:

24. The tree cover within the Musselman's Lake subwatershed is at a healthy level.
25. There are seven types of frog species, two turtles species and habitat for migratory and breeding birds, including loon, king fisher and osprey.
26. Majority of wetlands within the subwatershed are considered Provincially Significant.
27. This is an area identified as an active feeding are of blue heron, home to muskrat, beaver, mink, cream violet, bog laurel and hobblebush.
28. Very little terrestrial monitoring has taken place in this subwatershed.

5.0 Recommendations

The recommendation section is to give an overview about possible Best Management Practices, scientific research and educational opportunities that could be completed during the implementation phase. In the future, these recommendations will need to be prioritized based on the short-term and long-term goals of the Musselman's Lake subwatershed and the community's needs.

5.1 Groundwater

Groundwater Quality

Because contaminants on the surface can reach the groundwater aquifers through infiltration, potential contaminants and harmful land uses should be kept away from vulnerable areas (see Figure 9). These vulnerable features are being identified through the Drinking Water Source Protection program, which is currently being undertaken through the Clean Water Act. Proper storage and disposal of potential contaminants by all subwatershed residents will also protect groundwater resources.

Recommendation:

- 1. Information should be provided to all residents about the proper storage and care of potential harmful substances. These could include but are not exclusive to gasoline, fertilizers, pesticides and oil. Residents should dispose of household hazardous waste at proper drop off centres. The available Drinking Water Source Water Protection Program information should be used to identify and protect vulnerable areas. www.sourcewaterinfo.on.ca**
- 2. Information could be provided through mailouts, websites, news releases, posters and other approaches to be identified in the implementation plan.**

Groundwater Quantity

Wherever possible (and where groundwater contamination would not be a concern), impervious surfaces should be restricted and/or replaced with pervious solutions (e.g. natural surfaces, pervious pavement in parking lots). This will not only increase the quantity of groundwater that is available but will also reduce the peak flows that occur in urban areas following storm events by reducing the amount of surface runoff.

The implementation of water efficiency programs such as York Region's Water for Tomorrow program is important to educate users of the state of water supply in their area and how to conserve it.

Recommendation:

- 3. Through the use of official plan policy and site plan control the Town of Whitchurch-Stouffville should limit the use and location of impervious surfaces. Those surfaces should be limited and replaced with pervious solutions like natural surfaces and pervious pavement.**
- 4. Contact York Region's Water for Tomorrow program for more options and approaches to educate landowners on possible solutions. www.waterfortomorrow.com**

5.2 Surface Water

While some improvements in nearshore water quality have been observed between the data sets it is obvious that the waters of Musselman's Lake are still suffering from nutrient enrichment. The continued occurrence of algae blooms and excessive plant growth are evidence of this. In order to better understand the mechanisms that are responsible for this continued problem, it is necessary to implement a more comprehensive lake-based monitoring plan in place of a strictly nearshore monitoring program.

While enhanced monitoring will give a greater understanding of the lake, improvements in water quality will only occur with the cooperation of all lake residents and users. Nutrient sources will need to be addressed through the implementation of best management practices at all scales, from the individual lot level to the community level. This would include the construction of the stormwater pond identified, as well as looking at other stormwater management options and initiatives, again from the lot level to the community level. Being a kettle lake, Musselman's Lake is more susceptible to water quality problems than typical lakes. In order to restore and sustain the waters of the lake, it will require the continued commitment and vigilance of all parties to ensure its future.

Recommendation:

5. Residents should consider reducing or using natural alternatives to the pesticides, herbicides and fertilizers being used on their garden and lawns.
6. In order to better understand the water quality issue in Musselman's Lake, an increased amount of monitoring needs to occur. During the community consultation, it was suggested that motor boats, septic systems, stormwater runoff and many others are a concern on the lake. Currently, there is a lack of data surrounding what is affecting Musselman's Lake surface water quality and this needs to be researched further.
7. Undertake water quality monitoring for Musselman's Lake.
8. Information should be provided to residents about reducing or using natural alternatives to pesticides, herbicides and fertilizers being used on their gardens and lawns.
www.waterfortomorrow.com
9. Information should be provided to residents about the use and storage of fuel, fertilizers and other chemicals.
10. Prepare a stormwater management plan for the Musselman's Lake subwatershed.
11. Investigate the feasibility of implementing stormwater reduction at the lot level and other "unconventional" treatments where appropriate.
12. Identify the need for new stormwater ponds and retrofit current stormwater facilities and use new technology where possible.
13. Exploring an example of new technology could be Phoslock. Phoslock is a modified clay product which removes phosphorus from the water. Extensive testing and usage around the world, has demonstrated that Phoslock, reduces phosphorus in water. In addition, it is harmless to the water and its plants and animals. This product is currently being used as a pilot project in the Lake Simcoe Watershed. The results are being assessed and are subject to approval by the Ministry of Environment for use. Other innovative stormwater controls should be considered.
www.lsrca.on.ca/phoslock

Bathymetric Survey

As a starting point, a detailed depth map of Musselman's Lake is in the process of being created, starting in November 2008. The existing lake map is of unknown date (likely 1970s). Using new sampling methods (i.e. GPS and handheld SONAR) will improve our understanding of the lake's physical features and be used to determine suitable study sites to be used from this point forward. The completed map can be made available by the LSRCA to interested residents or recreational users of Musselman's Lake (e.g. boaters and anglers).

Recommendation:

- 14. A bathymetric map will be completed by the LSRCA and then distributed to interested residents or recreational users.**

Aquatic Plant Survey

In a recent survey completed by Musselman's Lake residents, aquatic plants (or "weeds") were the single largest environmental concern. While found in all lakes and are important areas of fish habitat, the type and quantity of aquatic plants can change under increased inputs of nutrient. No current data exists on these plant communities. However, a preliminary survey in September 2008 showed species and populations typical of nutrient-rich waters.

Plant samples will be taken from a series of sites set in lines across the lake. They will be taken at pre-determined water depths and the amount and number of species of plants will be recorded in order to determine: (1) what species are found where? (2) are exotic species present? (3) what changes are occurring in this plant community over time? By comparing this data to results from the Lake Simcoe Nearshore Program we will be able to determine how this plant community would likely change under reduced nutrient loading.

Recommendation:

- 15. Conduct an aquatic plant survey to determine what species are present, the existence of any exotic or invasive species and whether there are changes over time.**
- 16. Provide information to shoreline property owners and recreation users about the benefits of aquatic plants. Develop a communication plan around aquatic plants which could be implemented using websites, signs at access points, or flyers.**
- 17. Prepare a species identification card with pictures of plants found in Musselman's Lake.**

Analysis of algal diversity

A rapid index of environmental quality uses the biodiversity of algae, as the species found can be used to determine environmental conditions. To date, no studies have been undertaken on this important group. In addition to tracking changes in the algal community through different seasons and comparing results to other area lakes, this data will provide a baseline by which to compare the effectiveness of management practices.

Recommendation:

- 18. Complete an analysis of the algal community.**
- 19. Put in place an algae watch program to enable appropriate inventory and sampling of algae blooms.**

Paleolimnological Assessment

Paleolimnology – tracking the environmental history of a lake by using fossilized remains archived in lake sediments

While analysis of current environmental conditions are crucial to this project, they do not tell us what the original, background environmental conditions of Musselman’s Lake were before nutrients became a problem. To determine these missing data, we will carry out a rapid paleolimnological study on the lake. Lakes are depositional ecosystems and as such material from the atmosphere, surrounding landscape and water column are deposited in chronological layers in the lake’s sediments (older material is overlain by more recent material). These are assessed by taking vertical sediment cores from the sediment on the lake bottom. One vertical sediment core from a suitable location (determined using the bathymetric map) will be taken and sectioned into 0.5 cm intervals. This will give a resolution of approximately 1-2 years per section.

To start, two sections will be analyzed: one from the top of the core (0 – 0.5 cm core depth) which contains information on the past 1-2 years and a second sample from a pre-disturbance time (~ 20-25 cm core depth which would be ~ 1900). Using this data, we can determine how much environmental conditions have changed in Musselman’s Lake and what realistic recovery goals should be in this system. If there is interest for further analysis (e.g. dating of the sediment core to establish exact timing of changes and detailed analysis), the LSRCA can partner with universities to undertake this work.

This study will provide a large amount of environmental information at minimal cost. Most of the recommended studies can be carried out using existing personnel, facilities and equipment from the LSRCA. The results of this project will be directly usable by local interest groups and the LSRCA for establishment of detailed recommendations for watershed management. As an added benefit, these results will also be published in an appropriate, high quality, scientific journal and presented at both conferences and meetings of local interest groups. This scientific data can be used to establish a successful lake recovery and management plan and serve as a model for other systems in the Lake Simcoe watershed and other regions.

Recommendation:

- 20. Conduct a rapid paleolimnological study on the lake to determine the background environmental conditions of Musselman's Lake before nutrients became a problem.**

5.3 Aquatic Habitat

Fisheries

A detailed sampling program should be undertaken in Musselman's Lake in order to better understand its aquatic community. Trap and seine nets in conjunction with minnow traps would give a better representation of the fishery in Musselman's Lake.

At this time there is not enough information to make a judgment on the health of the fishery in the lake, but regular sampling will initially establish a baseline and then allow fisheries biologists to monitor changes in the community over time and will feed into decision making on how to best manage the aquatic community. This sampling should be completed between July 1st and September 15th of any year to avoid sensitive spawning seasons.

Shoreline owners should be encouraged to move towards naturalized shorelines around the lake. Native vegetation, both in and out of the water and along the shoreline, promotes nutrient uptake and filters surface runoff before it enters the lake. Shorelines of natural granite boulders and shrubs and trees not only provide habitat for fish but they prevent shoreline erosion and filter surface runoff.

Fish habitat should be created with bioengineered structures in the lake. Rocks, root wads and log structures can be placed or constructed in offshore areas to create artificial shoals, which can then be used by several species for feeding, resting and spawning. These can be located deep enough in the lake as not to cause navigation issues.

Recommendations:

- 21. Undertake trap net, seine net and minnow trap studies to provide a better representation of the fish species that inhabit Musselman's Lake.**
- 22. Shorelines should be naturalized around the lake.**
- 23. Fish habitat with bioengineered structures should be installed.**
- 24. Conduct inventories to identify specific areas that contain critical fish habitat (Type 1) and reduce disturbance of these areas.**
- 25. Continue to conduct inventories or creel surveys to determine the presence or absence of invasive species.**
- 26. Establish awareness program to prevent the spread of invasive species (i.e. not dumping bait buckets, not releasing unwanted pets, transferring boats, etc.) www.invadingsecies.com**

Benthic Invertebrates

An initial survey should be completed using the Ontario Benthic Biomonitoring Network (OBBN) Protocol for lakes. This will give us some baseline data on the health of the lake. Further monitoring could be completed on a yearly basis to see how the completed stewardship projects around the lake are affecting the benthic invertebrate community.

This monitoring can be conducted at any time during the year. However, it would be easiest to take the samples in the winter through the ice. Samples should be taken at the same time each year for comparability.

Recommendations:

- 27. Yearly benthic invertebrate monitoring will be completed to obtain baseline data on the health of the lake.**
- 28. Volunteers could help inventory benthic invertebrates.**

5.4 Terrestrial habitat

Monitoring

It is clear that human activities are having a significant impact on the health and quality of the Musselman's Lake ecosystem through population growth and land use change. By measuring or quantifying the value to

communities, we can more accurately account for land use changes which thereby help to inform land use and other decisions related to altering the landscape.

Recommendations:

- 29. Conduct breeding bird surveys and winter bird surveys to attain a base line condition from which to detect change in the landscape.**
- 30. Continue the Marsh Monitoring protocols and expand into the two PSW's as well as around the lake itself.**
- 31. Tree and flora inventories to document the health and structure of the upland forests; this again can be used as a resource for future planting plan lists, restoration plans, as well as gauging change.**
- 32. There is a lack of information on the presence and extent of species at risk in the subwatershed, including endangered and threatened species. It is recommended that further studies be conducted in the subwatershed to determine the location and extent of any species at risk and incorporate their habitat into the Natural Heritage System.**
<http://www.on.ec.gc.ca/wildlife/sar/sar-e.html>
- 33. There needs to be a communication program around invasive species.**

Policy Implementation

The Natural Heritage System (NHS) for the Lake Simcoe Watershed, 2007, was developed as a tool to identify lands of ecological value within the watershed and to provide guidelines for their protection.

Recommendation:

- 34. Incorporation of the NHS into municipal official plans, secondary plans, subwatershed plans, policies, etc. While the NHS is a useful tool for the LSRCA plan review, the greatest protection for the natural heritage comes through incorporation of this system into Official Plans.**
- 35. Municipality to circulate major development proposals or land use changes that require amendments to the Official Plan and Zoning Bylaws to the residents of Musselman's Lake so that they may provide comments in a timely fashion.**

Woodlands

Woodland habitat fragmentation is occurring at an increasing rate throughout the Lake Simcoe watershed and has a significant impact on biological diversity, primarily through two results: isolation and edge effects. This type of fragmentation occurs when large, continuous forest cover is divided into smaller blocks usually by encroachment of development. The Natural Heritage System identifies large woodlands as critical features for the health of the watershed and recommends that any new development in these areas not cause the removal of woodland, nor encroach upon woodland. However, where existing lots of record occur, that are designated for development (e.g., 'rural'), landowners may be technically able to develop a single residence.

Recommendation:

- 36. Must ensure that municipal policy incorporates NHS so that development applications are required in accordance with the Planning Act and the Provincial Policy Statement. All development in ecologically sensitive areas should be subject to site plan control.**

Natural Capital Incorporation

The provincial government, associated municipal governments and the conservation authority should examine creating an integrated natural capital account system for the entire Lake Simcoe watershed. Such accounts would document the quantity and quality of land, ecosystems and natural resources consistently over time. This information would assist in making decisions about development and permitted land uses.

Recommendation:

- 37. It is recommended that the municipalities in the subwatershed consider integration of ecosystem goods and services and their value into the development of growth strategies and as part of their land use planning and policy development decision making.**

Restoration

Terrestrial natural heritage features are important components of the Musselman's Lake subwatershed health, as they provide habitat for many species. Terrestrial habitat requires protection, restoration, and/or enhancement to mitigate the impacts of our changing land use.

Recommendations:

- 38. Areas should be identified for restoration, enhancement and securement opportunities. These opportunities should be prioritized and a plan to undertake these activities should be developed. This will include the identification of potential opportunities for woodland and wetland areas, as well as areas where landscape connectivity should be protected, restored or created.**
- 39. Planting plans should be developed to further enhance the urban and agricultural riparian areas.**

5.5 Best Management Practices

Best Management Practices (BMP's) are stewardship practices that can be implemented within urban and rural settings. They are environmental projects that will improve ground and surface water quality and quantity or enhance terrestrial and aquatic wildlife habitat. These BMP's could be completed on private or public property.

Most BMP's have technical and/or financial assistance available. Please see Section 6.3 for more details.

Land Ownership

Land ownership needs to be addressed within the Musselman's Lake subwatershed. The area has a long complicated history surrounding land ownership. There needs to be a document produced that shows each property and the current owner so that BMP's can be completed on private property. To complete stewardship projects on willing private land, we need documentation proving ownership.

Recommendation:

- 40. Determine who owns the land under Musselman's Lake.**
- 41. Detailed parcel mapping is required to ensure land ownership in the Musselman's Lake subwatershed is addressed.**
- 42. A general mailing list of names and addresses should be created and updated so that communication resources and other information may be mailed to everyone in the subwatershed.**

Septic Systems and Holding Tanks

Septic systems and holding tanks are particularly common on rural and cottage properties. Therefore, it is very important for residents near a waterbody to have a strong knowledge of them. Properties, which tend to have wetter soils, can pose extra challenges for these systems. Soil conditions can make systems less efficient in treating wastewater and allow harmful pollutants to get into the surface or ground water. Residents need to pay particular attention to their system. It is in your best interest to maintain your system. If you do not, you risk contaminating Musselman's Lake and, ultimately, your family's health.

The use of holding tanks has been brought up as a concern by the residents of Musselman's Lake. Holding tanks are permitted and section 8.8 of the Ontario Building Code outlines when a holding tank is permitted versus a septic system. In general terms, holding tanks are allowed when they are a temporary measure, a current septic system is unsafe, the lot size is too small, site slope is unsafe or clearance limitations do not allow any other system. Please see the Ontario Building Code for the full details.

There has also been consultation over the proposed changes to the Ontario's Building Code for septic system re-inspections. A number of changes to the Ontario Building Code have been proposed, with the intent of enhancing fire safety and water quality. One of these changes is the new administrative requirements to support the enforcement of the maintenance (re-inspection) and operation of existing private septic systems. Requirements for septic system inspection are being carried out in support of the Clean Water Act (CWA) 2006 and Justine Dennis O'Connor's Walkerton Inquiry recommendations which were that drinking water should be protected at its source through a coordinated planning process. Faulty and poorly maintained septic systems were identified as potential threats to drinking water. Amendments are also proposed to establish technical regulatory requirements for area beds, soil absorption systems used in conjunction with septic systems that offer tertiary treatment. The new standards will regulate area bed footprint size, sizing of stone and sand layers and when imported fill must be used, type of sand used, proper effluent distribution and maintenance and testing. While these requirements were proposed to come into effect January 1st, 2009, amendments have not been received to date from the Ministry of Municipal Affairs and Housing (MMAH).

Recommendation:

- 43. Septic re-inspection program be in place to ensure all of Musselman's Lake Septic systems and holding tanks are maintained. Faulty or malfunctioning systems should be upgraded to protect groundwater and surface water. Try to find additional funding to cover the expense of upgrading faulty septics. www.townofws.com or www.lsrca.on.ca**
- 44. Create and implement a communication plan to educate residents about maintaining septic systems, which could include awareness of impacts, maintenance tips, when to upgrade your system and where to obtain funding. Information could be provided through mailouts, websites, news releases, posters and other approaches to be identified in the implementation plan.**
- 45. Prepare a welcome wagon package of information about the lake and links to additional information and provide to new residents in the subwatershed.**

Tree and Shrub Planting

Forested areas provide environmental, social and economic benefits, such as protection of air, water and soil, improves wildlife habitat, recreation and the sustainable harvest of woodland products. Waterbodies, if sufficiently buffered by vegetation provide shade, shelter, food to the aquatic ecosystem and linkages between natural heritage features.

Trees are the natural filters of the air we breathe and the water we drink. They are home to countless animals. They help to combat greenhouse effects and provide buffers along watercourses and shorelines. The tree cover within the Musselman's Lake's subwatershed is relatively healthy but there is always room for improvement.

