BEAVERDAMS AND SHRINERS CREEK WATERSHED PLAN
PHASE ONE

WATERSHED CHARACTERIZATION AND PRELIMINARY ISSUES IDENTIFICATION

JUNE 2011

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Acknowledgments

The Niagara Peninsula Conservation Authority would like to extend our sincere gratification to everyone that had an active role in the creation of the Beaverdams and Shriners Creek Watershed Characterization and Issues Identification.

To the members of the public that attended the public open houses and workshops; your participation in these events and your input to the Characterization and Issues Identification Report has assisted the Conservation Authority in gaining a more intimate understanding of the study area and helped us to identify issues that we may not have been previously aware of.

A special thank-you also goes to the members of the Beaverdams and Shriners Creek Steering Committee for your commitment and dedication to the creation of the Beaverdams and Shriners Creek Watershed Characterization and Issues Identification Report. Your hard work and dedication to the project has resulted in the creation of a valuable and useful tool to be used as a resource for watershed managers and stakeholders that will aid in future planning decisions.

The Conservation Authority believes that stakeholder involvement in projects such as these are extremely important and we want you to know that the time you committed to the project is greatly appreciated.

Sincerely,

Tara Metzger
Watershed Planning Specialist

Beaverdams and Shriners Creek Steering Committee

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Introduction

The Regional Municipality of Niagara (RMN), Niagara Peninsula Conservation Authority (NPCA) and the Ministry of the Environment (MOE) formed a partnership to develop the foundation of a comprehensive water protection strategy for Niagara's watersheds. The result of this partnership was the *Niagara Water Quality Protection Strategy* (RMN 2003a), now known as the *Niagara Water Strategy* (*NWS*) (2006a). The *NWS* is a multi-jurisdictional strategy based on 32 Local Management Areas (LMAs) with the intent of guiding respective stakeholders on best management and protection strategies for Niagara's water-dependant resources. The strategy has identified the need to manage Niagara's watersheds in such a manner as to "*sustain healthy rural and urban communities in harmony with a natural environment, and rich in species diversity*". In 2005, the Regional Council of Niagara adopted new environmental policies for the Niagara planning area. These policies call for an integrated ecosystem approach to planning that includes the involvement of all respective stakeholders. An aspect of the framework for the environmental planning process under these policies is the preparation of watershed studies for Niagara's major watersheds.

Watershed Planning and the Beaverdams and Shriners Creek Watershed

A watershed, also referred to as a catchment basin, is an area of land from which surface runoff (water, sediments, nutrients and contaminants) drain into a common water body (e.g., Beaverdams Creek, Shriners Creek and Ten Mile Creek). Watersheds include all water and water-dependent features such as wetlands, forests, urban areas, and agriculture (Pollution Probe 2004).

A watershed management plan is a proactive document created cooperatively by government agencies and the community to manage the water, land/water interactions, aquatic life and aquatic resources within a particular watershed to protect the health of the ecosystem as land uses change (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993). The Beaverdams and Shriners Creek Watershed Plan provides a systematic strategy to guide development, identify and recommend alternative and preferred restoration programs, and strengthen stewardship and partnerships in the watershed. Completed in 2 phases, the Watershed Plan consists of:

- background data collection in the form of a watershed characterization;
- a summary of the key issues in the watershed;
- completion of any additional studies to fill in data gaps in the study area;
- identification and suitability of restoration sites, landowner incentive programs, and land acquisition based on key issues in the watershed; and
- creation of an implementation plan including a monitoring component.

The Phase 1 watershed characterization contains a detailed background report including a description of the watershed's physiography, soils, land use, ecological, cultural and natural heritage, as well as a description of surface and groundwater resources. Phase 2 of the watershed planning process provides a set of watershed objectives that are linked to a comprehensive list of watershed issues derived from the *NWS* (RMN 2006a), and public events. Issues specific to agriculture were gathered through the *Land Management Issues and Agricultural Best Management Practices* survey (NPCA 2006) (Appendix A), which was distributed to Ontario Federation of Agriculture members

through a partnership with the Niagara Peninsula Conservation Authority. Any issues derived from these documents and public venues form the foundation of the watershed strategy and subsequent action plan, which are the focus of Phase 2 of the watershed planning process.

The Beaverdams and Shriners Creek watershed (Figure 1) is a unique watershed for many reasons. The rich history of the Welland Canal has influenced and shaped the cultural and economic history of the area. The patterns of land use in the region are a result of the early construction of the Canal. The strategic location of settlements and industries that took advantage of the accessibility to markets flourished throughout the last century and a half.

Aside from being rich in cultural history, the Beaverdams and Shriners Creek watershed study area is also rich in ecological diversity with boasting 15 listed Species at Risk by the *Committee on the Status of Endangered Wildlife in Canada*, 21 provincially rare species, 25 fish species have been identified, and numerous provincially significant wetlands and natural areas can be found throughout the watershed.

A watershed management plan for the Beaverdams and Shriners Creek watershed will aid in protecting and enhancing these distinctive resources in the watershed.