Recommendation:

- 46. Musselman's Lake subwatershed needs to work towards York Regions 25% forest cover guideline. Planting projects have already occurred within the Musselman's Lake subwatershed, but more native trees, shrubs and wildflowers need to plant.**
- 47. Information about tree and shrub planting should be provided through a communication plan to make everyone aware about the importance of this activity. Information could be provided through mailouts, websites, news releases, posters and other approaches to be identified in the implementation plan.**
- 48. Priority areas should be identified (public and private) on a volunteer basis and community programs organized to engage people to participate in a tree planting events.**
- 49. Wetland buffer zones (minimum vegetation protection zones) be strictly enforced as 'no encroachment areas' and instead, be further planted and made more robust (as per the intent of the Oak Ridges Moraine Conservation Plan).**

Erosion Control

Bank stability is an active process and while erosion is natural part of this process, changes in land use can accelerate the rate of erosion. Erosion along watercourses and shorelines causes sediment and nutrients to enter the water and causes a decline in the quality of the water and habitat.

The erosion can be stabilized using bioengineering techniques, which use natural materials to stabilize banks. Slope stabilization can be accomplished using a combination of live cuttings, other native trees and shrubs and riverstone. These living structures have an inherent ability to become stronger with time as they will adjust or self repair in response to change on the site. Growth of the bioengineered material forms a healthy, natural groundcover of native plants, creating conditions favorable to the establishment of other native plant species and wildlife habitat.

Recommendation:

- 50. Portions of the Musselman's Lake shoreline should be stabilized using bioengineering techniques to naturalize the shoreline. This will reduce sedimentation, stormwater runoff and nutrients entering Musselman's Lake. There will be a need to prioritize areas and establish partnerships.**
- 51. Establish landowner contact program to work with shoreline property owners and provide information about maintaining natural shorelines. Establish a program to assist property owners with funding and information. www.lsrca.on.ca**

Agricultural practices

There are a number of water quality issues that are associated with agriculture. Runoff from pasture and cropland can contain high levels of nutrients, sediment and bacteria; and wind can erode topsoil with its associated contaminants. All of these substances can end up in local watercourses if the appropriate Best Management Practices (BMP's) are not implemented. BMP's are designed to enhance the sustainability of agricultural resources and minimize the impact to the environment. The agricultural BMP's will focus on reducing the inputs of chemicals, fertilizers, manure, pesticides and sediment, as well as limiting the amount of nutrients and sediment entering surface and ground water.

Recommendation:

- 52. Information about agricultural BMP's should be provided to farms within the Musselman's Lake subwatershed. These BMP's can include conservation tillage, cover cropping, maintaining vegetated buffers in riparian areas along watercourses, cattle fencing, managing manure, decommissioning unused wells and the appropriate use of fertilizers and pesticides.**
- 53. Farmers should also consider completing an Environmental Farm Plan. www.omafra.gov.on.ca**

Street Sweeping

Street sweeping is practiced in the Town of Whitchurch-Stouffville within this subwatershed. Street sweeping involves mechanically removing dirt and debris from streets and parking lot surfaces, thereby reducing the amount of pollutant available to be washed into area watercourses during rain or snow melt events. While the effectiveness of street sweeping for pollutant removal is thought to be relatively low compared to other accepted stormwater BMPs (the estimated removal rate from a recent Environment Canada study is 10 – 30 grams per curb kilometre [Rochfort et al., 2007]). However, this method does have the benefit from a water quality perspective in that it can be undertaken in areas where structural stormwater controls do not exist. Therefore, efforts to target additional street sweeping programs specifically within these uncontrolled areas will result in more effective water quality control. Targeted street sweeping in uncontrolled urban areas would result in a phosphorus reduction but depends on the removal rate.

The Town of Whitchurch-Stouffville currently undertakes street sweeping once a year, before the spring thaw. The catch basins are cleaned out once a year, prior to the Region of York larviciding for West Nile Virus.

Recommendation:

- 54. Obtain information on current street sweeping practices (exact timing, location, cost) within the Musselman's Lake subwatershed.**
- 55. Should look into increasing street sweeping within any uncontrolled urban areas in order to reduce nutrient and sediment inputs.**
- 56. Consideration should also be taken to cleaning catch basins on a regular basis.**

Rainwater Harvesting

Humans are wasteful in regard to water. For example, the use of potable water for flushing toilets, irrigating lawns and washing cars is a waste of a valuable resource. One method of reducing this use of water is rainwater harvesting, which involves the collection and storage of rainwater, usually from rooftops and other hard impermeable surfaces. The water can then be stored in tanks and used for non-potable uses such as watering plants, irrigating lawns and flushing toilets.

In addition to the conservation of potable water, the benefits of rainwater harvesting include reducing pollution from stormwater runoff and flood control. Collecting and storing stormwater decreases the volume and rate of runoff, which reduces the potential for the runoff to pick up pollution, as well as reducing the risk of flooding.

Under their Water for Tomorrow program, designed to promote water conservation, York Region offers rain barrels at a reduced price. While the widespread use of this practice, combined with downspout disconnection and other water conservation measures, will reduce the demand for water at peak times and reduce the potential for stormwater related issues, a more aggressive and targeted approach is recommended to achieve significant improvements for the purpose of stormwater management.

There are some concerns with large scale water harvesting, particularly with cost, maintenance and public acceptance. Another concern is the potential harmful impact of these large-scale takings on baseflow and maintaining environmental flows to surface waters. Concerns with large scale water harvesting can be mitigated by conducting a proper water balance for the affected site to ensure that there is adequate water to support baseflow.

Recommendation:

- 57. Musselman's Lake residents should request a free presentation and site visit from York Region's Water for Tomorrow program. The Water for Tomorrow representative could recommend water conservation opportunities on each property specifically. This could include using rain barrels, planting water efficient plants and grass, reducing water use and many others. www.waterfortomorrow.com**
- 58. A communication plan should be prepared to provide this information to all people in the subwatershed. Information could be provided through mailouts, websites, news releases, posters and other approaches to be identified in the implementation plan.**

Ditches/Grassed Swales

In the past, subdivisions were not built with curbs and gutters which connected to storm sewers, but simple ditches to convey water away from roads and homes. Ditches have a number of benefits over curb and gutter systems. They are much less expensive to construct, reduce the size requirements for stormwater management facilities, allow water to infiltrate into the ground and provide some snow storage during the winter months. The main drawbacks of ditches are that they use more space and are not as easy to maintain as curb and gutters.

The use of ditches and grassed swales are now making a comeback as resource managers and planners have realized the environmental benefits. Ditches and grassed swales have been estimated to remove 30% of the phosphorus, 70% of the suspended solids and greater than 50% of certain metals and hydrocarbons contained in urban runoff (Low Impact Development Center, 2003 <http://www.lowimpactdevelopment.org/>).

When grassed swales and ditches are combined with bioretention facilities or infiltration galleries, there can be a greater benefit to water quality and quantity. These areas require more routine maintenance than do curb and gutter systems and are therefore more costly, but the planting of native grasses, shrubs and trees can also be undertaken to add aesthetic value and can significantly improve the public's acceptance of these features.

Recommendation:

- 59. Complete a survey of areas which could be enhanced with grass swales or infiltration areas and determine priority areas for rehabilitation.**
- 60. Implement new swales or infiltration areas where possible using a prioritized list.**
- 61. Establish a pilot project on a priority area.**
- 62. Contact property owners and provide information about establishing and maintaining drainage ditches and swales on private lands. Information could be provided through mailouts, websites, news releases, posters and other approaches to be identified in the implementation plan.**

Roof Top Storage/Green Roofs

The concept is to reduce the amount of runoff and subsequent pollution resulting from a building/structure. Green roofs have been described as the creation of a contained green space on a roof for the purpose of improving water quantity and quality control. Green roofs are constructed by first placing an impermeable membrane on the roof top followed by a drainage medium and soil. The roofs are then planted with a variety of ground covers. Research conducted into green roofs has documented that there are additional benefits associated with their construction. These include reduced energy consumption and cost, improved air quality and a reduction in the urban heat island effect.

Recommendation:

63. Provide information to Musselman's Lake community members about creating green roofs on their residences. This will not be possible on all roofs but could be a great addition to homes that have that ability.

Soakaway Pits, Infiltration Galleries and Permeable Pavement

These BMPs, while different, have a common objective – to reduce surface water runoff by infiltrating water back into the ground. They are more useful for quantity control, reducing peak runoff and flooding and maintaining the water balance. There is also a benefit to water quality, by reducing the volume of runoff, the BMP's minimize water contamination.

Soakaway pits are the smallest and least expensive of these BMPs. They are designed to control roof top runoff from smaller buildings. They should be located well away from building foundation drains and require well-drained soils. They are sized according to the amount of roof runoff they will receive – a typical soakaway pit is 4-5 ft square, 3-4 ft deep and can be covered in grass or stone. This is one of the few BMPs that a homeowner can install, with resources for their construction easily accessible on the Internet.

Infiltration galleries can include trenches, chambers and large basins. They are generally designed to control larger volumes of runoff and are often twinned with some form of sediment control when involved with treating parking lot runoff. This ensures that they do not become plugged and increases their operational lifetime.

Permeable pavement is another option for reducing runoff through infiltration, particularly from parking lots, which can generate large volumes of runoff. Forms of permeable pavement include porous pavement, cement pavers and other turf grass pavers. While there are obvious benefits to reduce runoff and prevent flooding and erosion problems, there can be concern over potential groundwater contamination from the oils, metals and other contaminants that accumulate on pavement.

Recommendation:

- 64. To reduce surface water runoff areas in the subwatershed by infiltrating water back into the ground. A list of locations where infiltrating water using soakaway pits, infiltration galleries and permeable pavement should be produced and then implemented.**
- 65. Provide information to Musselman's Lake community members about creating and maintaining soakaway pits, infiltration galleries and permeable pavement on their properties or in the subwatershed.**

Oil Grit/Hydrodynamic Separators

A typical oil/grit separator (OGS) operates by settling sediments and large debris out of stormwater runoff and ultimately separating oils from the water. The units generally consist of 3-4 chambers, each designed for a specific function. The first chamber, referred to as the Grit Chamber, settles coarse sediment and large debris by slowing the flow of the water and screening larger debris with a trash rack. From there, the stormwater moves to the second chamber, the oil chamber, which traps and separates surface oils and grease from the stormwater runoff. This separation occurs because oil is lighter than water and floats on the surface. The discharge pipe is located near the bottom of the chamber, allowing the oil to pool on the surface and be contained. The third chamber houses the stormwater outlet pipe that discharges the overflow to the storm drain system.

These systems are effective at removing oil and sediment, but their capacity for phosphorus and other nutrient removal is low. Therefore, they should be used in combination with other stormwater practices. Another important consideration is maintenance – their efficiency is dependent upon regular maintenance. This involves cleaning them out at least twice per year and as necessary after major storm events. The maintenance costs can be high because they can contain hazardous materials which need to be safely disposed.

Some manufacturers have tried to increase the effectiveness of OGS for removing particulate and oil as well as additional contaminants such as phosphorus. An example of this is Imbrium Systems Incorporated's Jellyfish System. Systems such as this should be explored through pilot projects in this subwatershed.

Recommendation:

- 66. Locations should be identified where oil grit separators could be installed to reduce the amount of oil and sediment entering Musselman's Lake.**
- 67. Implement a pilot project in a priority area which will be identified during the implementation phase.**

Road Salt

Road salt has become an increasingly important issue as the urban areas of the Lake Simcoe watershed expand. The Canadian Environmental Protection Act defined road salt containing chloride salts as toxic under the Act (Environment Canada, 2001). Analysis of surface water quality throughout the Lake Simcoe watershed shows an increasing trend in chloride concentrations (see water quality section). While chloride concentrations in Musselman's Lake are not yet near the Canadian Environmental Protection Agency (CEPA) guideline of 210mg/L they have shown an increase of 72.5% over the last 25 years.

The use, storage and application of road salt as well as disposal of snow should be conducted in accordance with the Code of Practice for the Environmental Management of Road Salts (Environment Canada, 2004). To reduce the area of roads requiring salt during the winter and to limit the amount of impervious area, municipalities should also explore the feasibility of varying road widths – narrower streets could be used on less traveled routes to reduce impervious area, rather than simply using a standard width. Alternatives to the use of road salt should also be explored by both the municipality or road authority and private landowners. These measures would help slow the concentration of chloride in the lake waters and hopefully prevent concentrations from ever reaching 210mg/L.

Road maintenance on 9th line and the local road around Musselman's Lake are maintained by the Town of Whitchurch-Stouffville. 9th line from Aurora Road to Bloomington Road is under the jurisdiction of the Region of York. However, under a cost recovery agreement the Town of Whitchurch-Stouffville carries out winter maintenance on York Region's behalf. Region of York has implemented a Salt Management Plan that includes storage and application procedures for winter de-icing. The winter maintenance trucks use electronic spreader controls that can control the amount of material applied to roadways. They have GPS systems to track the location of vehicles and they have pre-calculated routes with set application rates. The plan is available on York Region's website www.york.ca

The Town of Whitchurch-Stouffville on behalf of York region applies road salt at a mixture of 20% salt and 80% sand. Only under extenuating circumstances, such as severe freezing rain conditions, is salt applied on its own.

Recommendation:

- 68. The road authority and private landowners should explore alternatives to salt that is being used on roads, driveways and other impervious surfaces. How the Town of Whitchurch-Stouffville and York Region are applying their road salt should be explored to ensure the application process is environmentally friendly in this sensitive area.**
- 69. Street cleaning should occur in the environmental sensitive areas first.**
- 70. Research whether water softeners and chlorinated water could be a cause of an increase in the chloride and ammonia levels.**
- 71. Provide information to property owners about the harmful impacts of salt and provide feasible alternatives. Information could be provided through mailouts, websites, news releases, posters and other approaches to be identified in the implementation plan.**

6.0 Implementation

6.1 Implementation Strategy

The Musselman's Lake implementation group will be made up of residents, the LSRCA and the Town of Whitchurch-Stouffville. The implementation group will create an implementation plan that will guide stewardship opportunities. These stewardship activities, which are discussed under the section Recommendations 6.0, include education, communications, restoration and monitoring. The tools and resources that are available to take action to promote and ensure a healthy and sustainable Musselman's Lake subwatershed will be discussed during this phase.

6.2 Defining roles and Responsibilities

The PST, upon completion of the Stewardship Opportunities Report, will establish an implementation group comprised of residents, LSRCA staff, Town of Whitchurch-Stouffville and other agencies as required. The implementation group will be responsible to confirm, prioritize and implement the recommendations in the Stewardship Opportunities Report that will promote and ensure a healthy subwatershed.

6.3 Funding

There are many organizations within the Musselman's Lake subwatershed that can assist technically or financially throughout the implementation phase. Below are some of the technical or financial assistance programs available in the subwatershed. This is not a complete list of funding programs as they are changing constantly. This list is accurate as of January 2009 and you should confirm with the organization directly to gain detailed information and ensure the program is still active.

LSRCA- Landowner Environmental Assistance Program (LEAP)

LEAP is a financial and technical assistance program for landowners within the Lake Simcoe watershed. The financial assistance ranges from 50% to 100%. Musselman's Lake is within the East Holland River subwatershed and is therefore part of the East Holland Clean Up. The East Holland River Clean up is a campaign through the Lake Simcoe Conservation Foundation and they apply a 25% top-up to all stewardship projects within the subwatershed. LEAP is to help ensure we have safe drinking water, a healthy aquatic ecosystem, increased recreational opportunities and sustainable agricultural operations. The programs include environmental farm enhancements, upgrading septic systems, decommissioning unused wells, improving streams and retrofitting on-line ponds, planting native trees and shrubs, diverting runoff from sources of contamination, enhancing wildlife habitat and upgrading stormwater management ponds. www.lsrca.on.ca

York Region – York Natural Planting Partnership (YNPP) and Water for Tomorrow

YNPP is a technical and financial assistance program established to further the York Region Greening Strategy by increasing forest cover and promoting private land stewardship. The aim of the partnership is to provide assistance to landowners to plant native trees and shrubs. www.lsrca.on.ca

Water for Tomorrow is a technical assistance program to educate York Region residents on water conservation. They provide a free site visit which could include general advice or solutions to specific problem areas that you may have with your lawn, garden and home. www.waterfortomorrow.com

Oak Ridges Moraine Foundation – Caring for the Moraine

Caring for the Moraine is a technical and financial assistance program that is a monumental collaboration of numerous environmental organizations that aims to conserve the important and sensitive environmental features of the Oak Ridges Moraine. www.moraineforallife.org

Windfall Ecology Centre

Windfall Ecology Centre focuses on community action that is informed by observation and participation at the global, national and provincial level. They have achieved results by mobilizing community cooperation and providing practical sustainability services and advice since 1998. They provide technical assistance through programs like Well Aware. The Well Aware program in York Region currently offers a comprehensive free information kit and a free on-site guided assessment of your well by trained Well Assessors.

www.windfallcentre.ca

Lake Simcoe Clean Up Fund (LSCUF)

The Lake Simcoe Clean-Up Fund is an Environment Canada initiative that will be used to support projects by federal, provincial and municipal governments, the conservation authority, non governmental and community organizations, land owners and Aboriginal communities. This will include projects with objectives such as:

- Reducing phosphorus inputs from rural and urban sources;
- Rehabilitating priority habitats to restore the health of the aquatic ecosystem and the coldwater fishery; and
- Improving scientific understanding of the lake for decision-making.

www.ec.gc.ca

6.4 Public Awareness

There are many programs and organizations mentioned above that provide technical assistance to landowners. The Musselman's Lake residents need to take advantage of these programs and initiate a broader public awareness campaign through forums, workshops and community stewardship events.

Through the Musselman's Lake resident survey there were examples of resident's lacking environmental awareness on specific subjects. (See Appendix C). The implementation group should prioritize the educational gaps and work towards ensuring the residents have all the available resources they require.

7.0 Management Policies and By-laws

Land use planning in the Musselman's Lake subwatershed is affected by legislation and policy enacted at the federal, provincial, regional and local levels. These acts and policies assist decision-makers in making sound planning decisions. The hierarchy of decision making ranges from the federal to the municipal government. Some of the primary policy tools are described below.

Federal Policy

The Fisheries Act

<http://www.dfo-mpo.gc.ca>

<http://laws.justice.gc.ca/en/showdoc/cs/F-14//en?page=1>

<http://www.ccg-gcc.gc.ca/eng/CCG/Home>

The Department of Fisheries and Oceans Canada (DFO) and its Special Operation Agency, the Canadian Coast Guard, deliver programs and services that support sustainable use and development of Canada's waterways and aquatic resources. The primary aims of the federal Fisheries Act are the management of the fisheries, the conservation of fish and their habitat and the prevention of pollution. The Federal Fisheries Act applies to all Canadian Fisheries Waters, including Musselman's Lake. In terms of planning, the Fisheries Act guides development proposals away from the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat.

Provincial Policy

The Planning Act

http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90p13_e.htm

The Planning Act regulates land use planning in Ontario and provides tools to control land use and sets out the powers of decision-making authorities.