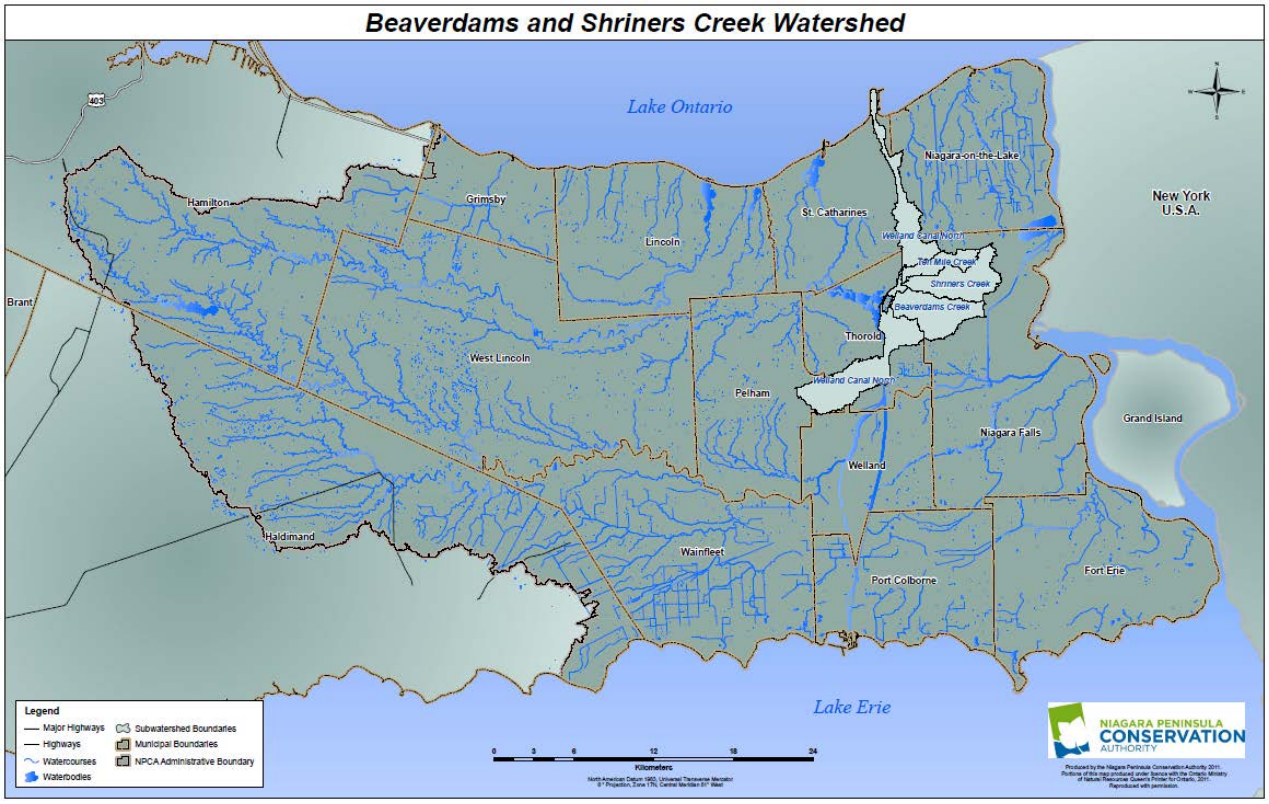

Figure 1: Geographic Location

Watershed Vision

Under the Conservation Authorities Act (R.S.O. 1990, c.C27), the mandate of the Niagara Peninsula Conservation Authority is to establish and undertake programs designed to further the conservation, restoration, development and management of natural resources. In keeping with the mandate of the NPCA, *NWS* (RMN 2006a), and the watershed challenges and issues, residents of the Beaverdams and Shriners Creek watershed envision the following:

The Beaverdams and Shriners Creek watershed will support healthy forests, wetlands, agricultural areas, meadows, watercourses and a diversity of flora and fauna while sustaining a viable agricultural industry and compatible communities. The Beaverdams and Shriners Creek watershed will offer opportunities for residents to learn about and experience a richness in diversity in a passive recreational and educational environment.

Proposed Watershed Objectives

Each watershed in the Niagara Peninsula Conservation Authority's jurisdiction is unique, having its own set of watershed planning objectives. The watershed objectives for the Beaverdams and Shriners Creek watershed have been categorized based on the watershed's resource components, including the social and built environment. In accordance with the *Provincial Policy Statement* [Ontario Ministry of Municipal Affairs(MMAH) 2005a], *Growth Plan for the Greater Golden Horseshoe* [Ontario Ministry of Public Infrastructure Renewal (MPIR) 2006], *Regional Policy Plan* (RMN 2007) and public input, natural resources will be managed on a watershed scale in the Beaverdams and Shriners Creek watershed to:

Water Resources

- improve, enhance, maintain or protect water quality and/or stream processes to support human uses and ecological functions in accordance with Provincial Water Quality Objectives;
- ensure storm water management practices minimize storm water volumes, sediment and contaminant loads;
- protect, improve and/or restore vulnerable areas (surface and groundwater features) that can be easily influenced or impacted by activities or events; and
- minimize erosion caused by human activity through the establishment and implementation of a comprehensive, priority based erosion control program;

Fish and Aquatic Habitat

- support healthy and diverse aquatic habitat;
- protect, enhance, create, and/or maintain native fish and aquatic habitat;
- eliminate barriers to fish migration; and
- investigate exotic fish and plant populations and their impacts.

Natural Heritage and Resources

- protect, enhance, create, and/or maintain natural heritage systems and linkages, including riparian;
- investigate impacts of exotic species and recommend mitigation measures;
- identify sensitive areas that need to be protected; and
- incorporate Species at Risk management plans into restoration.

Communication, Education and Recreation

- increase passive recreational opportunities;
- increase awareness for incentive programs;
- foster educational programs and awareness pertaining to urban and rural best management practices (e.g. water conservation practices, alternate farming practices, septic maintenance, buffers, native species); and
- encourage and establish partnerships with respective watershed stakeholders (e.g. landowners, agencies, community groups).

Development

- encourage intensification of urban boundaries;
- encourage compatible and sustainable land use;
- incorporate natural heritage features into management planning;
- incorporate alternative storm water management into development design(e.g. swales within parking lots);
- ensure storm water management practices address current and future growth capacity; and
- encourage opportunities for farm-related activities such as preservation of agricultural lands and funding programs.

Watershed Characterization

Location and General Description of the Beaverdams and Shriners Creek Watershed

The Beaverdams and Shriners Creek watershed includes Local Management Areas 1.9 and 2.11 as identified in the *NWS* (RMN 2006a) (Figure 2). The study area extends into the boundaries of the City of Thorold (37%), City of Niagara Falls (31%), and small portions of the City of St. Catharines (10%), City of Welland (10%), Town of Niagara on the Lake (7%), and Town of Pelham (5%). Numerous subwatersheds form the Beaverdams and Shriners Creek watershed including Beaverdams Creek, Shriners Creek, Ten Mile Creek and Welland Canal North (Figure 1). Major concentrations of urban land uses (residential, commercial, industrial) are within the City of Thorold and the City of Niagara Falls.

Local Management Area 1.9

Local Management Area 1.9 extends from Allanburg northward to Port Weller at Lake Ontario, covering the entire northern portion of the Beaverdams and Shriners Creek watershed study area. LMA 1.9 includes Ten Mile Creek, Shriners Creek, Beaverdams Creek and the Welland Canal North, north of Highway 20.

The Welland Canal has been classified as marginal fish habitat whereas the remaining watercourses in LMA 1.9 are classified as important fish habitat.

The topography below the escarpment is relatively flat with a gentle slope towards Lake Ontario. Above the escarpment the topography is also relatively flat with a gentle undulating pattern in the Ten Mile Creek, Shriners Creek and Beaverdams Creek subwatersheds. Land use is characterized primarily by residential with a mix of agriculture and vacant lands.

Natural heritage features in LMA 1.9 include provincially significant wetlands Welland Canal Turn Basins and Reservoir, and Lake Gibson, Moodie Lake and Welland Canal wetland complex. In addition, this portion of the study area includes significant remnant wooded areas, numerous unevaluated wetlands and Shriners Creek Conservation Area.

Local Management Area 2.11

The remainder of the study area is in Local Management Area 2.11. LMA 2.11 includes the Welland Canal North subwatershed south of Highway 20 and to the west of the canal.

The Welland Canal North subwatershed has been classified as marginal fish habitat whereas the remaining watercourses are classified as important fish habitat. The main watercourse in this portion of the study area is classified as municipal drain; Singers Drain.

The topography in this area is relatively flat aside from the north-western portion of the study area which encompasses the south-eastern slope of the Fonthill Kame Complex. Land use is characterized primarily by residential with a mix of agriculture and vacant lands.

Natural heritage features in LMA 2.11 include Kunda Park Life Science Area of Natural and Scientific Interest (ANSI), several unevaluated wetlands and numerous provincially significant wetlands including Niagara Street-Cataract Road Woodlot complex and Port Robinson Woodlot. In addition, several significant remnant woodlots are present throughout the study area.

The Land Management Areas of the Beaverdams and Shriners Creek watershed are illustrated on Figure 2.