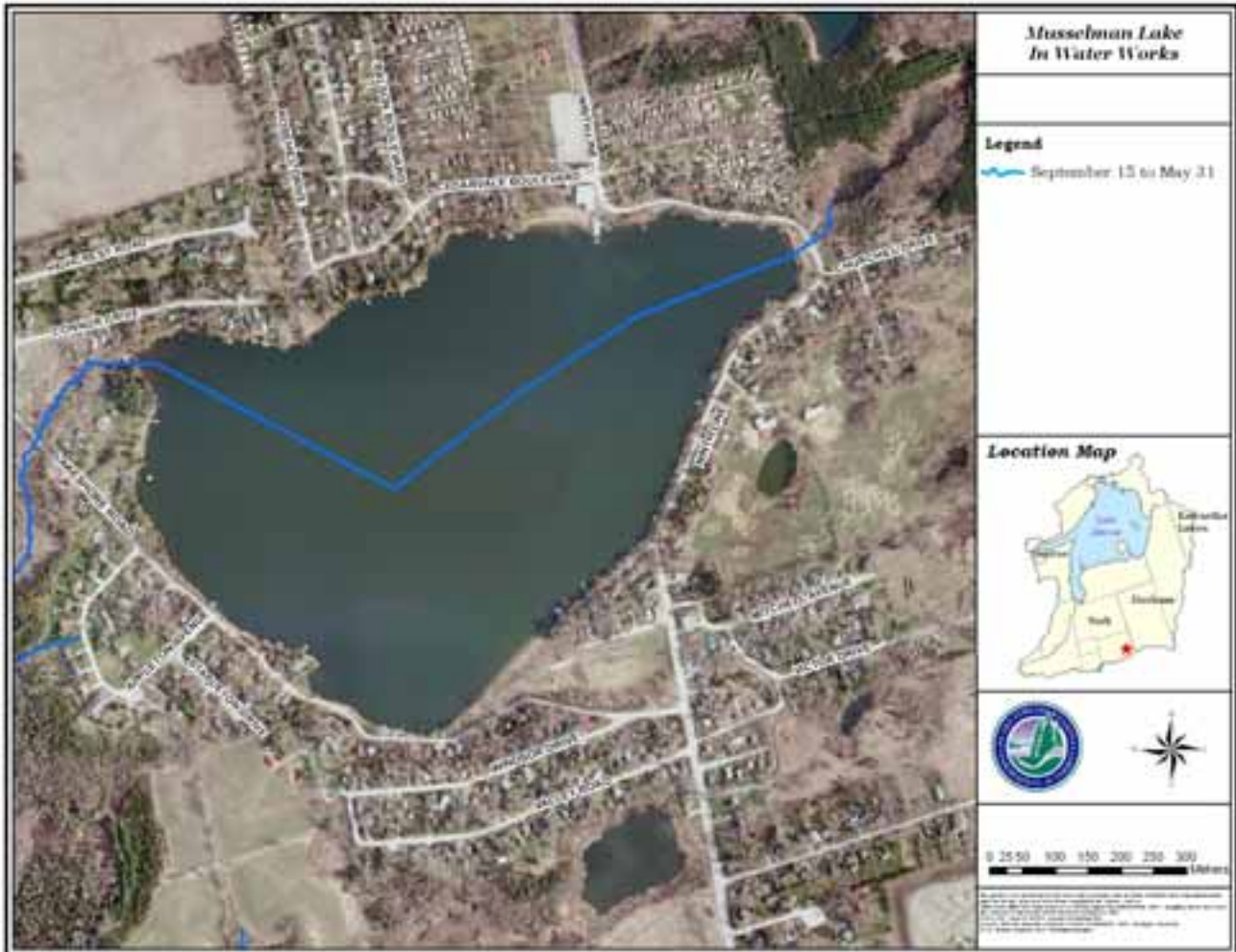
The Ontario Ministry of Natural Resources

<http://www.mnr.gov.on.ca/en/index.html>

The Ontario Ministry of Natural Resources (OMNR) is responsible for determining in-water works restrictions such that the most critical stages of fish and aquatic life are permitted to carry out their life processes undisturbed.

These restrictions are based on the presence of warm and cold-water fish communities as determined by contemporary thermal regime and fisheries studies (see Figure #17).

Figure 17: OMNR warm water in-water works timing restrictions within the Musselman's Lake subwatershed.



OMNR has the responsibility to provide advice and direction for implementation of the following three key pieces of provincial legislation:

- The Lakes and Rivers Improvement Act, which applies to the management, protection and preservation of the lakes and rivers of Ontario;
- The Conservation Authorities Act, empowering the 36 conservation authorities to establish and undertake programs designed to further conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals; and,
- The Public Lands Act, which applies to Crown land use planning, lands management, sales, development, etc.

The main federal law with respect to fishing is the Fisheries Act, which protects and conserves fish and fish habitat. The Fisheries Act also regulates such things as fishing seasons, catch and possession limits, size limits, allowable gear and fish sanctuaries.

The Fish and Wildlife Conservation Act is the main provincial law regulating fishing, hunting and trapping. This Act is enforced by Conservation Officers and Deputy Conservation Officers.

Licenses and Permits:

http://www.mnr.gov.on.ca/en/Business/Enforcement/2ColumnSubPage/STEL02_164550.html

The OMNR enforces 27 Acts and Regulations and administers 45 Acts and Regulations. These Laws and Regulations are in place to protect and preserve Ontario's natural resources. Ontario's Conservation Officers have powers of inspection, arrest, search and seizure under the various statutes they enforce.

OMNR Enforcement:

<http://www.mnr.gov.on.ca/en/Business/Enforcement/index.html>

FAQs:

<http://www.mnr.gov.on.ca/en/Business/Enforcement/FAQ/more/index.html>

Ministry of Environment (MOE)

<http://www.ene.gov.on.ca/en/water/index.php>

The Ministry of the Environment is responsible for protecting clean and safe air, land and water to ensure healthy communities, ecological protection and sustainable development for present and future generations of Ontarians.

The government's aim is to protect both our drinking water and our fresh water resources at large from pollution, whether it's from industrial sources, sewage systems, chemicals in use on farms, or any other source – even rainwater containing particulates from polluted air.

For information on Drinking Water Ontario-Whitchurch-Stouffville Area:

To report a spill or other environmental emergency, call the Spills Action Centre at 1-800-268-6060.

For reporting acts of pollution, contact the 24 hour public hotline at: 1-866-MOE-TIPS (1-866-663-8477).

moe.tips.moe@ontario.ca

The Provincial Policy Statement (PPS)

<http://www.mah.gov.on.ca/Page1485.aspx>

The Provincial Policy Statement (PPS) issued under the authority of Section 3 of the Planning Act came into effect on March 1, 2005. It contains clear, overall policy directions on matters of provincial interest related to land use planning and development. The PPS states that the decisions of Planning Authorities shall be consistent with the policies outlined in the PPS.

Section 2.1 of the PPS outlines the policies related to Natural Heritage and states that the diversity and connectivity of natural features in an area and the long-term ecological function and biodiversity of natural heritage systems should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features. For the purposes of the PPS, natural heritage features are defined as features and areas including; significant wetlands, significant coastal wetlands, fish habitat, significant woodlands south and east of the Canadian Shield, significant valleylands south and east of the Canadian Shield, significant habitat of endangered species and threatened species, significant wildlife habitat and significant areas of natural and scientific interest, which are important for their environmental and social values as a legacy of the natural landscapes of an area.

Figure 18: The natural heritage protection line from the Provincial Policy Statement.

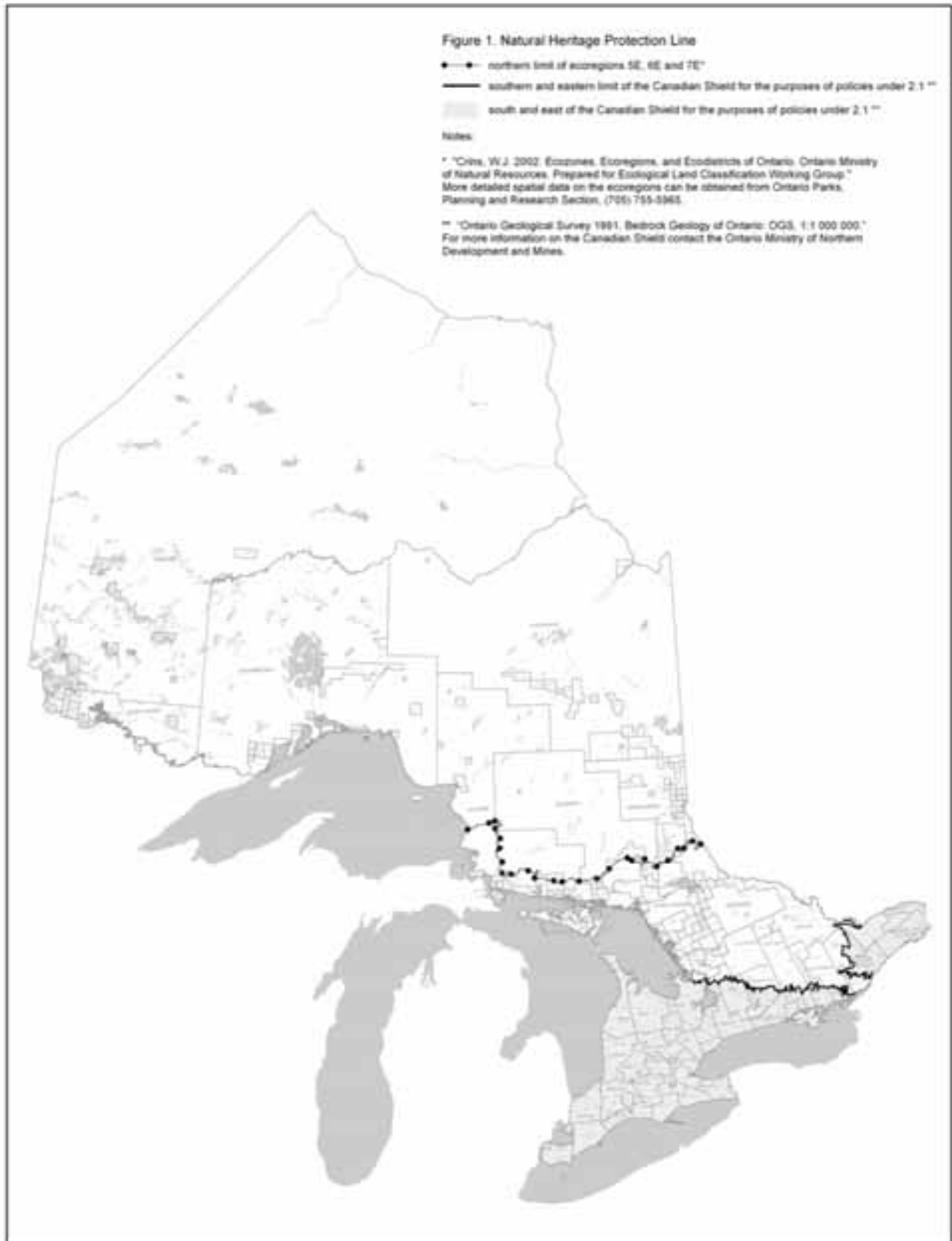
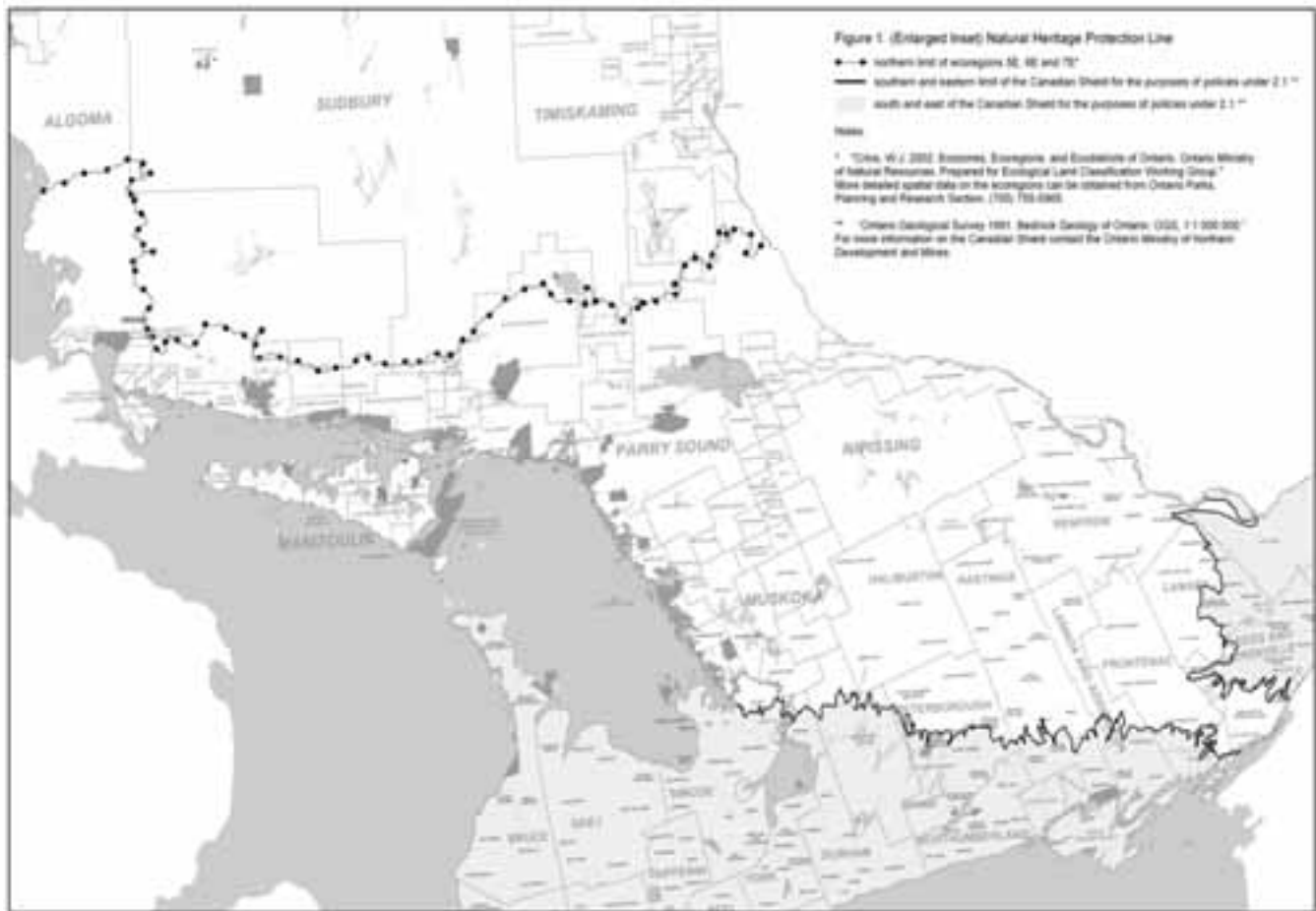


Figure 19: Natural Heritage Protection Line from the Provincial Policy Statement.

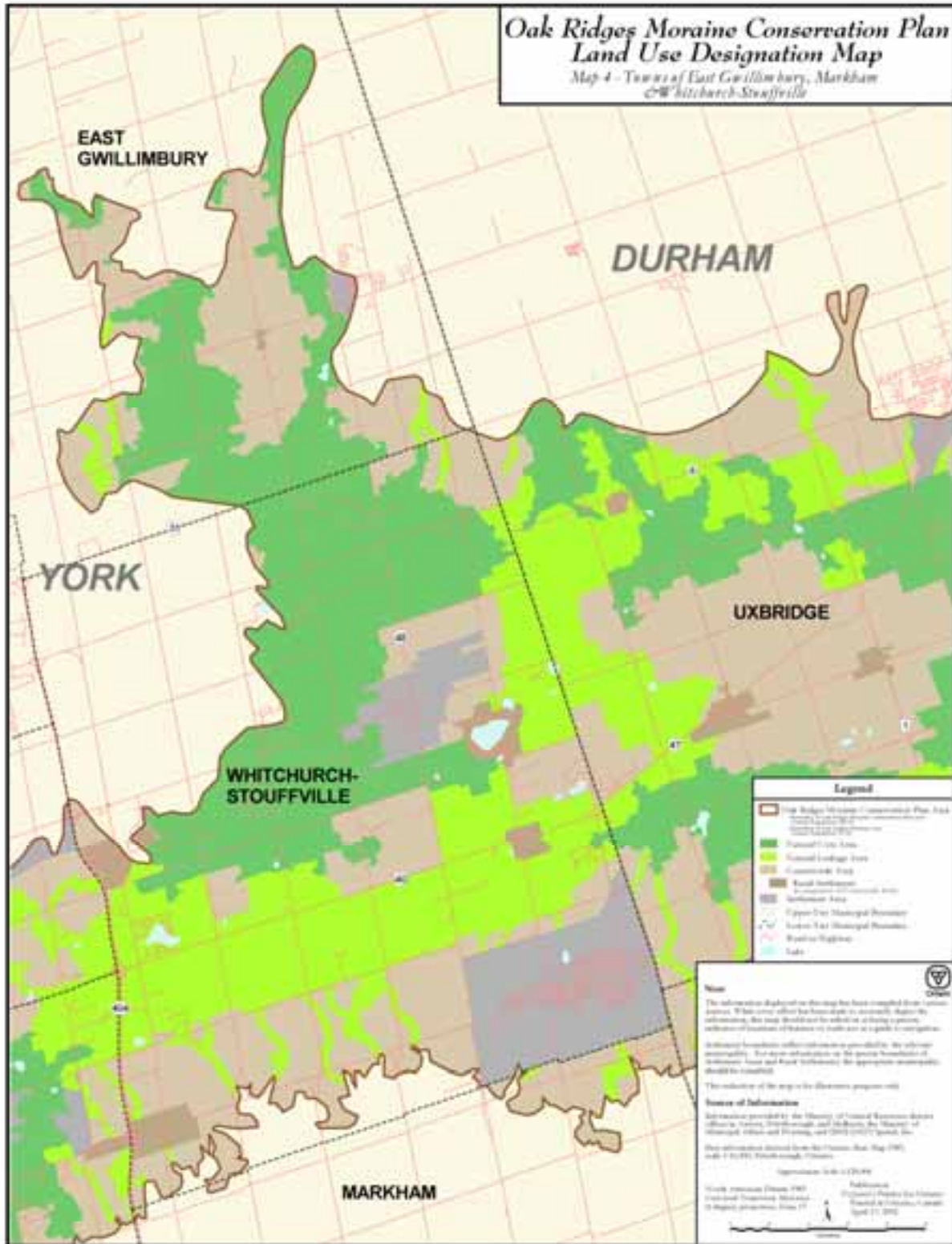


Oak Ridges Moraine Conservation Act and Plan

<http://www.mah.gov.on.ca/Page1707.aspx>

The Oak Ridges Moraine Conservation Act, 2001, was passed by Ontario Legislature in December 2001. This Act establishes a clear policy framework to provide planning direction on land use and resource management, to be implemented by municipalities. The Oak Ridges Moraine Conservation Plan (ORMCP) was subsequently established as a Regulation. The ORMCP provides land use and resource management direction to provincial ministries, agencies, municipalities, municipal planning authorities, landowners and other stakeholders on how to protect the ecological and hydrological features and functions of the ORM.