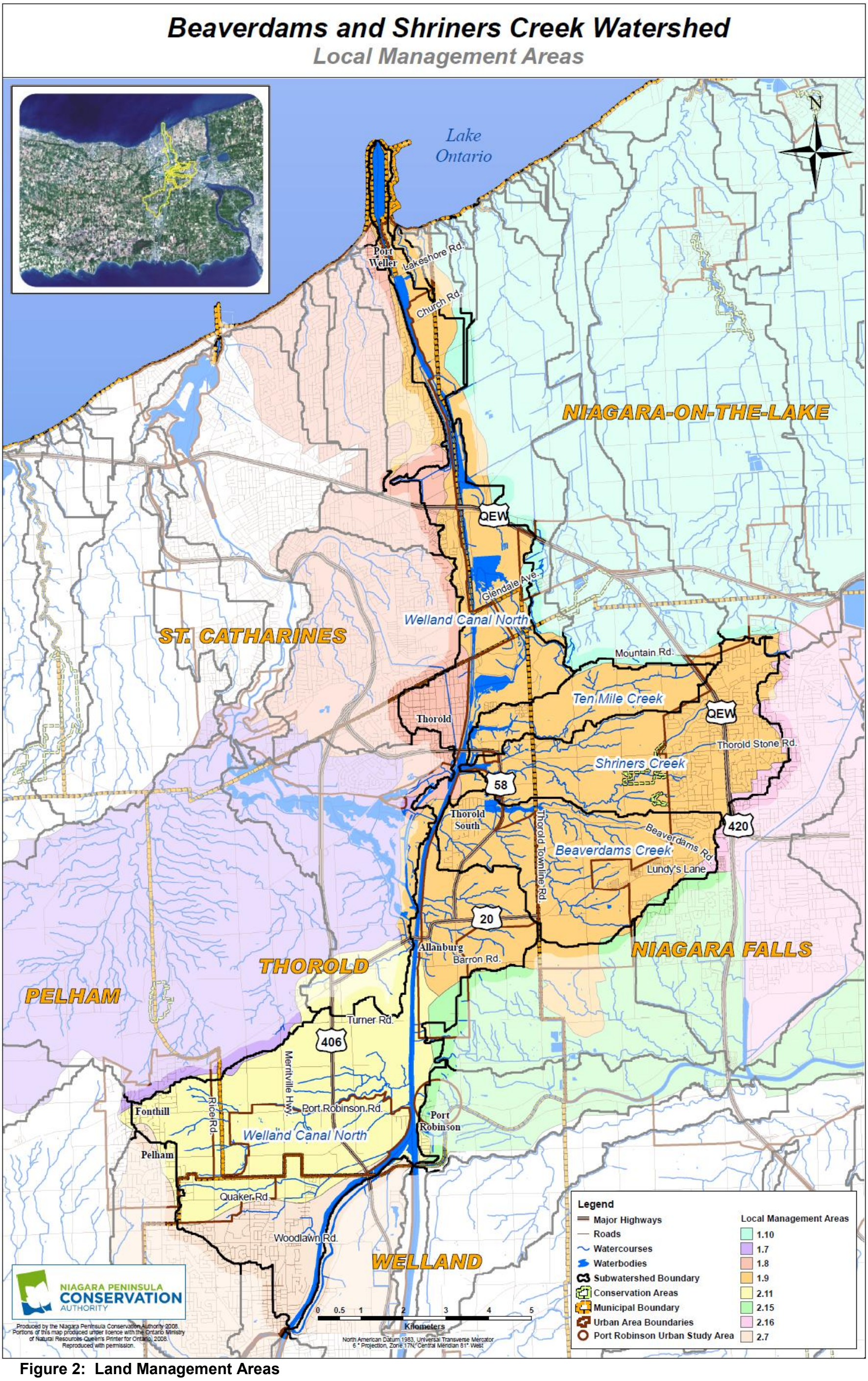

Figure 2: Land Management Areas

Topography

The north-south orientation of the Beaverdams and Shriners Creek watershed results in a diverse topography.

Below the escarpment the topography is relatively flat indicating the lake bed of historic Lake Iroquois. This lake bed gently slopes upward towards a discontinuity in the flat landscape below the escarpment that marks the shoreline of this historic lake. This shoreline is evident today along Highway 8.

The most prominent feature in the study area is the Niagara Escarpment which rises to an elevation approximately 180 meters above sea level (m.a.s.l.). Above the escarpment the topography is also relatively flat with a gentle undulating morphology that has subsequently determined the fluvial courses of Ten Mile Creek, Shriners Creek and Beaverdams Creek.

The southwestern portion of the study area rises gently upwards on the offshore slope of the proglacial delta, the Fonthill Kame, which was built into proglacial Lake Warren (Tinkler 1994). The topography is also slightly elevated in the headwater region of Ten Mile Creek, Shriners Creek and Beaverdams Creek. The topography of the Beaverdams and Shriners Creek watershed is illustrated on Figure 3.

Geology

The north-south orientation of the Beaverdams and Shriners Creek watershed also results in the study area having a unique geologic composition as it stretches from Lake Ontario, southward towards the centre of the Niagara Peninsula. The study area is overlain with bedrock from the mid-Ordovician period and the Silurian period of roughly 425 to 410 million years ago.

The most northern extent of the study area consists of Queenston shale; the oldest formation in Niagara Region and the basal unit of the Niagara Escarpment. The Queenston shale was deposited during the mid-Ordovician period approximately 470 million years ago. During the mountain building along the east coast of present day North America, rivers flowing south-west off the mountain range deposited sediments in inland seas as delta deposits. Eventually these deltas merged forming one huge delta; the Queenston Delta. These delta sediments occur in Niagara Peninsula as Queenston shale (Bowden 1991).

During the Silurian period approximately 425 million years ago, intermittent trends of transgression and regression of the Paleozoic Sea coupled with mountain building, uplifting, and periods of sedimentation and deposition resulted in the sedimentary composition of the Clinton-Cataract member. The various layers of the Clinton-Cataract member can be identified in numerous locations along the face of the Niagara Escarpment.

The cap rock of the Niagara Escarpment is composed of the limestone and dolomites of the Lockport group. The Lockport group represents an extended period of clear water carbonate shelf deposition in Niagara Region (Bowden 1991). Four formations comprise the Lockport group; these include the Gasport, Goat Island, Eramosa and Guelph. The Gasport formation is limestone whereas the remaining formations in the Lockport group

have been altered to dolomite. This happens when water saturated with magnesium flows through the limestone replacing calcium atoms with magnesium atoms (Bowden 1991). The Beaverdams and Shriners Creek Watershed Plan study area is predominately overlain with bedrock of the Lockport group.

During the upper Silurian period, the seas became shallower resulting in land surfaces becoming more arid, and deposition of shale and fine grained dolostone occurred (Lewis 1991). Restricted circulation and increased evaporation of the sea resulted in deposition of evaporites (halite, gypsum, anhydrite), evaporitic carbonates and shales of the Salina Formation (Ministry of Northern Development and Mines No Date). The geology of the Beaverdams and Shriners Creek watershed is illustrated on Figure 4

Physiography

Like its geologic composition, the north-south orientation of the Beaverdams and Shriners Creek watershed study area also results in a distinctive physiography as the study area boundary encompasses a number of physiographic features as it stretches from Lake Ontario, rises above the escarpment and encompasses portions of the Fonthill Kame Complex and the Niagara Falls moraine.

The most northern extent of the study area is comprised of glaciolacustrine deposits of the Iroquois Plain which was inundated by Lake Iroquois during the recession of the Wisconsin glacier. The Iroquois Plain extends from Lake Ontario southward where it meets the Haldimand Clay Plain towards the base of the Niagara Escarpment. Below the Niagara Escarpment a band of glacial shorecliff cuts across the Haldimand Clay Plain marking the historic shoreline of Lake Iroquois.

The predominant physiographic region of the Beaverdams and Shriners Creek watershed is the Haldimand Clay Plain which extends from the Niagara Escarpment to Lake Erie. The Haldimand Clay Plain was submerged by post-glacial Lake Warren and much of it is covered by lacustrine clay deposits. During the retreat of the Wisconsin ice sheet, Lake Warren flooded the area south of the ice front. This retreat halted for a period south of the Niagara Escarpment. Evidence of this is marked by the presence of 2 low recessional moraines built by the ice lobe occupying the basin of present day Lake Ontario. Both moraines are orientated in an east-west direction; the Vinemount Moraine and the Niagara Falls Moraine. The Vinemount Moraine hugs the crest of the escarpment slicing through the study area and the Niagara Falls Moraine lies east of the Welland Canal in line with the Fonthill Kame.

At one point a river flowed south over the ice surface emptying into Lake Warren. As a result, sand and gravel accumulated in the lake forming a delta that rested against the ice lobe, while finer particles were swept away to settle on the lake bottom. When the ice retreated further, the side of the delta collapsed resulting in a long low hill with a gentle southwest slope and a steep northeast slope (Murphy 1982). Today this is known as the Fonthill Kame. Gravelly beaches found on the Fonthill Kame fortify that this feature was a small isolated island of Lake Warren (Chapman & Putnam 1984). Only a touch of its south-eastern slopes extend into the Beaverdams and Shriners Creek watershed. The physiography of the Beaverdams and Shriners Creek watershed is illustrated on Figure 5.