Figure 20: Oak Ridges Moraine Conservation Plan Land Use designation map.



The existing community of Musselman's Lake is identified as Rural Settlement within the Oak Ridges Moraine Conservation Plan. Rural Settlements are existing hamlets or similar small, generally long-established communities that are identified in official plans. The rural character of the Rural Settlements is intended to be maintained. Within the Musselman's Lake subwatershed, there are also areas identified as Natural Linkage and Natural Core. Both land use categories have the aim of maintaining and restoring the ecological integrity of the Plan area. The primary purpose of the Linkage area is to improve and protect linkages and corridors to the Natural Core areas.

The Musselman's Lake subwatershed contains multiple Key Natural Heritage Features (KNHF) as described by the ORMCP, including wetlands, fish habitat, Areas of Natural and Scientific Interest (ANSIs), significant woodlands and kettle lakes. ANSIs are locations that contain natural features that have been identified as being important to protect due to their natural heritage, education, or scientific study value. Most development within the KNHF or their minimum vegetation protection (vegetative buffers to the area) zone is prohibited in order to protect and restore the ecological and hydrological integrity of the area. Development may be permitted adjacent to the KNHF and their associated minimum vegetation protection zone buffers, provided that a natural heritage evaluation be completed. This evaluation must demonstrate that the proposed development or site alteration will have no adverse effects on the KNHF.

Parts of the Musselman's Lake community have also been identified as being part of a landform conservation area. These areas contain significant landform features including steep slopes, kettles, ravines and ridges. The purpose of the landform conservation areas is to limit disturbance to these important features.

Conservation Authorities Act

http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90c27_e.htm

Section 28 of the Conservation Authorities Act allows for the creation of regulations on development. In May 2006, the generic regulation was enacted, resulting in the LSRCA's Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. Under Ontario Regulation 179/06, the Lake Simcoe Region Conservation Authority has produced Watershed Development Policies, which provide specific guidelines for development in the watershed. The primary aims of the regulation are to address natural hazards such as flooding, dynamic beaches and erosion and natural heritage considerations, such as wetlands. The Musselman's Lake community contains many natural hazards including flood prone areas, steep slopes and areas prone to erosion. Moreover, the community contains multiple natural heritage features, including provincially significant wetlands, ANSIs and the lake itself. The LSRCA assists people in the development process to avoid or mitigate for these hazards and features.

Regional Policy

York Region Official Plan

www.york.ca

The Regional Official Plan is a resource used to manage growth and contains policies that help guide economic, environmental and development decisions. These policies help to guide more detailed planning by area municipalities.

Musselman's Lake subwatershed falls within the Agriculture and Rural Area, Forest Resource Areas, Oak Ridges Moraine Conservation Plan Area, Regional Greenlands System, ORM Aquifer Vulnerability and ORM Landform Conservation Area sections of the Regional Official Plan.

Within the Agriculture and Rural Area, the Community of Musselman's Lake falls within the Rural Policy Area. The main objective of the Rural Policy Area is to retain the rural character of the lands and to protect the viability of existing agricultural operations. The Rural Policy Area contains many areas of environmental significance, including the Oak Ridges Moraine. Development shall be limited in this area.

Forest Resource Areas of regional significance are to be protected and reforestation is to be encouraged to provide environmental, social and economic benefits to the residents of York Region. Development or site alteration within Significant Forested Lands and within the minimum vegetation protection zone is prohibited, except where it meets the applicable provisions of the Oak Ridges Moraine Conservation Plan. The objectives of the applicable policies are to encourage reforestation and to increase forest cover to a minimum of 25% of York's total land area.

The main objectives of the Oak Ridges Moraine Conservation Plan Area are to protect the ecological and hydrological integrity of the Oak Ridges Moraine; ensure that only land and resource uses that maintain, improve or restore the ecological and hydrological functions of the Moraine are permitted; ensure the ORM Area is maintained as a continuous natural landform; and provide for land and resource uses and development/site alteration that is compatible with the other objectives of the ORMCP, including providing for continued development within existing urban areas and hamlets.

Within the Regional Greenlands System, the Musselman's Lake subwatershed is within the Natural Core Area and Natural Linkage Area. The main objective of the Regional Greenlands System is to identify, protect and restore the Regional Greenlands System composed of natural areas and connecting links as an essential structural component of the region.

The Oak Ridges Moraine Aquifer Vulnerability Area refers to the shallow groundwater aquifer's susceptibility to contamination from both human and natural sources.

The regional objective of the Oak Ridges Moraine Landform Conservation Area is to encourage and support the conservation of significant landscapes, views and vistas. Any proposed development or site alteration in landform conservation areas (Category 1 and 2) shall be accompanied by the appropriate study as required by the ORMCP (Section 30).

York Region also has a private land Tree By-law. In 2005, the Region adopted a new Forest Conservation By-law. The new by-law requires the issuance of permits (good forestry practices, harvest permit and special permit) to restrict and regulate the destruction of trees on private lands.

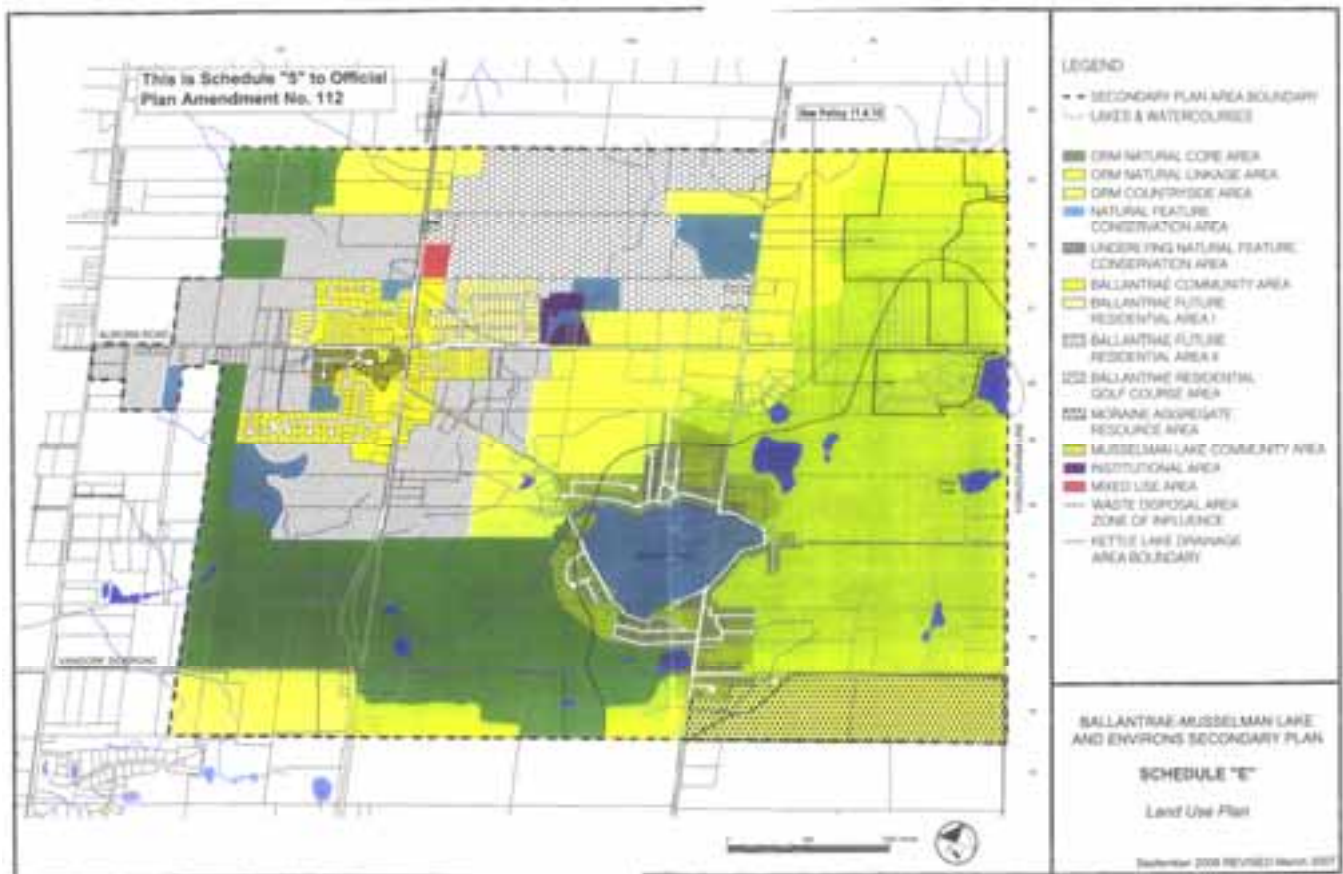
Municipal Policy – Town of Whitchurch-Stouffville

OPA 90-Ballantrae-Muskelman Lake and Environs Secondary Plan

OPA 112-Oak Ridges Moraine Conformity

The Ballantrae-Muskelman Lake and Environs Secondary Plan Area includes two small existing settlement areas, Ballantrae and Muskelman’s Lake, as well as the surrounding rural lands. Its location on the ORM and the number of significant environmental features it contains means that it is also an area of environmental sensitivity.

Figure 21: The map of the OPA No. 112 within Muskelman’s Lake subwatershed and surrounding area.



The Secondary Plan contains detailed goals, objectives, principles and policies for Musselman's Lake and the surrounding community.

Musselman's Lake itself is designated as Natural Feature Conservation Area, with the immediate surrounding residential area designated Musselman Lake Community Area. The Natural Feature Conservation Area designation identifies Areas of Natural and Scientific Interest (ANSIs), Wetlands, Kettle Lakes, Regional Forests, Environmentally Significant Areas (ESAs), as well as public parkland and undeveloped areas adjacent to kettle lakes. The purpose of the designation is to protect and enhance these key natural features. Its main principles include the protection of natural environmental systems and features and the restriction of additional development adjacent to the kettle lakes.

Other land use designations surrounding the community are ORM Countryside Area to the north of the Community Area, ORM Natural Linkage Area to the east, Moraine Aggregate Resource Area to the south and ORM Natural Core Area to the west and south-west.

The ORM Countryside Area designation provides an agricultural and rural transition and buffer between the Natural Core Areas and Natural Linkage Areas and the urbanized Settlement Areas. Prime agricultural areas and natural features are to be protected.

The ORM Natural Linkage Area designation recognizes areas identified in the Oak Ridges Moraine Conservation Plan as areas forming part of a central corridor system that support or have the potential to support the movement of plants and animals among the lands designated ORM Natural Core Area and Linkage Area, as well as river valleys and stream corridors.

The Moraine Aggregate Resource Area designation recognizes existing mineral aggregate operations in the Moraine Plan Area and may be zoned to permit the existing use in accordance with the provisions of the Moraine Plan.

The ORM Natural Core Area designation recognizes areas identified in the Oak Ridges Moraine Conservation Plan as areas with a high concentration of key natural heritage features, hydrologically sensitive features or landform conservation areas.

The Musselman's Lake Community Area recognizes existing development in the Musselman's Lake settlement area and prohibits new development. Redevelopment of existing developed areas and adjacent lands may be considered where the intention is to enhance natural features, improve water and sewer services and implement storm water management practices that reduce negative impacts or potentially enhance water quality in the kettle lakes.

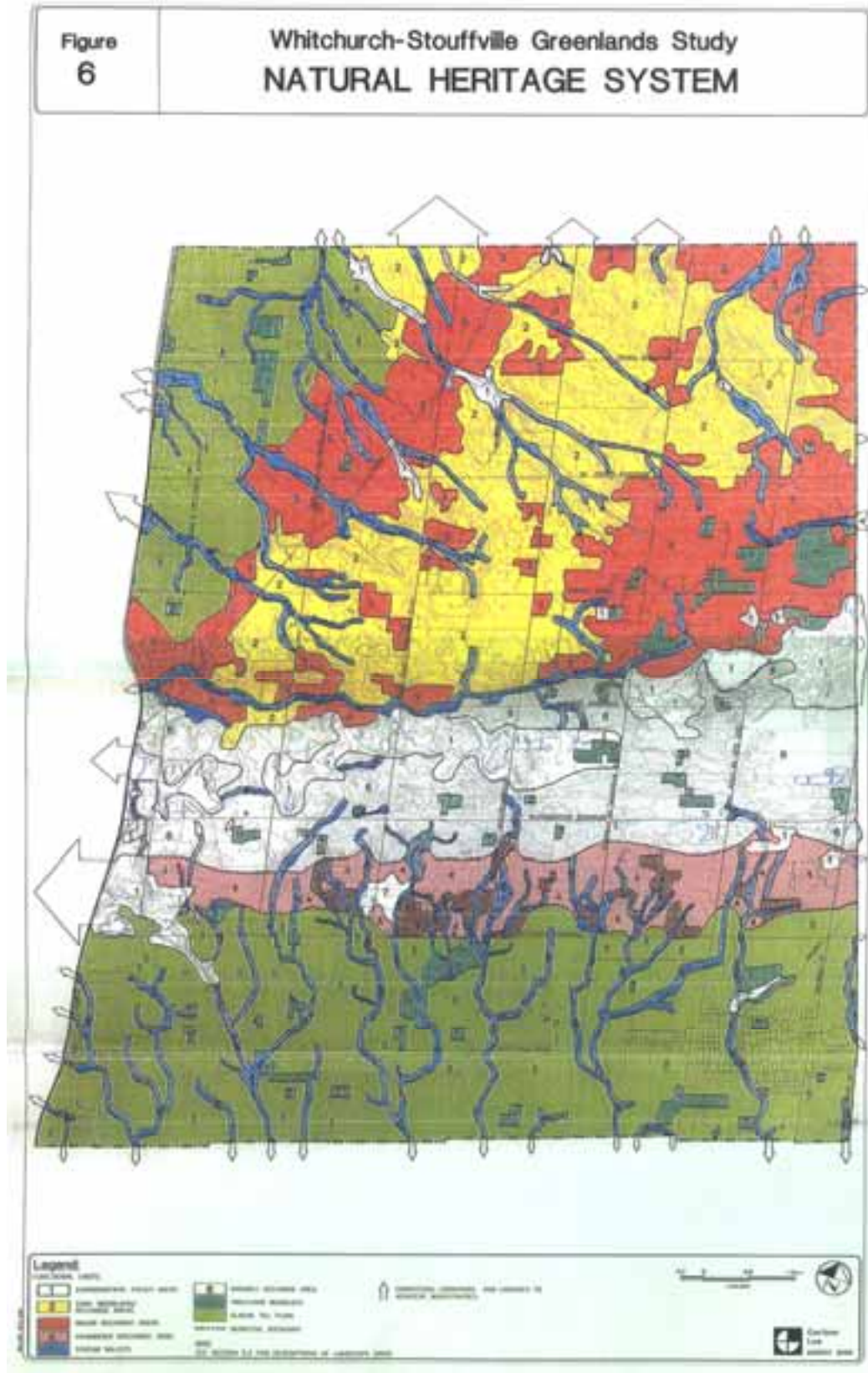
Natural Features and Greenlands Study

A Greenlands System represents natural areas that perform important ecological functions, contain significant attributes, and/or support linkages to other systems. The town's Greenlands Study provides a long-term vision for resource protection within the town. The Greenlands Study addresses Environmental Features and Fish Habitat, Forest Cover and Natural Heritage Systems within the Musselman's Lake subwatershed.

There are various Environmental Policy Features, including the Musselman Lake Complex (Provincial Life Science Area of Natural and Scientific Interest), the Musselman Lake Kettle Complex (PL-ANSI), East Musselman Lake Wetland Complex (PSW) and Musselman Lake Wetland Complex (PSW).

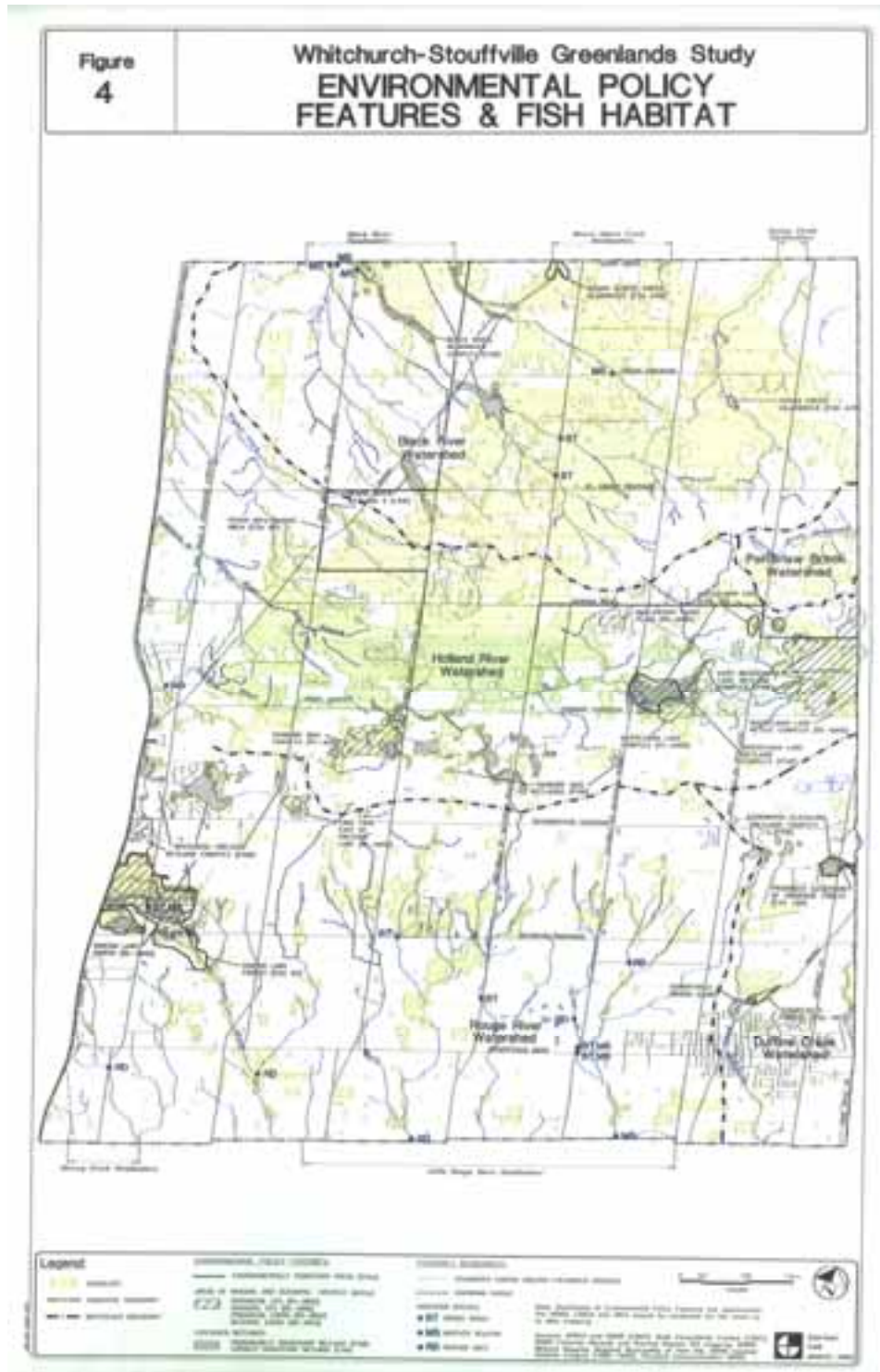
Within the Natural Heritage Systems, Musselman's Lake falls within the Environmental Policy Area, Major Recharge Area, Variable Recharge Area and Tableland Woodlots of the Study.