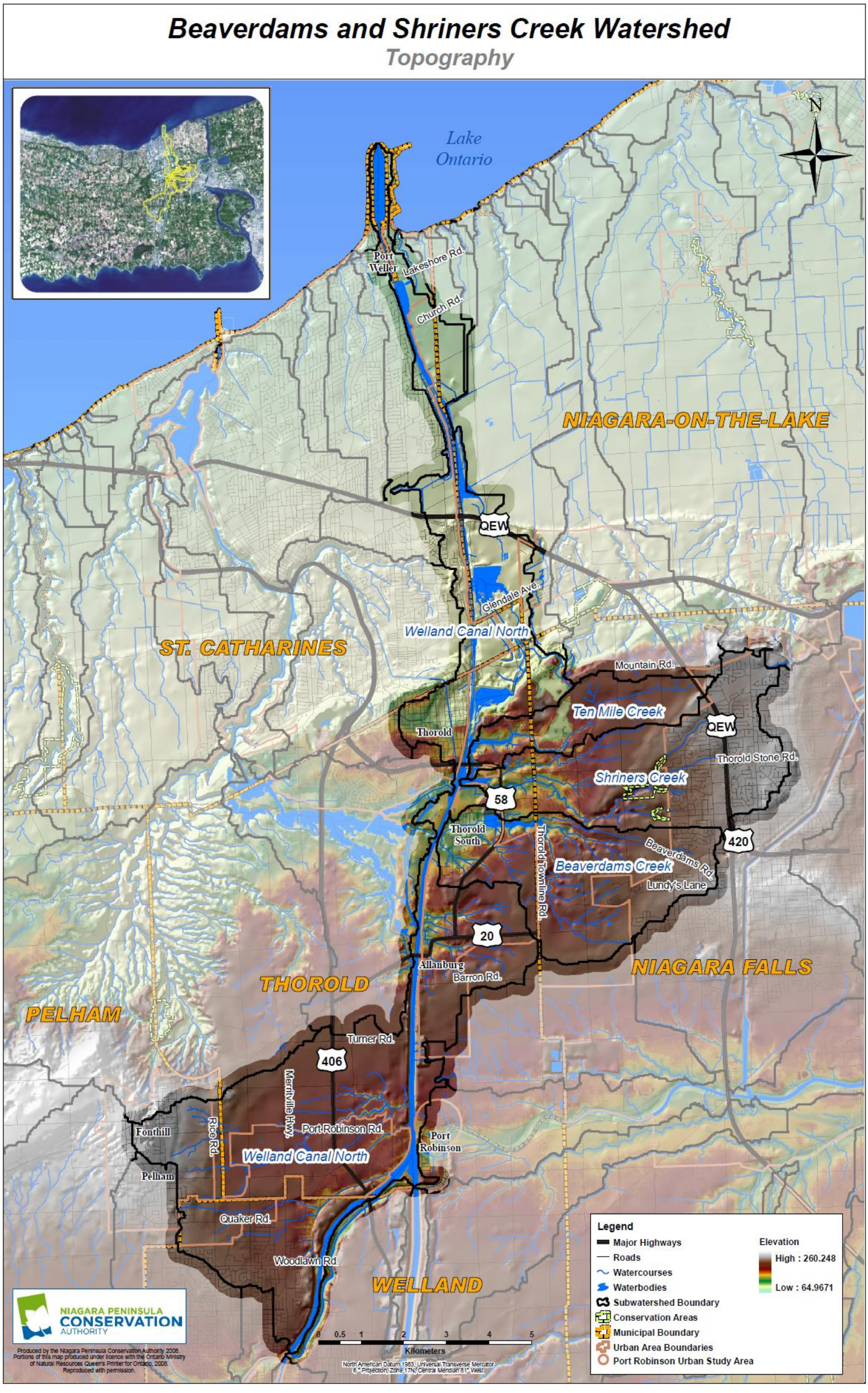

Figure 3: Topography

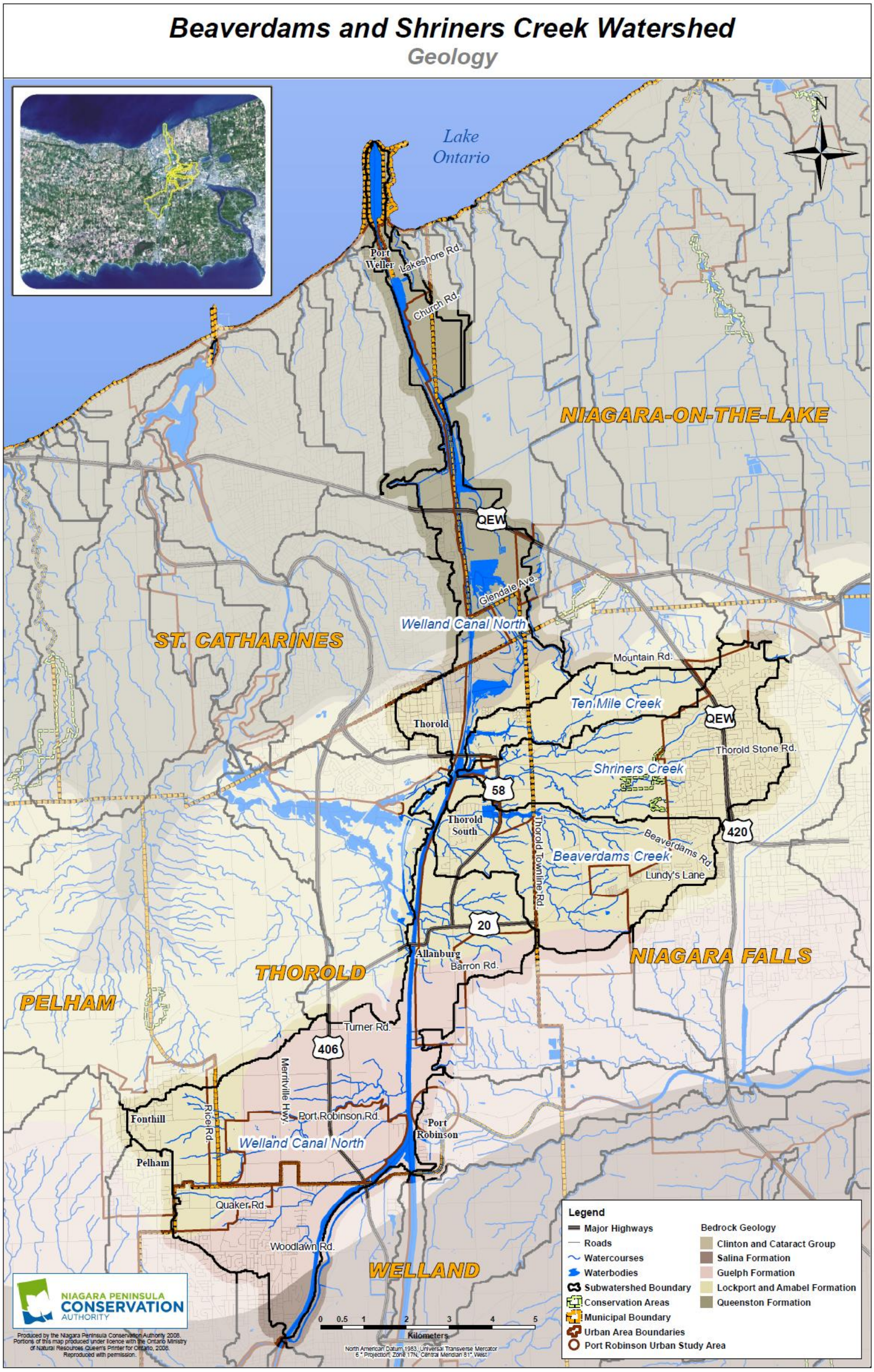

Figure 4: Geology

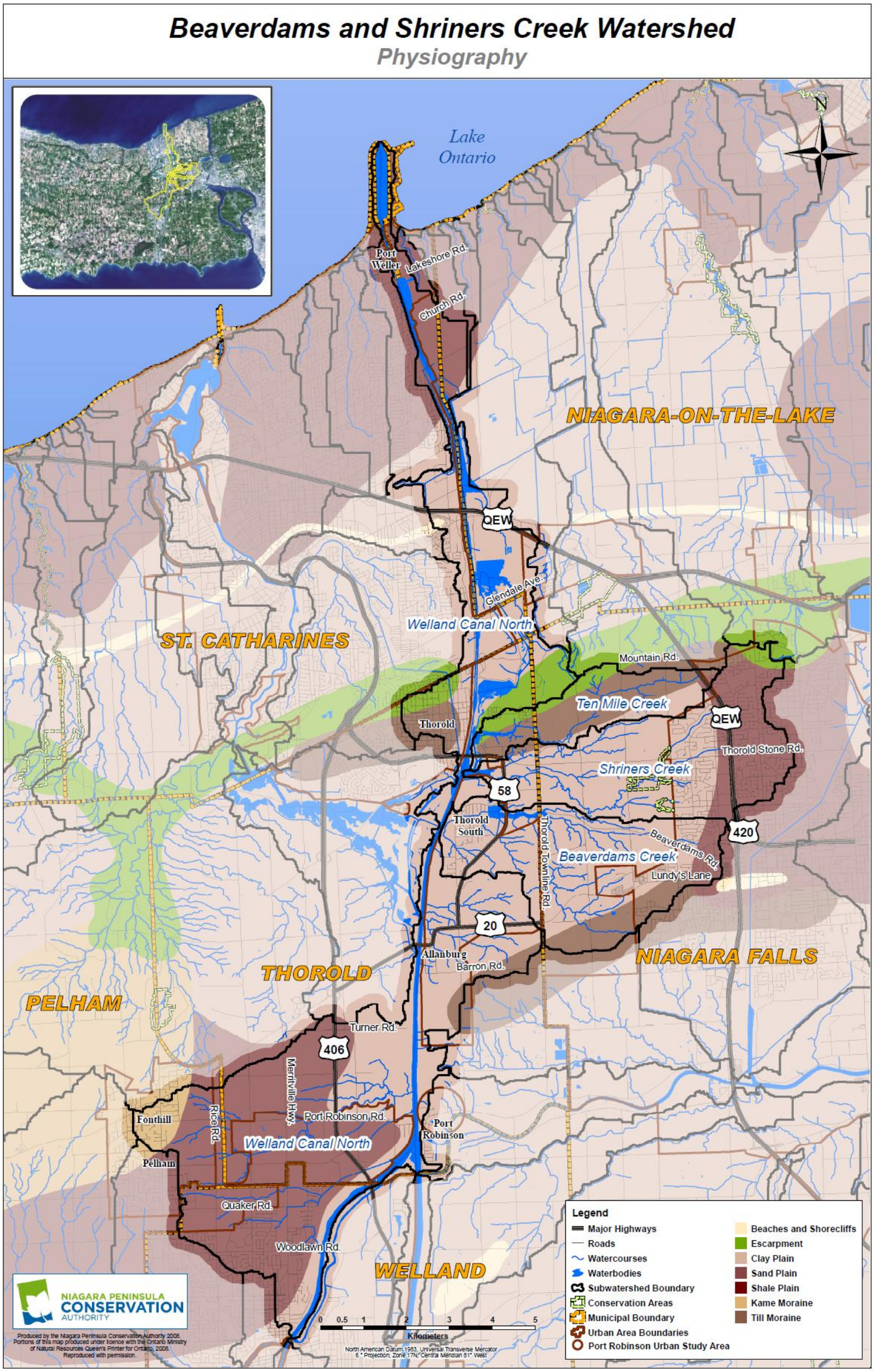

Figure 5: Physiography

Soils

The soils in the Niagara Region were resurveyed and documented in a report entitled *The Soils of Regional Niagara* (Kingston and Presant 1989) by the Ontario Ministry of Agriculture and Food and Agriculture Canada. This study included geological and physiological features; soil groups and types; soil moisture characteristics; drainage and variability; common properties of soil groups; as well as information related to agricultural soil use and classification. The following soil descriptions and associated map (Figure 6) are derived primarily from this document.

Numerous soil groups characterize the Beaverdams and Shriners Creek watershed; however, it is generally dominated by the lacustrine silty clay groups of Beverly and Toledo soils. Beverly soils are imperfectly drained. Their permeability is moderate to slow, and they have a medium to high water holding capacity. For a period each year, groundwater occupies the surface horizons. Saturation periods tend to be prolonged in cultivated fields where the subsoil has been overcompacted from use of heavy equipment. This soil group is commonly used for small grains, corn and forage crops. Commonly associated with Beverly soils are Toledo soils. Toledo soils are poorly drained and typically slowly permeable with a high capacity to hold water. Like Beverly soils, groundwater levels tend to stay near the surface much of the year. Due to the high degree of subsoil compaction with these soil groups, tile drainage and continued maintenance may be required.

The eastern portion of Beaverdams subwatershed and the northern portion of the Welland Canal Turn Basins are dominated by lacustrine heavy clays of Haldimand soils and associated Lincoln soils. Haldimand soils like Beverly soils are imperfectly drained. Haldimand soils are slowly permeable with a medium to high capacity to hold water; however they can be droughty during dry periods. Typically, there is some temporary perching of groundwater during seasonal high groundwater levels. They are commonly associated with Lincoln soils. Lincoln soils are poorly drained and like Haldimand soils, are slowly permeable, have a high water holding capacity and can be droughty during dry season. Care must be taken with both soil groups when using heavy equipment to avoid compaction. Both soils groups are commonly used for field crops.

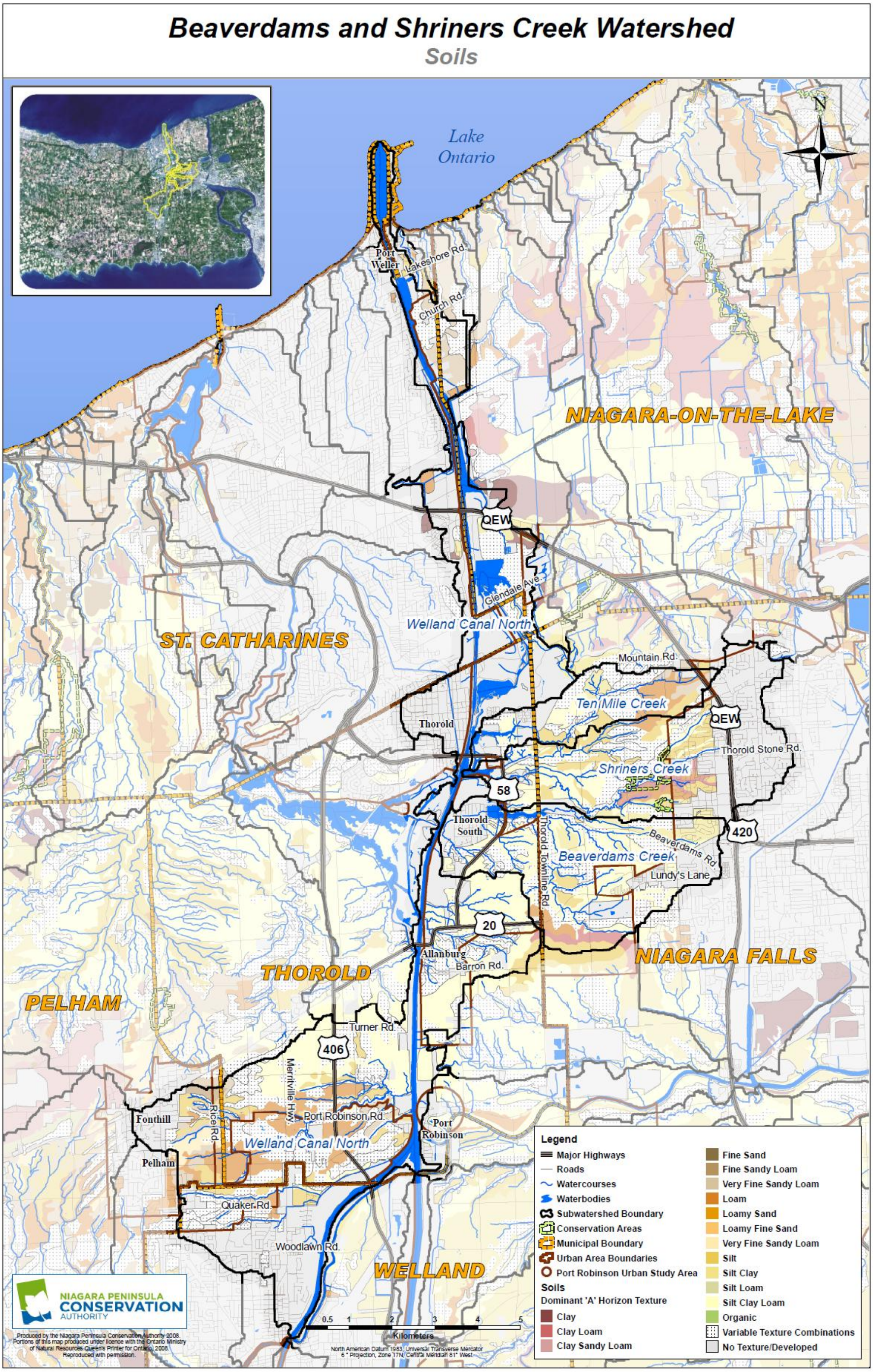

Figure 6: Soils

Historical Land Use

The obstacle presented by Niagara Falls and the lack of adequate land transport across Niagara led to an increasing need for a canal system. In addition, the development of the Erie Canal from Buffalo to the Hudson River was viewed as a political and economic threat due to the interest of the United States to gain control over the Great Lakes region. As a result the location of the Welland Canal was chosen as a strategic need to be away from the American border (Gayler 1994).

Construction of the first Welland Canal in the mid to late 1820's resulted in the establishment of a series of settlements (e.g. Port Dalhousie, Thorold, Welland, Port Colborne, and Dunnville) along the route of the canal and the feeder canal. The communities were primarily made up of canal workers and workers attracted to the industries that were starting to establish along the canal route.

As technology improved and vessel size increased so did the Welland Canal. From 1845 to 1973, three successive Welland Canals were built. Each succession was equipped with fewer locks made from more durable material, and improvements to the canal route were carried out. From its initiation, the Welland Canal was a major channel of commerce on the lower Great Lakes, influencing the economic and social network of the region.

Current Land Use

The Beaverdams and Shriners Creek watershed extends into the municipalities of the City of Thorold (37%), City of Niagara Falls (31%), and small portions of the City of St. Catharines (10%), City of Welland (10%), Town of Niagara on the Lake (7%), and Town of Pelham (5 %). Land use in the study area is predominantly residential and agriculture.

Agriculture

The location of the Niagara Peninsula between the moderating influences of the Great Lakes and the Niagara Escarpment creates a unique microclimate that supports a viable agricultural community (Planscape 2003). In 2001, the Region of Niagara commissioned a study to assess the nature of agriculture in Niagara; *Regional Agricultural Economic Impact Study 2003.* The study confirmed that "*agriculture is of tremendous importance to the Niagara economy both directly and indirectly"* (Planscape 2003). According to the study, in 2001 the agricultural industry generated over $511 million in gross farm receipts in Niagara.

In terms of the watershed municipalities in the Beaverdams and Shriners Creek Watershed study area, the main commodity groups are:

- City of Thorold: grain and oilseed, fruit, and miscellaneous speciality;
- City of Niagara Falls: miscellaneous speciality, cattle, and field crops;
- City of St. Catharines: fruit, miscellaneous speciality, and grain and oilseed;
- Town of Niagara on the Lake: fruit, miscellaneous speciality, and poultry and egg;
- Town of Pelham: miscellaneous speciality, fruit, and grain and oilseed; and
- Welland: miscellaneous speciality, grain and oilseed, and field crops.