Figure 22: The natural heritage system in the Town of Whitchurch-Stouffville within the Greenlands Study.



Environmental Policy Areas contain a high level of environmental sensitivity, with types of development being restricted to conservation, enhancement and preservation of the natural environment, as well as limited outdoor recreational and educational activities.

Figure 23: Environmental policy areas within the Greenlands study

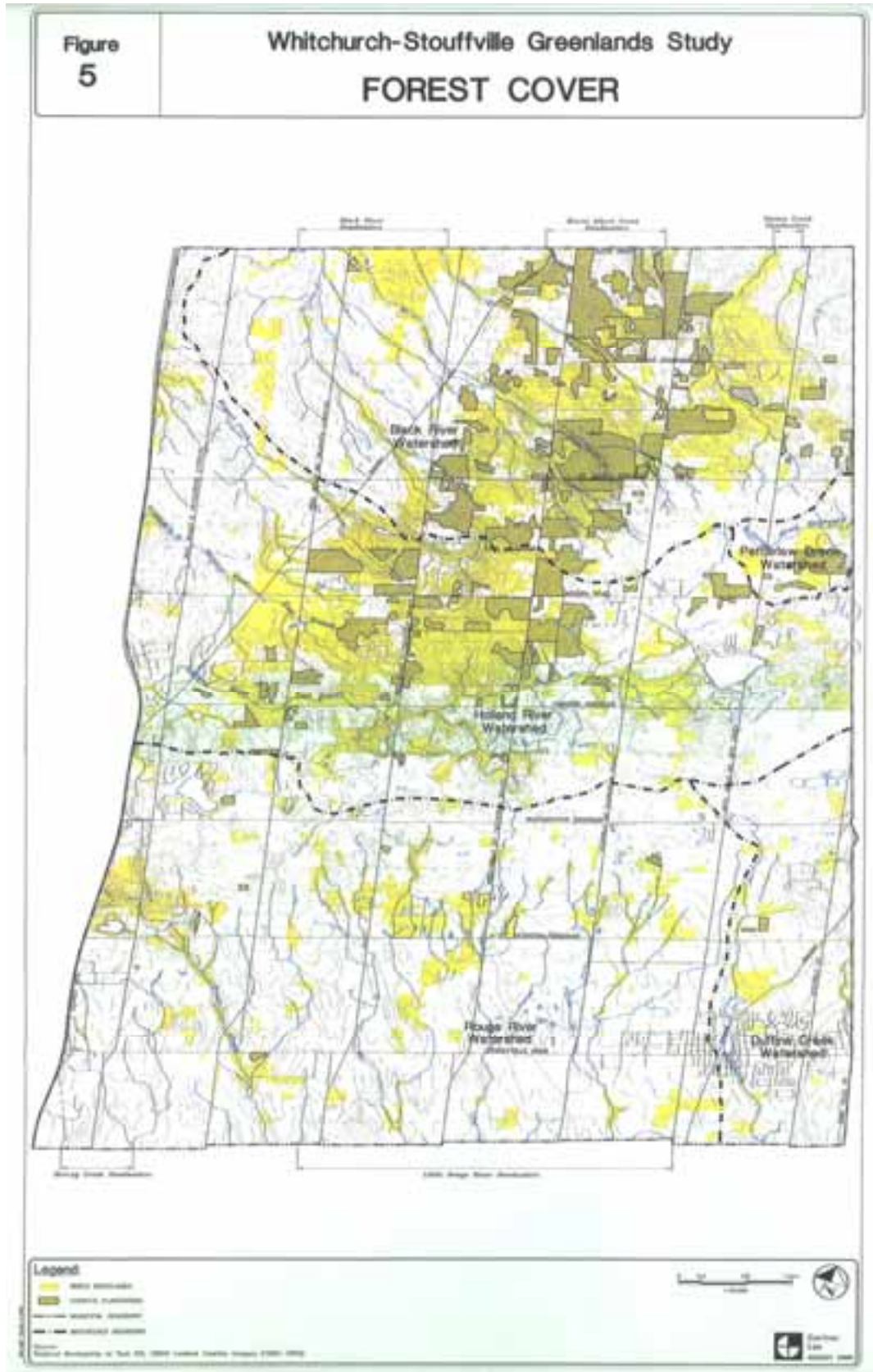


Major Recharge Areas occupy most of the northern half of the town and form part of the core recharge area of the Oak Ridges Moraine. Care must be taken to protect this environmental feature as it is exposed in some areas and the groundwater is highly susceptible to contamination.

Variable Recharge Areas form a broad east-west band through the central part of the town. The underlying Oak Ridges Moraine Aquifer is often capped by a surface layer of glacial till. This affords some protection from surface sources of contamination; however, because the thickness of the till cap can vary the aquifer is exposed at the surface in places. This is where groundwater recharge likely occurs to a greater extent but also provides a potential avenue for the introduction of contaminants. Portions of this Recharge Area are hummocky and can support wetland/pond conditions, which can be sensitive to physical disturbance.

Woodlots of varying size, age and composition are scattered throughout the town but are generally isolated from each other. They support a variety of common birds and mammals and have the potential to provide habitat for more interior dwelling species of birds. Protection of these woodlots is encouraged.

Figure 24: Forest cover within the Town of Whitchurch-Stouffville in the Greenlands study.



Zoning By-law

Musselman's Lake is also regulated by comprehensive zoning by-laws which regulate land uses and provide a way for municipalities to implement official plan policies. A number of properties and structures around Musselman's Lake enjoy legal non-conforming status, with smaller lot sizes and structures that pre-date the Zoning By-law. An Open Space Environmental (OSE) Zone borders Musselman's Lake. Within the OSE Zone, no building or structure is to be erected, modified or changed and no fill is to be placed, except for purposes of flood or erosion control.

The Planning Framework

Within the Musselman's Lake subwatershed, multiple levels of government policy work in concert to provide direction for rational planning decisions. Given the unique character and environmental sensitivity of the area, extra care must be given to land use planning decisions. The LSRCA, the Town of Whitchurch-Stouffville, the Region of York, the Province and the federal government all have an important role to play in maintaining the character and improving and restoring the ecological function of the Musselman's Lake community.

Town of Whitchurch-Stouffville

www.townofws.com

By-law Officers enforce the Town's General Zoning By-law as it relates to permitted and prohibited uses, zoning regulations such as setbacks, height and size of buildings and structures, as well as various other By-laws, including property standards (including outside storage, excessive weed growth, sewage, unlicensed vehicles), noise and parking. To report a by-law infraction, please contact the Town of Whitchurch-Stouffville enforcement staff.

Under the Ontario Building Code, staff have a statutory obligation to investigate reported unsafe septic systems. To report unsafe septic systems, contact the building or engineering department at the Town of Whitchurch-Stouffville. <http://www.townofws.com/pdfs/HOMEINFO.PDF>

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Appendix A – August 2007 Workshop

Workshop Purpose

On August 23rd, 2007, the Lake Simcoe Region Conservation Authority (LSRCA) and the town of Whitchurch-Stouffville hosted a community workshop as the first step in developing the Musselman's Lake Stewardship Plan. The purpose of the workshop was to bring together the Musselman's Lake community to collaborate on a stewardship plan to help improve the health and quality of Musselman's Lake and its watershed.



During the discussion period, community members identified important values and special features that exist on the lake and in the watershed. Participants were also encouraged to link the issues that impact these values and suggest possible solutions. The thoughts and comments that were generated by the community will be used to guide the development of the Musselman's Lake Stewardship Plan.

The workshop began with a welcome by Town of Whitchurch-Stouffville Councillor Phil Bannon and CAO David Cash. Brian Kemp, Director of Conservation Lands for the LSRCA then provided participants with background information on the Musselman's Lake Stewardship Plan. This was followed by a presentation by Randy French of French Planning Services Inc., who provided an overview of the purpose, objectives and benefits of the Musselman's Lake Stewardship Plan.

During the presentation, participants were asked to fill out two worksheets that helped to pinpoint values, special places and memories that they have of the lake and its surrounding areas. Participants were also asked to identify issues that impact these values and places and then discuss possible solutions.

Developing a Community Map of Values, Special Places and Memories

Important Lake Values

The following list of values identifies some of the reasons why the Musselman's Lake watershed appeals to residents, cottagers and visitors:

“Some of the most important values of Musselman’s Lake and its surrounding watershed are ...”

- Water Quality – cleanliness of Musselman’s Lake
- Wildlife and Vegetation – birds, waterfowl. Loons, Blue Herons, deer, etc.
- Recreational Enjoyment – boating, swimming, fishing, skiing, skating, snowmobiling, kite boarding, waterskiing, walking, sailing, cross country skiing
- Beauty of Musselman’s Lake – scenic area
- Natural Habitat – it’s an environmentally significant area
- Proximity to Toronto – 35 minutes to downtown Toronto, very accessible
- Opportunity to teach your children about the environment
- Heritage – lots of history and family connections
- Good neighbours/community
- Peace and tranquility – solitude
- Aquatic life – fish species
- Being a Kettle Lake
- Beautiful sunrises and sunsets
- Rural/Country atmosphere
- Nice houses- eclectic homes
- Oak Ridges Moraine
- Campfires
- Cleanliness of the shoreline

Special Places

Some of these “special places” are specific locations on Musselman’s Lake and others are unique features.

- The Sink Hole
- Windsor Lake (Mud Lake)
 - “It’s a special place because it has my family name and our children are 4th generation residents”
 - “It houses the swans and herons”
 - “It’s a focal point and natural drainage basin”
- Cedar Beach
 - “Summer entertainment”
 - “Historical presence”
 - “Good food at Cedar Beach Grill”
 - “Cedar Beach Pavilion”
 - “Corner store at Cedarvale has great ice cream”
- “Laing’s Point”
- “My front deck over looking the lake”

- “My dock”
- “My canoe”
- “My hammock”
- “Glendale Beach”
- “Wigmore Shores”
- “Churchill Community Park”
- “9th line (used as a bike or walking path)”
- “The whole Musselman’s Lake”
- “In front of (our place) we would gather as a family and enjoy the lake”
- “I love opening my curtain to the morning sparkle of the sun rising over our precious little lake. I love the way my dogs splash and swim along the beach front and the spring ducks in the marsh”
- “The wetland west of the lake has wildlife like deer and coyotes”
- “The centre of the lake because when I’m there, I feel I have left civilization and I am totally free”

Unique features

- “Quietness in the centre of the lake”
- “Driving or walking around the lake”
- “Backyard campfires and neighbourhood get-togethers”
- “The view from my home”
- “Clean shoreline”
- “Spring ducks at the marsh”

Memories

Memories provide us with an idea of what values need to be protected and what issues need to be considered. Understanding the collective memories of a community explains why people are so passionate about protecting their Lake.

“I remember”

- ...coming to the lake as a child. My husband’s family have been cottagers on the lake since 1928. We met here and have been married for 34 years and raised our children here”
- ...in 1986-87 taking blue-green algae to Queen’s Park”
- ...swimming at Glendale Beach and Cedar Beach and going to dances”
- ...watching an osprey try and catch fish, the ducks that rest on my floating dock, hawks and eagles float on a thermal over the lake”

- ...raising my family around the lake and using it to it's full extent in both summer and winter as a recreational facility"
- ...watching osprey, herons, loons, turtles and fish nesting"
- ...hearing frogs at night and geese"
- ...canoeing on the lake with my family"
- ...being able to see the stars"
- ...our old cottage house"
- ...visits as a child"
- ...music coming from the dance hall"
- ...catching my first fish in the lake"
- ...jumping off my boat into the water and being free"
- ...the first time I saw a heron on a dock a few doors away"
- ...the day we tore our old cottage down and built our new house"
- ...being here on my grade 8 graduation school trip approximately 40 years ago"
- ...seeing swans on the lake, hearing loons, watching bass protect their nesting beds, watching 14 baby geese following in a line behind parents"
- ...when you could go in the water and enjoy swimming without getting tangled in weeds"
- ...fondly swimming in the lake before the weeds have made it impossible at my shoreline"
- ...the loon's call before the roar of powerboats, leaf blowers and traffic"
- ...a very active meeting place on summer weekends. Both beaches were full of people enjoying the water, boating, swimming, picnicking, etc. So busy you couldn't see the sand"
- ...teaching my children about the environment and having it right outside our front door"
- ...when you could safely swim in the lake, there was a lot less weed growth and less urbanization of the community"

Issues and Actions

We need to consider the diversity of challenges that the future holds for the lake, the watershed and for the people and wildlife that call it home. The community has identified several important issues and has suggested these actions.

Water Quality

Issues

- Poor septic systems, septic runoff and septic pollution
- Stormwater runoff
- Heavy pesticide and fertilizer use
- Too many weeds and geese
- Too much boat traffic (large powerboats)
- Banks are eroding and the road is falling into the lake
- Swamp land (outflow on west end is closed off)
- Storm septicors are not maintained
- Too much development

Actions

- Septics need to be inspected, tested
- Municipal sewer should be brought in
- Methods developed for weed control/removal
- Remove white foam
- Water quality monitoring
- Improve water turnover
- Stormwater runoff should be filtered and treated
- Town council and government should put money and effort into the lake
- Municipal and regional leaders should show unbiased support
- Use less salt on the roads
- Increase the number of catch basins and storm septicors
- Ban pesticides and fertilizers
- Collect health unit historical records
- Shoreline needs to be naturalized

Recreation

Issues

- Over-fishing, no MNR patrol, non-locals over-fishing, anglers using antifreeze while ice-fishing
- Public beach is overused and under-maintained
- Too many snowmobiles, ATV's and dirt bikes
- Too accessible to non-residents

- No playground area, need parkland
- No public transportation

Actions

- Need fishing regulations to be enforced
- Local sheriff regulating the area
- Increased monitoring of fish populations with protocols in place
- Create a park for the community
- Need public transportation
- Have pedestrian traffic areas to promote walking

Natural Areas

Issues

- Wildlife survival is poor because of unbalanced state of watershed
- The shoreline is not naturalized
- The area is not being kept tranquil
- Trees are being cut down
- Citizens do not have the ability to preserve the area (tools/resources)

Actions

- Garbage and recycle bins should be placed around Musselman's Lake
- Need to balance the state of wildlife through monitoring protocols
- Crown land should be protected
- Expropriation (remove the control from the landowner)
- Ban tree cutting

Safety Concerns

Issues

- Pedestrians and pets are not safe because of a lack of walking path
- Road traffic speed is too fast with no enforcement
- The water is not safe for swimming (weed control)
- There is not adequate lighting

Actions

- Create lit walking paths
- Need traffic calming devices
- People should report speeders

Working Together

Issues

- Needs to be more community involvement
- Community needs to be educated about issues
- Lack of involvement by government agencies

Actions

- Community needs a single cause in order to work together as a team
- Take ownership of the problems
- Public needs to be informed and educated
- Council and government needs to be involved

The Next Steps

The future of Musselman's Lake depends on everyone in the community. The following is a list of ideas to encourage you to get involved.

- Engage other residents about relevant issues on the lake
- Participate in developing the Musselman's Lake Stewardship Plan
- Join the next community workshop on November 14, 2007. 7:00 – 9:00 p.m. at the Ballantrae Community Centre
- Check www.lsrca.on.ca for updates
- For more information on lake plans, please visit: www.frenchplanning.com

Appendix B – November 2007 Workshop

Workshop Purpose

On November 14, 2007, the Lake Simcoe Region Conservation Authority (LSRCA) and the Town of Whitchurch-Stouffville hosted the second in the series of Musselman's Lake Community workshops. The purpose of holding these workshops was to work together with the community on a stewardship plan that will help improve the health and quality of Musselman's Lake and its watershed.

This workshop provided a forum for residents to ask questions and be kept informed on the activities that had taken place to move the stewardship plan forward. Along with other updates, the status of the blue-green algae (cyanobacteria) outbreak was discussed as well as the role of ongoing water quality monitoring programs. Additionally, this workshop focused on the Technical Working Group and the process by which an inclusive and informative community survey could be produced.

Workshop Overview

Following the success of the August workshop, November's meeting was second in the series of workshops with the Musselman's Lake community. Seventeen new participants joined this process towards the completion of a comprehensive Stewardship Plan for Musselman's Lake.

This meeting was facilitated once again by Randy French of French Planning Services Inc. The LSRCA was represented by Brian Kemp, Phil Davies, Christa Sharp and David Lembcke. The Town of Whitchurch-Stouffville was represented by Paula Viola and Andrew McNeely. Bernard Mayer, from York Region's Health Service Department, and Rob Boudreau, representing the Preston Lake community, were also on hand.

Randy facilitated the meeting with a welcome and presented an overview of the agenda. A brief discussion followed to investigate how people heard about this meeting and how they would like to hear about future meetings. Most people agreed that more notice would be beneficial.

Next, Dave Lembcke gave a presentation on cyanobacteria. Community members were encouraged to ask questions about the health and environmental risks posed by blue-green algae outbreaks. Dave followed this discussion with a presentation about the ongoing lake monitoring activities of the LSRCA.

Following the cyanobacteria discussion, Andrew McNeely updated the community about recent town events. Christa Sharp followed to discuss the effectiveness of the first summary report. Rod Boudreau then presented on the Preston Lake Management Plan. Randy French finished the meeting with a discussion of the establishment of the technical working group and the community survey.

Blue-Green Algae Alert

While conducting routine water quality sampling at Musselman's Lake, LSRCA staff observed an algae bloom close to the shore. They immediately sent a sample of the algae bloom to the Ministry of Environment (MOE) lab for analysis. The results indicated the presence of various species of blue-green algae (Cyanobacteria). Upon receiving notification from the MOE of the results of the test, the York Regional Health Department was notified and they immediately posted the public beach at the east end of the lake as closed to public access. The Township of Whitchurch-Stouffville was also notified and undertook activities to notify the residents.

What are Cyanobacteria?

Cyanobacteria is the scientific name for a variety of species of blue-green algae or "pond scum". Some species of algae may contain toxins that can pose a risk to the health of humans and animals. Blue-green algae blooms naturally occur in fresh water lakes, bays and inlets, usually during warmer weather in late summer and early fall. They thrive where water is shallow, slow moving and warm, but may also be present below the surface in deeper cooler water.

Cyanobacterial blooms are often related to serious issues with septic systems, such as improper installation or a system failure. This situation is a clear indication of some of the problems facing this lake and a solution will need to be incorporated into the Management Plan.

Why are Cyanobacteria a Concern?

Although residents of Musselman's Lake receive their drinking water through the municipal system which is fed by ground water sources, cyanobacterial blooms can affect the health of the residents. Residents and their pets may be exposed to the bacteria if they go into the water for recreation. Exposure by adults may result in sickness, but is of greater risk to children and animals. Some Cyanobacteria are known to attack the liver or the nervous system; others simply irritate the skin.

For More information on Cyanobacteria:

Health Canada: http://www.hc-sc.gc.ca/ewhsemt/water-eau/drink-potab/cyanobacteriacyanobacteries_e.html

Ministry of Environment: <http://www.ene.gov.on.ca/cons/5089.pdf>

Participants asked:

Is there a connection between weeds and the algae?

The weeds and the algae are connected in that they collectively indicate that there are problems with the health of the lake. Each of these factors is a symptom of the larger lake health issues rather than one being a cause or result of the other.

Is blue-green algae connected to Canada Geese or ducks?

According to the WHO, animals consuming high levels of cyanotoxins have experienced liver damage (hepatotoxicosis). There is no data showing whether low doses over the long-term will cause adverse health impacts in animals. Since cyanobacteria are active and producing toxins for only a few months of the year, long-term exposure is unlikely.

Source: Bernard Mayer, Safe Water Program

Can algae be carried in to lake by migrant birds?

Blue-green algae are in the environment at low levels all the time so transport is not really an issue. More importantly, is what causes it to bloom and this is not well understood.

What about the toxicity of the algae that is found in health products?

Health Canada has conducted some testing on products available to Canadians and has found that for some products containing non-Spirulina species of cyanobacteria if one followed the manufacture's instructions they would ingest an unacceptable amount of microcystin.

Source: Health Canada

Can long-term exposure to low levels of blue green algae lead to liver cancer in dogs?

Currently, this is not supported with scientific evidence. What is known is that some of the toxins associated with blue-green algae are hepatotoxins that attack the liver. Treatments to counteract the effects of cyanobacterial toxins in animals have not been extensively investigated to date.

Source: Health Canada Web

Why is the LSRCA not sampling at catch basins or in the open lake?

Sampling at catch basins would not be reflective of true conditions because of the stagnant water in them. When water is stagnant, all kinds of algae, bacteria and weeds can grow. However, plans are currently underway to expand sampling to include the open lake.

Updates

- Websites have been created and updated at the LSRCA (www.lsrca.on.ca) and the Town of Whitchurch-Stouffville (townofws.com/mlsp.asp);
- The LSRCA published, distributed and made available online, the August 2007 Musselman's Lake Community Workshop Summary Report;
- The August Town Council meeting discussed nuisance ATV's and snowmobiles;
- The town's work-plan is scheduled to be completed in January/February and includes providing public forums on septic systems, maintenance and operation and plans to provide better public education;
- The town is participating in the Source Water Protection Technical Working Group which was formed to protect groundwater and publish regulations that increase the ability to monitor septic systems;
- The town and the LSRCA have been applying for additional funding grants to be used towards the stewardship plan;
- The town is considering creating a park with trail system in Musselman's Lake area; and
- The LSRCA is exploring possible Stewardship Projects e.g. naturalize shoreline, erosion control, etc.

The LSRCA performs ongoing lake monitoring and water quality sampling at seven stations around the lake, providing information on levels of phosphorus, nitrogen, ammonia, nitrate, nitrite, chloride, bacteria and total suspended solids.

A Technical Working Group has been formed that will set future meeting dates. Check the LSRCA and town's websites regularly for updates.

Preston Lake Management Plan

In order to show the potential for positive change with the implementation of a Musselman's Lake Stewardship Plan, Preston Lake Representative Rod Boudreau delivered a presentation to the community to highlight the success of the Preston Lake Management Plan. After a public consultation process in conjunction with Toronto and Region Conservation (TRCA), the Preston Lake Management Plan was created in order to suggest best management practices and priorities to protect, enhance and rehabilitate this natural kettle lake ecosystem within the Rouge watershed.

This comprehensive plan can serve as a guide for the creation of a Musselman's Lake Plan. Some of the ideas discussed included:

- Citizens participated in the Government of Ontario's Lake Partner Program to do water quality testing
- Group created an award-winning homeowners' guide
- Major project was repairing a storm water pond

- Storm water runoff is a major issue and is the #1 contributing factor to the declining health of Preston Lake
- Had success with the use of weed mats
- To remind the community of their responsibilities, they posted “No Pesticide Use” on all of their flyers

For more information, please go to www.prestonlake.org

The goal of the Lake Partner Program is to protect the quality of Ontario's inland lakes by involving citizens in a volunteer based water quality-monitoring program. The Lake Partner Program is a province wide, volunteer-based, water-quality monitoring program. Volunteers collect total phosphorus samples and make monthly water clarity observations on their lakes. This information will allow the early detection of changes in the nutrient status and/or the water clarity of the lake due to the impacts of shoreline development, climate change and other stresses.

For more information:

Ann DeSellas, Acting Coordinator

Lake Partner Program

1-800-470-8322

E-mail: bev.clark@ontario.ca

The Next Steps...

Formation of a Technical Working Group

The LSRCA and the Town of Whitchurch-Stouffville accepted letters of intent to join the Technical Working Group. The goal of this process is to have a representative group, free of apparent bias that will be able to move the process forward in a productive manner. The members of the Technical Working Group will be charged with the task of representing all interest groups, attending regular meetings and creating and implementing an inclusive community survey.

At the workshop it was suggested by the community that in order to ensure adequate coverage and equal representation, members be selected from these sectors:

- Resident and community associations
- The Lake Simcoe Region Conservation Authority
- Regional and Municipal Staff
- Elected council
- Commercial – Cedar Beach
- Agriculture

- Aggregate
- York Regional Health Services
- MNR/MOE
- Rod Boudreau – Preston Lake Representative

Community Survey

One of the responsibilities of the Technical Working Group will be to create a community survey process that is inclusive and informative. The Working Group will develop survey methodology and will consider these suggestions as put forth by the community:

The survey should:

- Have neutral questions
- Be simple to understand
- Not have open ended questions
- Have full community coverage (door to door)
- Be appropriately timed
- Have a high level of participation (>80%)
- Have measurable outcomes
- Prioritize residents issues
- Be paper (not web) based

The next meeting is scheduled for the spring of 2008 (check web for updates) and will cover a variety of topics, including:

- Technical Working Group update
- Survey results
- Planning & Permitting presentation
- Stewardship plan update

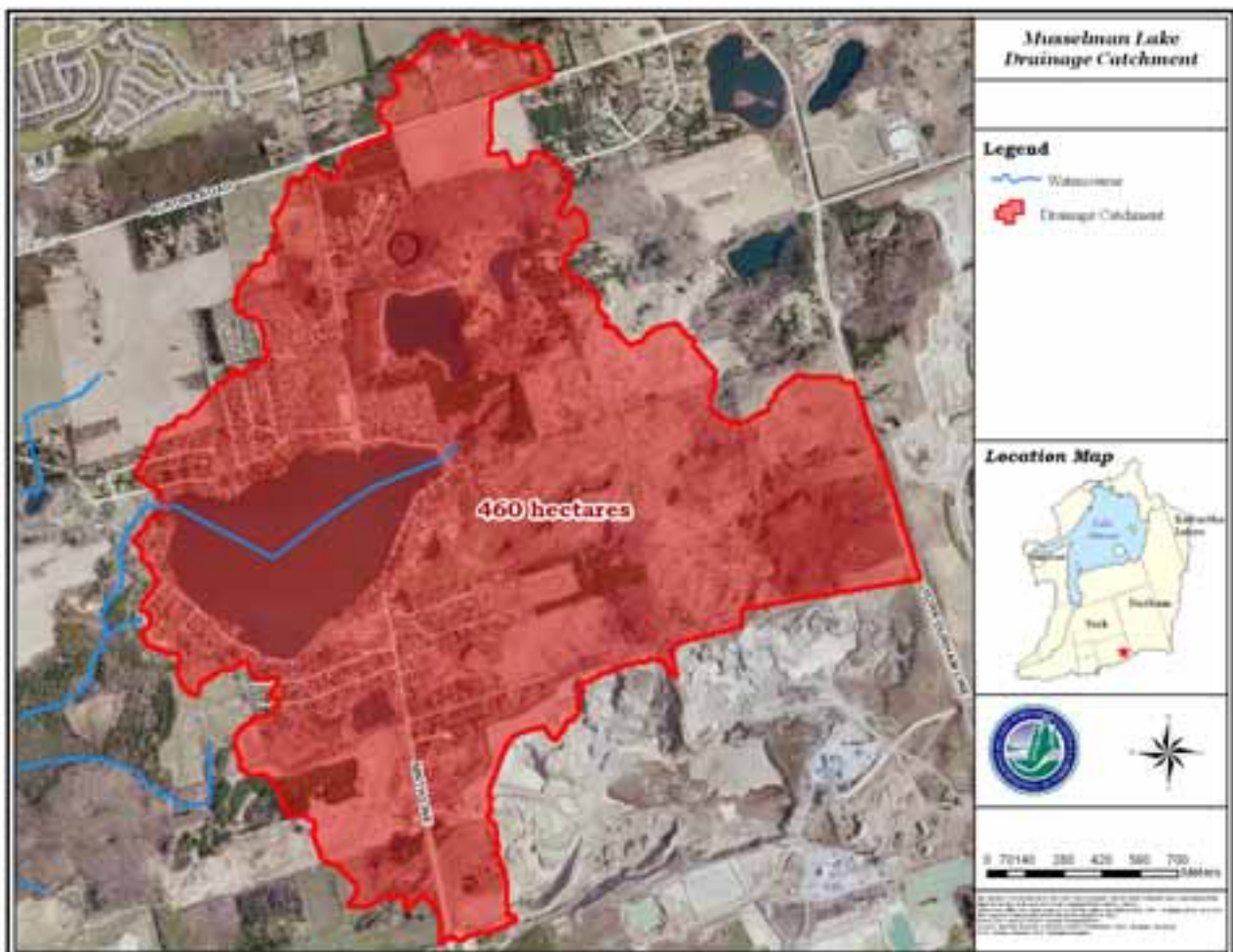
Appendix C – August 2008 Resident Survey

What is the History of Musselman's Lake?

Musselman's Lake is a small, shallow kettle lake with a surface area of 46 hectares, a subwatershed area of 460 hectares (4.6 km²) and a maximum depth of approximately 8 metres. Located in the south-east corner of the Lake Simcoe watershed it lies in the ecologically significant and sensitive geological landform of the Oak Ridges Moraine.

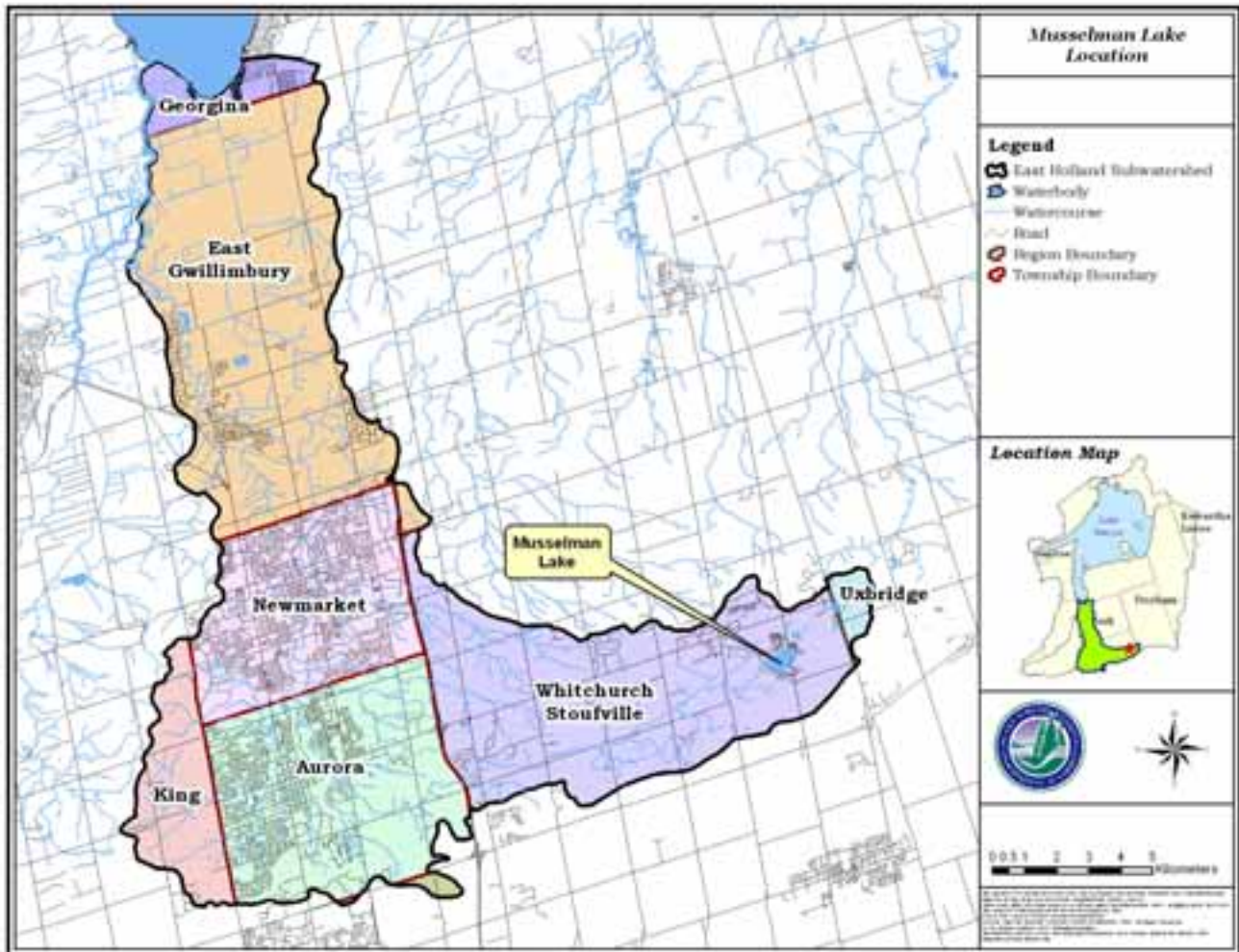
Like other kettle lakes, Musselman's Lake has only intermittent outflow, through a small culvert at the northwest end. Precipitation, surface runoff and groundwater are the sources of inflow into Musselman's Lake with the outflow draining into an adjacent wetland area. This area eventually drains into the East Holland River, which flows to the west and then north through Newmarket and East Gwillimbury where it joins with the West Holland River to become the Holland River, which flows into Cook Bay at the south end of Lake Simcoe.

Figure 1: Musselman's Lake subwatershed.



The community of Musselman's Lake is located in southern Ontario in the Town of Whitchurch-Stouffville, approximately 45 minutes north east of Toronto. Musselman's Lake is one of the many kettle lakes located along the Oak Ridges Moraine, a 160 kilometre long geological landform that is known as southern Ontario's rain barrel.

Figure 2: Location of Musselman's Lake within the East Holland subwatershed.



What is the Musselman's Lake Subwatershed Assessment and Stewardship Opportunities Report?

The ecosystem approach to environmental management takes into consideration all of the components of the environment. These components include the movement of water through the system, the land use, climate, geology and all of the species that comprise the community living in the system. These ecosystem components are all intricately related and changes in any can have significant effects on the others.

To manage natural resources using an ecosystem approach it is essential to establish biophysical boundaries. In the Lake Simcoe watershed, the subwatersheds or river systems that drain into the lake have been identified as the best “fit” for the implementation of an ecosystem study because they are virtually self-contained water-based ecosystems (OMOE and OMNR, 1993c). Watersheds are defined as the area of land drained by a watercourse and, subsequently, the land draining to a tributary of the main watercourse is called a subwatershed.

Subwatershed planning is an integrated approach that takes all socioeconomic, physical and biological factors into consideration. This subwatershed plan:

- Identifies the subwatershed location;
- Establishes the relationship of the subwatershed plan to other planning documents;
- Describes and analyzes the form, function and state of the natural systems contained within the subwatershed based on current information;
- Outlines resource management goals and objectives for the subwatershed; and
- Recommends options for protection, rehabilitation and enhancement of conditions in the subwatershed.

This plan establishes a baseline of information and provides recommendations based on what we know today. As new information is collected we must adapt our management approaches.

The main objective of this project is to develop a Musselman’s Lake Subwatershed Assessment and Stewardship Opportunities Report (Stewardship Opportunities Report), in consultation with appropriate government agencies, landowners, non-government environmental groups, resident associations and interested members of the public.

This project was completed using a community-based planning process that encouraged community members and other key stakeholders to become actively involved from start to finish - a plan that is developed by them and for them.

What is the purpose of the survey?

The Musselman’s Lake TWG and PST undertook a community survey to gather information on the important values and features that make Musselman’s Lake a special place.