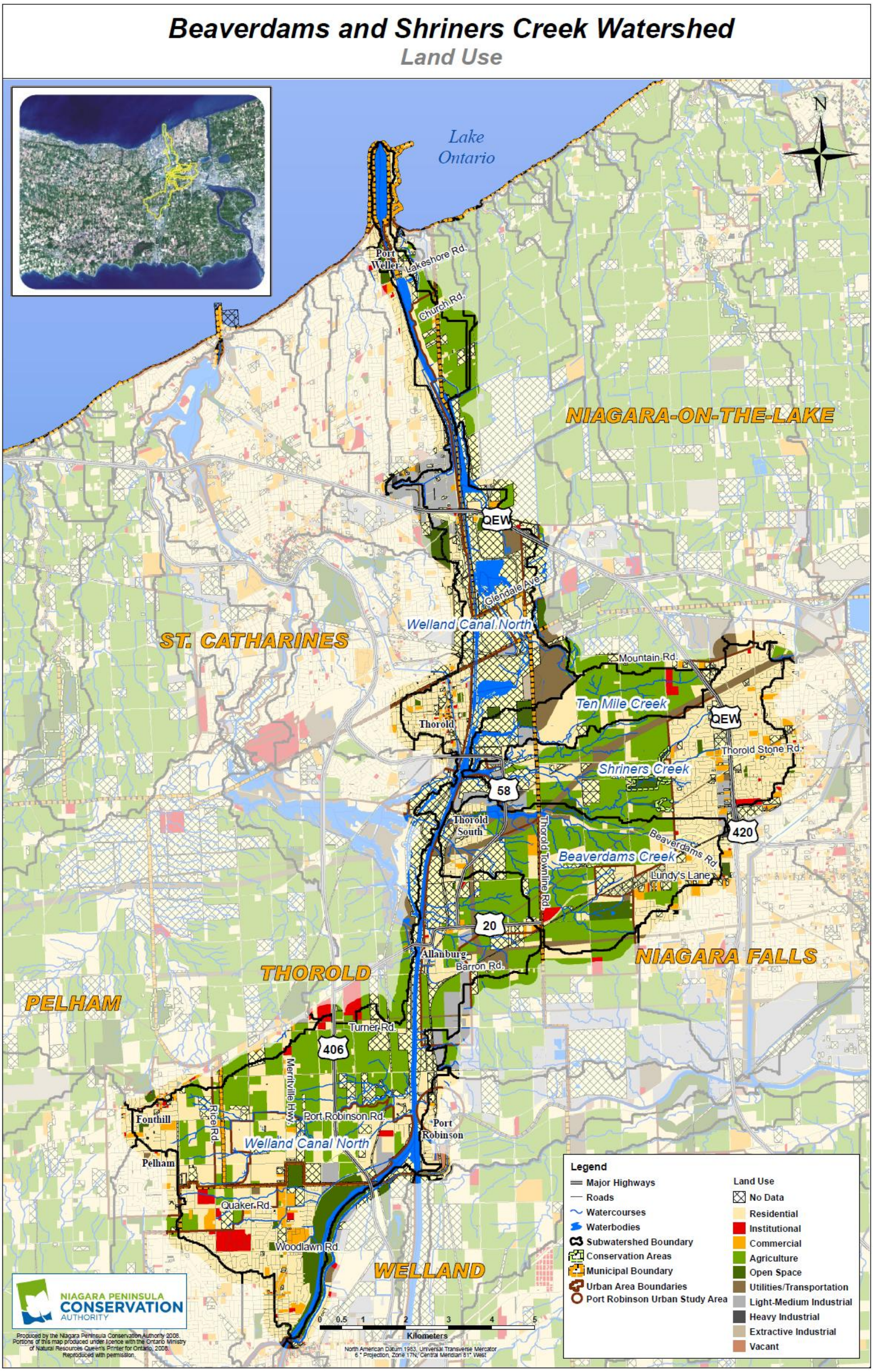

Figure 7: Current Land use

Urban/ Rural Residential

Major concentrations of urban land uses (residential, commercial, industrial) include the City of Niagara Falls in the eastern portion of the study area and the City of Thorold in the central area of the study area. Smaller concentrations are located in Pelham, St. Catharines and Welland (Figure 7). There is one active gravel pit and landfill (Walker Brothers) in the study area, located in western Niagara Falls.

Recreation

The Beaverdams and Shriners Creek watershed offers numerous recreational opportunities throughout the watershed. Several municipal parks provide residents with an opportunity for passive recreation, and there are 4 golf courses and driving ranges in the watershed: Lock 7 Golf Centre in Thorold, Lundy's Lane Driving Range, Niagara Falls Golf Club, and Beechwood Golf and Country Club all of which are located in the City of Welland.

Hiking and biking trails can be enjoyed throughout the area, including portions of the Welland Canal Trail, Regional Bicycle Network, Greater Niagara Circle Route and Scenic Bike Loops such as the Port Robinson and St. Catharines loops; in addition, the Bruce Trail intersects the northern portion of the study area.

One conservation area falls within the boundary of the Beaverdams and Shriners Creek watershed study area; Shriners Creek Conservation Area. This conservation area acts as a wildlife refuge with no public access permitted. In 2009-2010, the Niagara Restoration Council, with several partnering agencies, initialized the naturalization of the Thorold-Lake Gibson corridors with the planting of 52,000 trees, seeding with a native prairie/meadow mix, and the removal of over 7 tonnes of garbage (NRC 2010).

Future Land Use

In Ontario planning decisions are influenced by all levels of government: federal, provincial, regional and local (e.g. municipal). Although each tier has an appropriate role in planning decisions, co-ordination between tiers is necessary for effective planning and management of respective jurisdictions. For example, in Niagara the federal government would be responsible for regulating railroads, the Welland Canal, and the defense of our international boundary; whereas the provincial government's major responsibilities are primarily concerned with matters of provincial interest, for example, provincial transport routes, utilities, property assessment, land use planning, and protection of the environment, as well as numerous aspects of municipal development. Regional governments are responsible for planning, waste management, regional roads, treatment and distribution of water, and community services (e.g. police, health and welfare). However, some of the aforementioned responsibilities are shared with respective municipalities with some direction from the provincial government; areas such as treatment and distribution of water, waste management, planning and land use regulation.

Therefore, implementation of the Beaverdams and Shriners Creek Watershed Plan should be integrated into planning initiatives and roles of regulation by all levels of government. Land use changes in the Beaverdams and Shriners Creek watershed

should also consider recommendations put forth by the Watershed Plan and supporting studies and documents where appropriate.

Provincial Tier

In Ontario, the *Growth Plan for the Greater Golden Horseshoe* (GGH) (MPIR 2006) has been prepared under the *Places to Grow Act* (MPIR 2005), to help guide land-use planning decisions in the Greater Golden Horseshoe area. The plan provides a framework for managing the projected future growth in the region by guiding decisions on a wide range of important planning aspects such as future transportation needs and infrastructure, natural heritage and resource protection, land use planning and housing requirements. The *GGH* promotes intensification of existing built-up areas and revitalization of urban growth centres while recognizing the vital economic and cultural importance of our rural communities. The *GGH* works with other government initiatives such as the *Greenbelt Plan* [Ontario Ministry of Municipal Affairs and Housing (MMAH) 2005b] which provides for the permanent protection of the agricultural land base and ecological features by identifying where urbanization should not occur, and the *Provincial Policy Statement* (PPS) (MMAH 2005a), which provides overall direction on matters related to land use and development in Ontario, and municipal official plans by providing growth management policy direction.

The *Greenbelt Plan (MMAH 2005b)* identifies where urbanization should not occur in order to provide permanent protection to the agricultural land base and the ecological features and functions occurring on the landscape. Protected Countryside lands identified in the *Greenbelt Plan* are "*intended to enhance the spatial extent of agriculturally and environmentally protected lands currently covered by the NEP*[Niagara Escarpment Plan] *and the ORMCP* [Oak Ridges Moraine Conservation Plan-not in study area] *while at the same time improving linkages between these areas and the surrounding major lake systems and watersheds*"(Section 1.1). The *Greenbelt Plan* outlines 3 key policy areas for lands within the Protected Countryside designation. The policy areas as described in the *Greenbelt Plan* are as follows:

- Agricultural System is comprised of specialty crop areas, prime agricultural areas and rural areas;
- Natural System is comprised of the Natural Heritage System, Water Resource System and key natural heritage features and key hydrologic features; and
- Settlement Areas are comprised of Towns/Villages and Hamlets (1.4.2 Section 3).