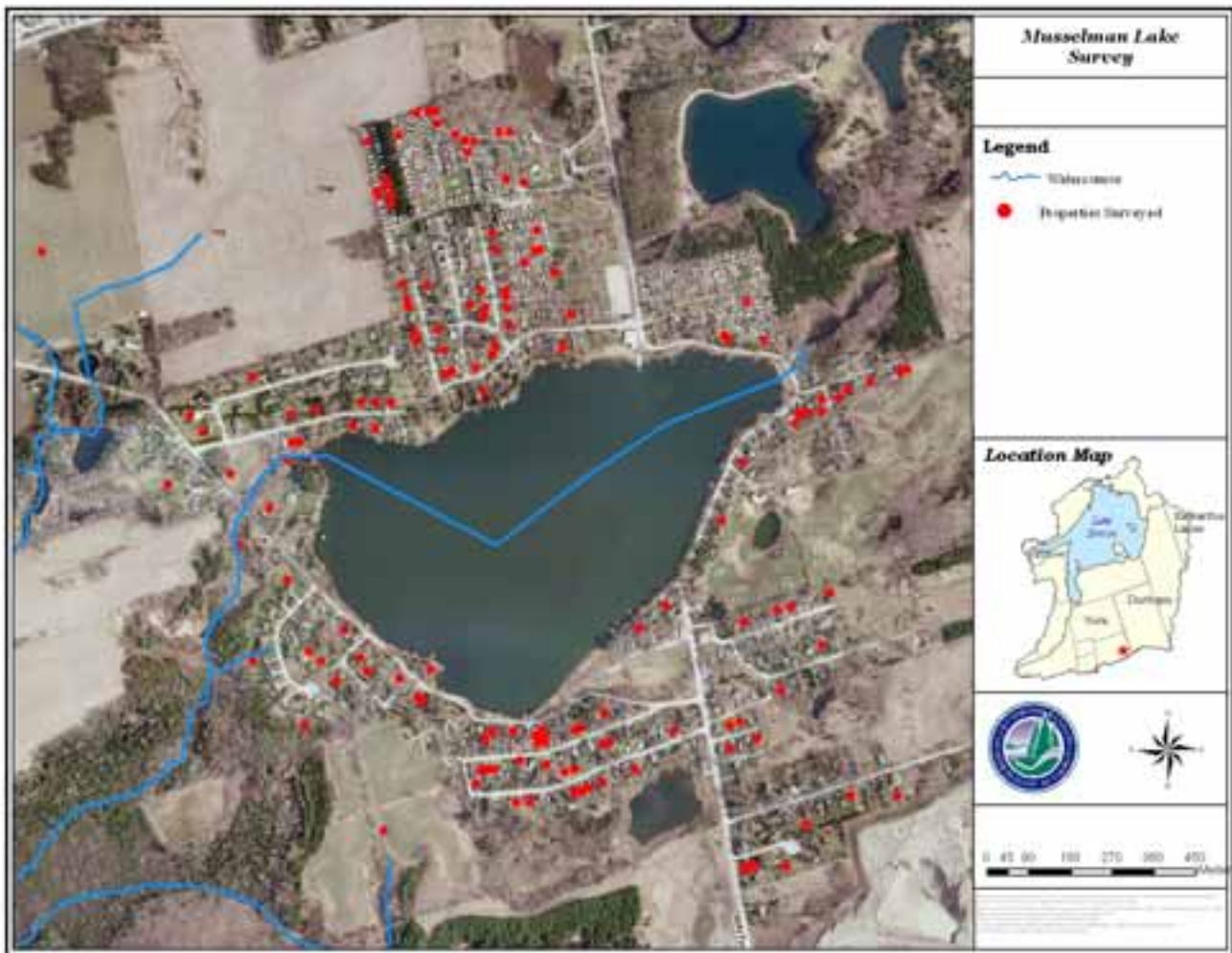
The objective of the survey was to obtain the opinion of the residents in the Musselman’s Lake subwatershed area regarding land-use, water quality, recreation, resource management issues and educational opportunities. The results of the survey were used during the preparation of the Stewardship Opportunities Report to ensure that the community member’s ideas and views were considered.

Survey Results

General Results

LSRCA staff distributed the survey to Musselman's Lake residents. The surveyors visited 517 homes during a two-week period in August 2008. The community was canvassed from Monday to Saturday, alternating between days and evenings. There was a "complete" survey with 16 questions for residents to complete. There was also a "no" survey with 3 questions allowing residents to complete a shorter version. Out of 517 homes, 178 residents were present at the time of the survey representing 32% of the Musselman's Lake population. There were 154 "complete" surveys, 10 "no" surveys and 14 residents did not wish to complete any survey. Of the residents present at the time of the survey (178 homes), 164 surveys (154 "complete" and 10 "no" surveys) were completed which translates to an 85 % success rate.

Figure 3: Where the 154 surveys were completed.



In general, the residents were enthusiastic about participating in the Musselman's Lake Stewardship Opportunities Report by completing the survey. They wanted to provide their input into preserving and enhancing the lake. The residents are actively using the area for recreation. The community survey showed that the residents of Musselman's Lake were concerned with protecting and conserving the subwatershed. Some of their concerns included water quality, recreation and natural heritage features.

Musselman's Lake Community

Figure 3 shows where the 154 surveys were completed. Of those homes surveyed, 80% are permanent and 20% are seasonal residents. 70% of residents have access to the lake either directly from their property, a community access point or the local business (Cedar Beach).

The residents were asked how long they have lived in the community of Musselman's Lake.

Figure 4: Length of time residents have been living in the Musselman's Lake community.



Health of Musselman's Lake and the surrounding community

The residents were asked whether Musselman's Lake and the surrounding community in its current condition is environmentally healthy. 42% felt that the environmental health was in good condition but 72% are concerned about the environmental health. Please see Figures 5 and 6 for the complete details.

Figure 5: How residents feel about the environmental health of Musselman's Lake and the surrounding community.

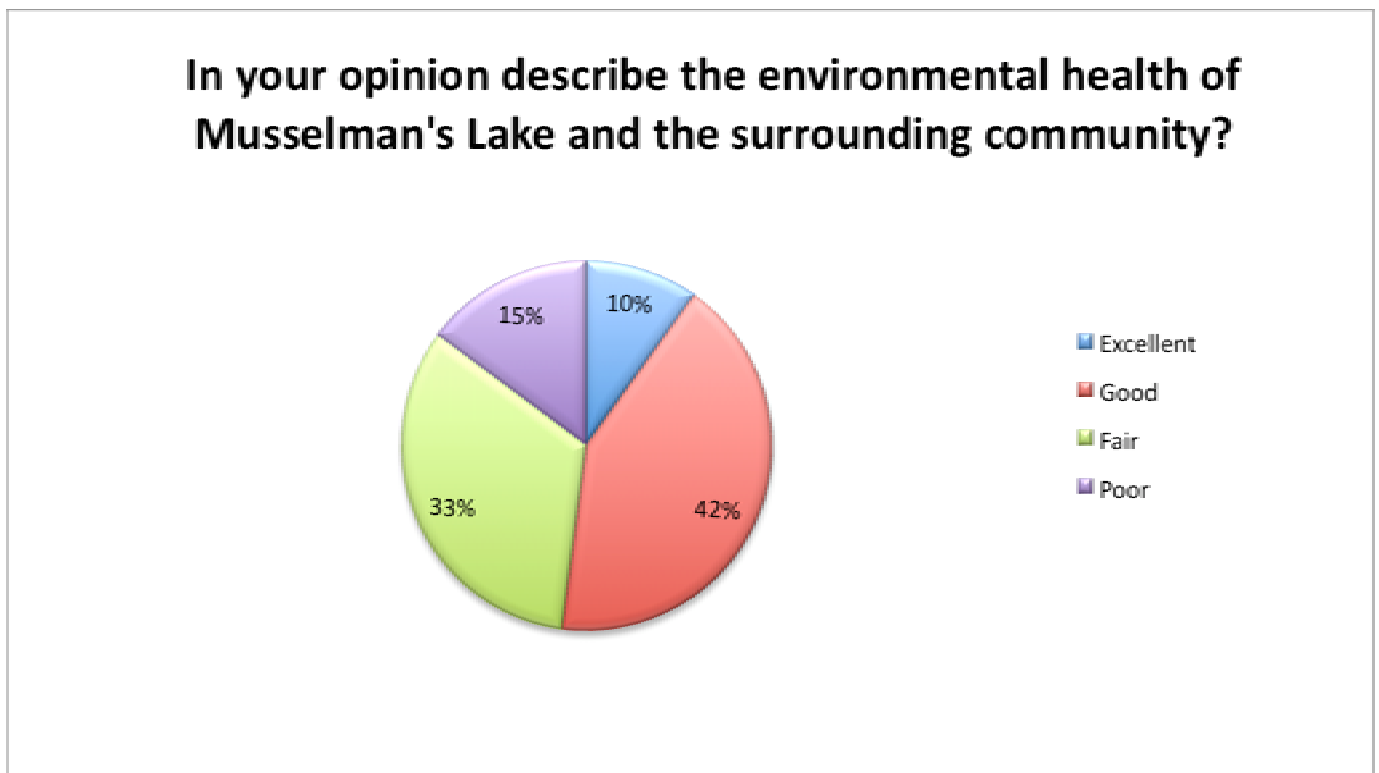
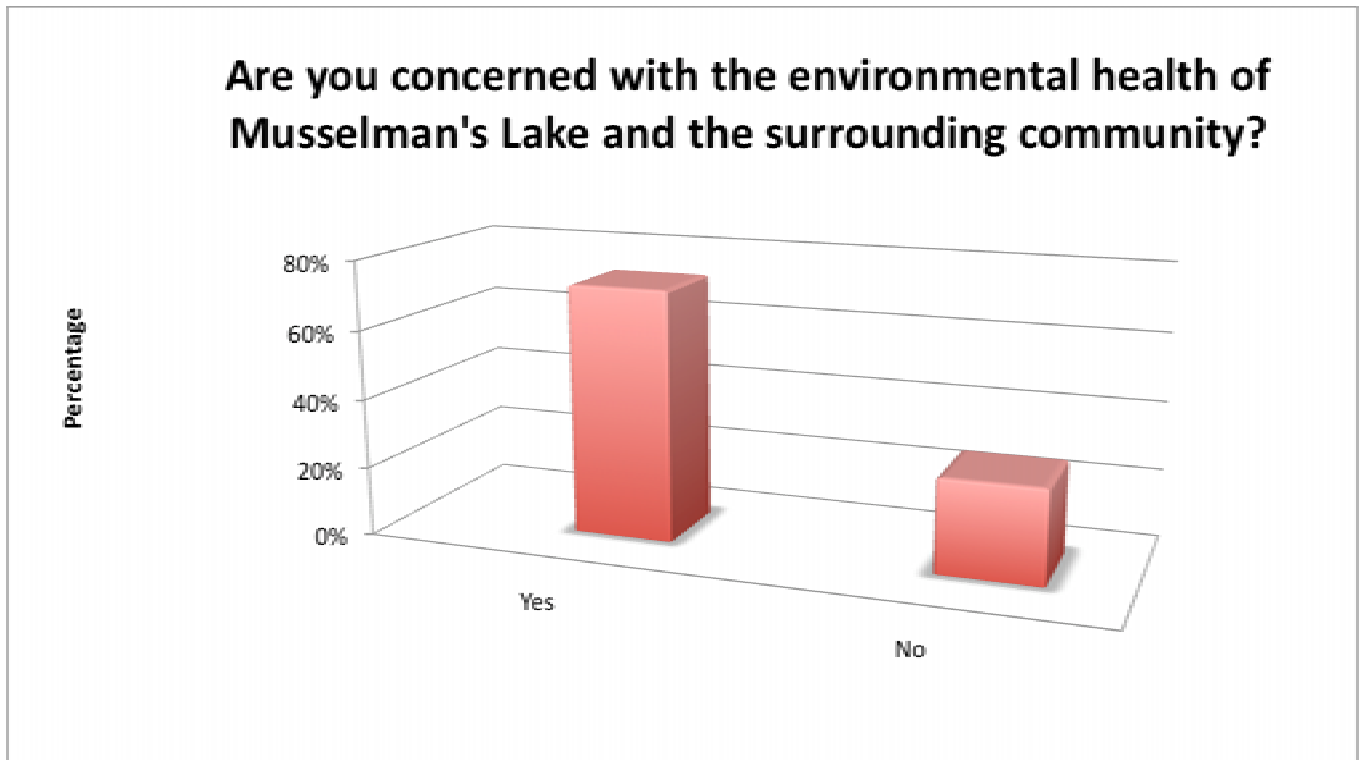


Figure 6: How concerned the residents are with the environmental health of Musselman's Lake and the surrounding community.



The residents concerns were broken into 3 categories; Natural Heritage, Water Quality and Recreation/Transportation. Natural Heritage included species at risk, tree cover, invasive species and wildlife and was 21% of those surveyed. Water quality was their greatest concern at 67% which included water pollution, stormwater runoff, water clarity, bacteria, aquatic vegetation, septics and smell. Snowmobiles, all terrain vehicles, personal watercraft, boat and road traffic, noise and safety made up the recreation/transportation category. This category received 21% of the residents concerns. Please see Figure 7.

Figure 7: What concerns the residents have with respect to the environment health of Musselman's Lake and the surrounding community.



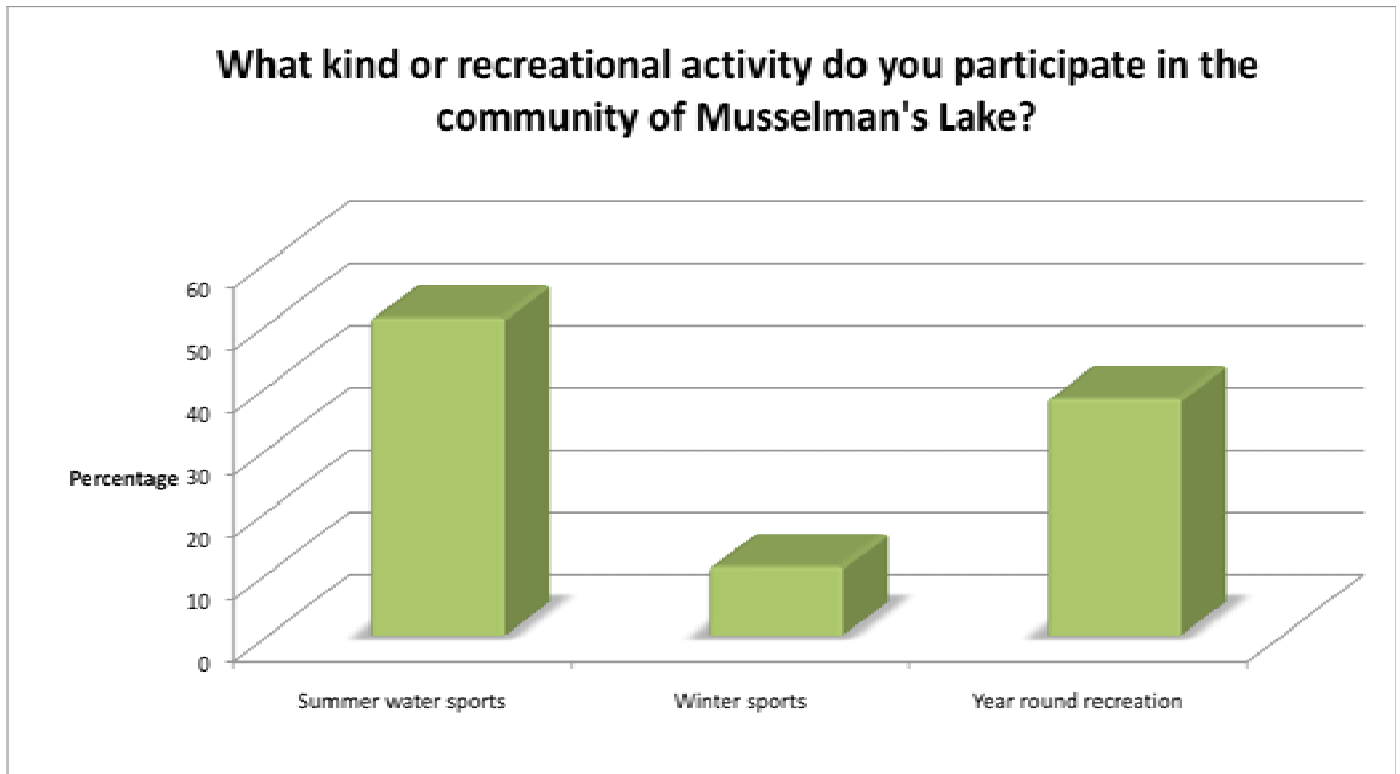
Eighty-three percent of residents are interested in having technical and financial assistance to make positive environmental changes on their property.

There are many organizations within the Musselman's Lake subwatershed that can assist technically or financially on environmental projects. These technical and/or financial assistance programs available in the subwatershed are listed within the stewardship opportunities report. This is not a complete list of funding programs as they are changing constantly.

Recreational activity on Musselman's Lake and the surrounding community

There are many forms of recreational activities occurring within the Musselman's Lake community. The activities were grouped into summer water sports, winter sports and year-round activities. Summer water sports include kayaking, canoeing, water skiing, boating, fishing, swimming and scuba diving. Winter sports include ice skating, cross-country skiing, ice fishing and snowmobiling. Year-round recreational activities include walking, nature appreciation and community programs. See Figure 8 for details.

Figure 8: Recreational activity residents participate in.



The residents were asked the specific question of, would you swim in the lake, 64% of respondents said they would not swim in the lake. The main reasons why they did not swim in the lake included; they used to swim in the lake but no longer do, there are too many weeds, they have gotten skin or ear infections, other family members swim but they do not.

Septic Systems and Holding Tanks

Septic systems are small scale sewage treatment systems which are common in areas that do not have a connection to the main municipal sewage system. A septic system has an anaerobic bacterial environment that develops in the tank and decomposes the waste which was discharged into the tank. Maintenance and inspections are required to ensure that the septic system and the tile bed are working properly.

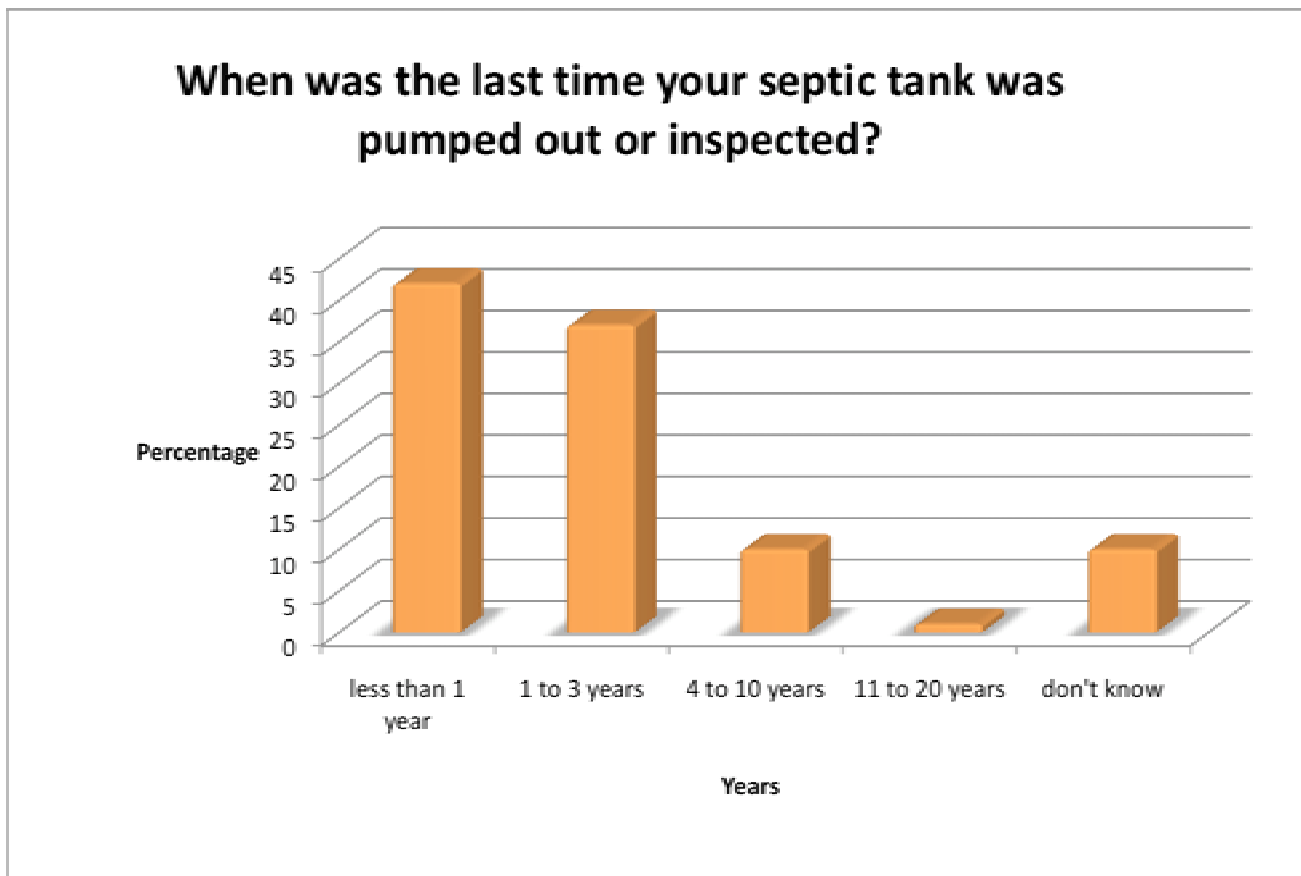
Holding tanks could also be called a black water tank. It is a container which stores sewage from households. The raw sewage does decompose in the tank, which means the contents need to be emptied on an ongoing basis.

Septic systems and holding tanks are particularly common on rural and cottage properties; therefore it is very important for Musselman's Lake residents to pay particular attention to their system. It is in a resident's best

interest to maintain their system. If they don't, you risk contaminating Musselman's Lake and, ultimately, your family's health.

Seventy-four percent of residents have a septic system. 98% of those residents are knowledgeable about the location of their septic system. 62 % of those residents know the age of their septic system and the majority of the septic systems are between the age of 6 and 30 years. See Figure # 9 for details on how often residents are having their septic tank pumped out or inspected. It is extremely important to pump out and have your septic system inspected because if solids or bacteria escape the tank or tile bed they can infiltrate the soil and contaminate groundwater and surface water.

Figure 9: How often residents pump out or inspect their septic tank.

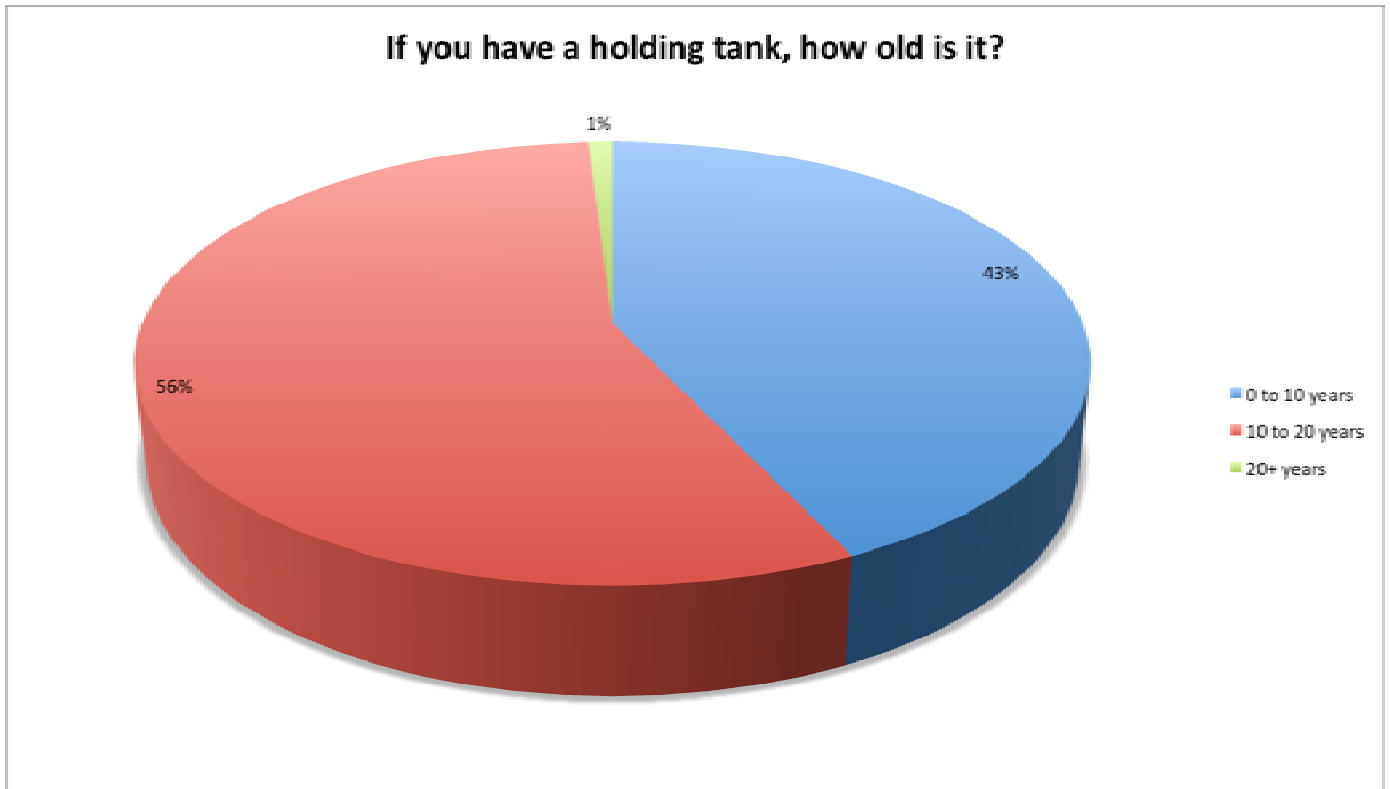


Only 3% of septic tank owners add enhancement to their system. Those enhancements could include effluent filter and aerobic units. Enhancements are used to accelerate the digestion of the solids in the tank.

Holding Tanks

Twenty-two percent of residents have a holding tank. 72% of those residents know the capacity of their holding tank. Most residents pump out their system numerous times per year and there are a few that pump them out once per year.

Figure 10: Age of the holding tanks. The majority of holding tanks are between 10 to 20 years old.



Lawn and garden care

The impact of our lawns and gardens on our health and the environment is becoming an increasing concern. A well cared for lawn can be achieved without putting your health or the environment at risk by using chemicals. There are many tips about chemical free and water efficient lawn and garden care on York Region’s website, www.waterfortomorrow.com

Fertilizers

Twenty-two percent of those surveyed fertilize their lawns. Of those homes, 52% are fertilized by the resident and 48% by a contractor. 48% use a chemical fertilizer, 44% use a natural product and 8% use another product or a combination of products. Please see Figure 11.

Figure 11: How often residents fertilize their lawns.



Weed Control

Fifty-five percent practice weed control. 75% of those homes use manual removal and 25% use chemicals for weed removal. Of these homes 81% complete weed control on their own, 18% use a contractor and 1% use a combination of both. Please see Figure 12.

Figure 12: How often residents practice weed control.



Appendix D – Terms of Reference

Background

The community of Musselman's Lake is located in southern Ontario in the Town of Whitchurch-Stouffville, approximately 45 minutes northeast of Toronto. Musselman's Lake is one of the many kettle lakes located along the Oak Ridges Moraine, a 160-kilometre long geological landform that is known as southern Ontario's rain barrel.

The drainage basin and lakeshore of Musselman's Lake have been extensively developed for residential, recreation and agricultural uses. The shift from small summer homes/cottages to larger full-time residential homes has placed a strain on the lake due to direct input of stormwater to the lake without treatment and the absence of a sewage treatment plant, resulting in water quality degradation in the lake. A study completed by the Lake Simcoe Region Conservation Authority in 1989, called the "Musselman Lake Surface Water Quality Report", confirmed that water quality in the lake was degraded and remedial measures and control options were recommended.

Objective

The main objective of this project is to develop a State of Musselman's Lake Sub- Watershed Report and Stewardship Plan, in consultation with appropriate government agencies, landowners, non-government environmental groups and resident associations and interested members of the public.

This project will be undertaken utilizing a community-based planning process that encourages community members and other key stakeholders (such as Lake Simcoe Region Conservation Authority (LSRCA) and municipal politicians and staff) to become actively involved from start to finish - a plan that is developed by them and for them.

The State of Musselman's Lake Sub-Watershed Report (SMLR) will identify the present condition of Musselman's Lake and its surrounding drainage along with the land-use, water, recreation and resource management issues that need to be addressed. The Stewardship Plan (MLSP) will provide an action plan that guides stewardship opportunities, including education, communications, restoration and monitoring. The MLSP will also identify the tools and resources that are available and/or required to take timely actions to promote and ensure a healthy and sustainable lake and associated drainage basin for present and future generations.

Planning Area

Musselman's Lake is a small, shallow kettle lake with a surface area of 46 hectares, a drainage basin area of 179 hectares (1.79 km²) and a maximum depth of 7.3 metres. Located in the south-east corner of the Lake Simcoe watershed it lies in the ecologically significant and sensitive geological landform of the Oak Ridges Moraine (Figure 1).

Like other kettle lakes, Musselman's Lake was formed by glaciation approximately 12,000 years ago and has only intermittent outflow through a small culvert at the northwest end. Precipitation, surface runoff and groundwater are the sources of inflow into Musselman's Lake with the outflow draining into an adjacent wetland area (Figure 2). This area eventually drains into the East Holland River, which flows to the west and then north through Newmarket and East Gwillimbury where it joins with the West Holland River to become the Holland River, which flows into Cook's Bay at the south end of Lake Simcoe.

Project Details

The State of Musselman's Lake Sub-Watershed Report and Stewardship Plan is expected to contain the following information:

- An overview chapter in which the physical setting of Musselman's Lake and its surrounding drainage basin, human settlement and water use will be described;
- Identification of the natural features and functions of Musselman's Lake and its drainage basin - divided into three categories (land, water and community) for detailed investigation;
- Identification and discussion of the issues in the drainage basin as a whole that are particularly important to preserving the ecological integrity of the lake;
- Evaluation of land use policies and recommendations for change;
- Responsibilities pertaining to the management of Musselman's Lake; including resource managers and landowners;
- Recommendations pertaining to the communication of the report's findings;
- Report will close with a conclusions/recommendations that will describe the overall state of Musselman's Lake and its drainage basin and recommendations that would identify specific measures needed to improve its future state, as well as a process for ensuring the recommendations do not fall on infertile ground; and
- Following the publication of the report, a presentation of the report findings will be prepared for use in meetings or presentations - not only will this consultation bring the science and results of the study to the public, but it will ensure that the recommendations are brought to the forefront of discussions across the entire drainage basin.

Formation of the Technical Working Group

The first step in the project will be to develop the Musselman's Lake Technical Working Group (ML-TWG) to help identify sources of data, determine the format that will be most useful in the project and develop a detailed workplan that outlines specific tasks, lead agency, supporting roles and timeline for completion. This committee will consist of technical staff from the Town of Whitchurch-Stouffville, York Region and the LSRCA, as well as provincial staff from Ministry of Natural Resources. These agencies will provide scientific information and direction to the project. As was mentioned earlier, they will be important in the development of the project, as they will be utilizing the end product.

Other groups, such as smaller community groups will be consulted in order to obtain an understanding of what activities are already taking place and to identify local community interests. These groups will also be invited to take part in the planned community meetings and asked to review the draft documents and make recommendations.

Objectives of the State of Musselman's Lake Sub-Watershed Report and Stewardship Plan Project

1. Involve all partner agencies and the public through active participation.
2. Integrate disciplines, policies, mandates and requirements of all agencies and interests.
3. Identify the location, area, extent, present status, significance, function and sensitivity of the existing natural environment within the sub-watershed.
4. Identify the location and type of development constraints within the subwatershed.
5. Identify sources of surface water contaminants from agricultural, urban, rural and natural areas and areas where there is a potential for rehabilitation.
6. Evaluate potential impacts on water quality and on the natural environment associated with future development in the sub-watershed.
7. Identify remedial measures and control options to rehabilitate ecosystem health. Prioritize measures and options based on their cost/benefit and produce an implementation strategy (Stewardship Plan), which identifies agency roles and responsibilities and a schedule for completion.
8. Identify opportunities for community involvement.
9. Assess the impact associated with future urban growth on the health of Musselman's Lake and its surrounding drainage basin and develop a strategy to minimize and/or eliminate these impacts.
10. Provide direction for the protection and rehabilitation of natural heritage features.

Consultation Process

Disseminating information and providing opportunities for consultation/feedback will be critical to the success of this project. The consultation process will include, but is not limited to, the following:

- A "Public Information Session" that should be held as a kick-off to the project to obtain initial comments and/or concerns of the area residents;
- A second "Public Information Session" should be hosted once the state of the Lake is assessed and preliminary options for remediation are developed;
- A third workshop should be hosted to gather feedback regarding the detailed recommendations for the Stewardship Plan; and
- A final consultation meeting should be held once the draft report(s) is/are available.

In conjunction with the four (4) community meetings -- a hot button link on either the town or the LSRCA website should be made available so that the community can stay up to date on the development of the State of Musselman's Lake Sub-Watershed Report and Stewardship Plan.

This component of the project will be undertaken by French Planning Services Inc., a private consultant that is well versed in community consultation and facilitation, as well as a working knowledge of lake management strategies and processes.

Scope of the Consultation Process

The scope of the consultation process will include:

- Working alongside the ML-TWG, including providing guidance and advice for the consultation process;
- Gathering and analyzing the existing science and resource information and preparing communication materials for the consultation process that are easily understood by the community;
- Facilitating, preparing and/or reviewing summaries of stakeholder workshops;
- Providing input and reviewing a resident survey; and
- Preparing and/or reviewing the final Stewardship Plan and associated communication materials.

Requirements of the Consultant

The consultant will be required to:

- Provide a work plan that includes the sequence of tasks and associated schedule set out within the time frame of the Terms of Reference;

- Work alongside the Musselman's Lake Technical Working Group to facilitate the consultation portion of this project;
- Contact organizations/develop partnerships for sharing and using existing data; and
- Review report outlines, drafts and final reports with the Technical Committee.

Consultant Deliverables

See attached schedule (includes task, details, timeline and costs (Appendix 1)).

Roles and Responsibilities

1. Brian Kemp, LSRCA, shall be the contact person for the MLSP and shall provide the consultant with necessary guidance and advice.
2. The consultant shall submit the outlines, drafts and final reports on time.
3. Brian Kemp, LSRCA, shall organize and handle the formal review of the Draft reports, in consultation with the consultant.
4. The ML-TWG shall prepare reports as outlined in Appendix 1.
5. The Consultant shall prepare reports as outlined in Appendix 1.

Project Component	Lead	Timeline
Formation of Technical Working Group	LSRCA	July 13, 2007
State of Musselman's Lake Sub-Watershed Report Identification/examination of natural features and functions (incl. monitoring, issue identification, existing natural features, etc.) <ul style="list-style-type: none"> • Provides information on the natural and cultural resources found in the sub-watershed and attempts to assess their health • Developed using an ecosystem approach and indicates where linkages exist between resources • Provides those working to develop the Stewardship Plan with sufficient information to identify areas that require protection, as well as areas that require rehabilitation 	LSRCA (undertaken by LSRCA staff in consultation with Technical Working Group)	TBD, based on detailed workplan developed by the ML-TWG
Consultation Process and Stewardship Plan <ol style="list-style-type: none"> 1. Kick-off (Public Information Session) 2. State of Sub-Watershed Review and preliminary remedial options 3. development of detailed stewardship plan 4. draft report(s) consultation 	LSRCA under the direction of a private consultant	<ol style="list-style-type: none"> 1. July/August 2. Late fall/early winter 2007 3. Late winter/early spring 2008 4. Early spring

Time Frame and Costs

See details in Appendix 1. The consultant will be paid upon a progress schedule based on deliverables identified in the attached schedule (Appendix 1). A 10% holdback will apply until completion of the project. See Appendix 2 - Payment Schedule.

Project Steering Team (PST)

The Project Steering Team for the development of the Stewardship Plan consists of Lake Simcoe Region Conservation Authority and the Town of Whitchurch-Stouffville. The PST will have support resources as needed,

including the project consultant (French Consulting Ltd.) and other governments. The PST is responsible for the overall management of the project, consultation process, funding and the finalization of the state of the watershed report and the Stewardship Plan. The PST will hold its meetings as required to complete the project. Agendas for the Technical Working Group (TWG) will be set by the PST and PST members will attend Technical Working Group (TWG) meetings on a periodic basis.

The PST will also initiate the creation of an advisory TWG during the study process. It is intended that through the creation of a TWG, a larger group of stakeholders will work together to share data, information and provide the basis for the development of the Stewardship Plan itself. The PST, upon completion of the study, will establish an implementation group comprised of residents, agriculture and aggregate partners, Town of Whitchurch-Stouffville and LSRCA staff. The implementation group will be responsible to advise members of recommendations arising from the adopted study.

The PST will recommend a final plan to the LSRCA Board of Directors and the Town of Whitchurch-Stouffville Council for endorsement.

Technical Working Group (TWG)

The purpose of the Musselman's Lake Technical Working Group is to advise the Project Steering Team as part of the completion of the Musselman's Lake Stewardship Plan (MLSP). The TWG will help identify sources of data and share scientific information which relates to the project. The TWG will work with the consultant on a survey to be completed by residents of the area. This group will also formulate stewardship recommendations and propose a work plan that outlines specific tasks, lead agencies, costs, supporting roles and timelines. The TWG will operate based on consensus.

TWG meetings will be held regularly. During the community meeting on November 14th, 2007 it was suggested that the following sectors be represented on the working group; Resident and community associations, Agriculture, Aggregate, Preston Lake Representative, Commercial, Lake Simcoe Region Conservation Authority, Regional and Municipal Staff, York Regional Health Services, Ministry of Natural Resources and Ministry of Environment.

The Chair of the TWG will be responsible for facilitating TWG meetings and ensuring that discussions follow the established agenda. The Chair will ensure that all TWG members are given equal opportunities to share their thoughts and ideas with the group and that members respect each other and their input. It will be the responsibility of the Chair to facilitate the development of consensus amongst TWG members and identify recommendations of the TWG to the PST.

The co-Vice chairs will be responsible for chairing TWG meetings in the absence of the Chair, on an alternating basis. The co-Vice Chairs will coordinate meetings, record minutes and act as a liaison between the TWG and PST. The co-Vice chairs will assist the Chair in developing consensus amongst TWG members as required.