The *Greenbelt Plan* must be read in conjunction with all other applicable land use planning policy and regulations including but not limited to, the *GGH*, *PPS*, official plans (upper, lower and single), and zoning by-laws.

The *PPS* recognizes that sustainability of Ontario's natural and cultural heritage resources over the long term is of key provincial interest given that they provide significant social, economic and environmental benefits; "*Strong communities, a clean and healthy environment and a strong economy are inextricably linked"* (PPS 2005a). Accordingly, while providing direction on appropriate development, the policies of the *PPS* provide protection for; resources of provincial interest, quality of the natural environment, and public health and safety by focusing growth within existing settled areas and away from sensitive or significant natural resources or areas that may pose as a threat to public health and safety.

The *PPS* calls for the wise use and management of resources by imposing stringent limitations on development and site alteration for numerous natural settings, including, but not limited to; significant and /or sensitive natural areas (terrestrial and aquatic), lands adjacent to significant and /or sensitive natural features, and areas of fish habitat. The *PPS* also calls upon planning authorities to "*protect, improve or restore the quality and quantity of water"* (Section: 2.2.1) by means of for example, using the watershed as the ecological scale for planning activities; ensuring stormwater management practices have minimal negative impacts; and linkages and related functions between terrestrial/aquatic features are maintained.

In terms of agricultural areas, the *PPS* calls for the protection of prime agricultural areas for long-term agriculture and related usage, and for respective planning authorities to designate specialty crop areas in accordance with provincial evaluations. In regards to extraction of mineral aggregate resources, the *PPS* requires extraction to be *"undertaken in a manner which minimizes social and environmental impacts"* (Section: 2.5.2.2), and rehabilitation of the extraction area is required to "*accommodate subsequent land uses, promote land use compatibility, and to recognize the interim nature of extraction"* (Section 2.5.3.1).

In addition to requiring the wise use and management of resources, the *PPS* calls for promotion of healthy, active communities by for example, providing public accessibility to natural settings for recreation, including "*parklands, open space areas, trails and , where practical, water-based resources"* (Section: 1.5.1), including shorelines.

The *PPS* policies may be complemented by other provincial (e.g. *GGH*), regional (e.g. Regional *Policy Plan)*, and municipal policies (official plans) regarding matters of regional and municipal interest. Together, provincial plans, and regional and municipal official plans provide a "*framework for comprehensive, integrated and long-term planning that supports and integrates the principles of strong communities, a clean and healthy environment and economic growth, for the long term"* (PPS 2005a).

Regional Tier

The *Planning Act* (MMAH 1990) designates the *Policy Plan: Regional Strategy for Development and Conservation* (RMN 2007a) as the paramount planning document for Niagara Region as stated in *Section 27.1* of the *Planning Act*: "*The council of a lower-tier municipality shall amend every official plan and every by-law passed under section 34* [addresses zoning by-laws]*, or a predecessor of it, to conform with a plan that comes into effect as the official plan of the upper-tier municipality."* Additionally, the *Planning and Conservation Land Statue Law Amendment Act, 2006 [(Bill 51)* MMAH 2007] provides direction for updating municipal official plans and zoning by-laws by requiring that municipalities assess the need for official plan updates every five years and update the respective zoning by-laws no later than three years after the official plan revisions are made as part of the five year review (Section 26.1; 9).

In accordance with the *GGH, PPS* and other provincial policies, the *Policy Plan* outlines numerous regional policies and strategies addressing local interests. For instance; land use and development, agriculture, cultural and natural heritage and aquatic resources, tourism and recreation are a few of the areas of interest addressed in the *Policy Plan*.

In 2009, Region of Niagara updated the Urban Areas policies in the *Policy Plan* (Amendment 2-2009) to implement strategic directions of an extensive 5-phase growth management strategy. It is the intent of the Region of Niagara to "*promote an integrated land use planning framework for decision making"* that involves all respective

stakeholders, and it is the position of the amended policies to "*represent an opportunity for Niagara to affirm its commitment to building sustainable, complete communities"* [(Section 2) RMN 2009]. Accordingly, objectives of the Urban Policies include strategies that are intended to guide decisions related to "*land use planning, infrastructure development, natural and cultural resource management and fiscal planning"* (Section 2.2). Strategies in the *Policy Plan* for implementing this balance include policies related to for example, urban structure, intensification, Greenfield areas and transportation corridors.

Recognizing that Niagara supports a viable agricultural industry, the Region of Niagara commissioned a study to support the establishment of "*agricultural value added activities*" by considering "*how the land use planning process in Niagara can identify and encourage such value added activities*" (Planscape 2009). The study makes a series of objective recommendations to be included with the existing agricultural policies of the *Policy Plan*. Recommendations include for example, "*To recognize the range of impacts that different types of value added activities may have on the farm and on surrounding farms, and provide for different regulatory provisions"* (Objective 6.10), and "*To recognize the role of the Region to establish flexible, performance based criteria for use by the local municipalities, and recognize variations in the range of diversification activities within individual municipalities*" (Objective 6.9).

The *Policy Plan* also outlines a number of objectives and strategies to maintain and foster a viable agricultural industry by preserving Niagara's agricultural lands and production through a multi-tier government coordinated effort by supporting the following policies; tariff/quota protection from imports (federal); adequate marketing and protection of unjustified taxes (provincial and local); and financial assistance and protection of unique and good agricultural lands are some of the local policies that the *Policy Plan* outlines.

The environmental policies entitled *Healthy Landscape* apply an ecosystem approach to the environmental policy framework by employing proactive sustainable principles. Some of these principles include: stewardship plus regulation; environmental protection plus enhancement; and ecosystem health and sustainability. These principles are also applied to the mineral extraction sector to ensure that these resources are not only available for future use, but the extraction and "*management is compatible with the natural and human environment" (Section 7.E)*.

Extensive trail systems such as the Welland Canals Trail and The Greater Niagara Circle Route not only provide an abundance of recreational opportunities for residents and tourists, but these trail systems link Niagara Regions' history and cultural heritage with its natural heritage. It is the intent of the *Policy Plan* to promote and coordinate further development of recreational trails in Niagara to promote recreational opportunities and encourage healthy lifestyles while fostering the expansion of the tourism industry. For example, in the Beaverdams Shriners Creek Watershed Plan area, nearly 11 kilometres of abandoned railway line from Thorold to Fonthill has been proposed to become an extension of the Greater Niagara Circle Route.

The *Policy Plan* also recognizes that successful planning and environmental conservation requires coordination and cooperation involving all levels of government and respective stakeholders (e.g. municipalities, landowners, environmental agencies and interest groups). Accordingly, the *Policy Plan*, which adheres to provincial policies, provides an overall framework for development and planning in Niagara Region that the respective municipalities are to adhere to with further detail at a municipal level.

Conservation Authorities

Conservation Authorities are the governing body responsible for hazard lands in Ontario. Hazardous land, as defined in the *Conservation Authorities Act* [section 28 (25)], is *"land that could be unsafe for development because of naturally occurring processes associated with flooding, erosion, dynamic beaches or unstable soil or bedrock"*. Accordingly, under the *Planning Act*, the NPCA is delegated provincial responsibility for reviewing hazard lands for respective municipalities on any proposed development within the NPCA jurisdiction. In the Region of Niagara, the NPCA has a Memorandum of Understanding with regional and local municipalities whereby NPCA provides comments on all natural hazards and natural heritage matters. Comments provided by the NPCA outline implications of development proposals from a watershed perspective pertaining to natural hazard planning, natural heritage planning, or groundwater and surface water management [NPCA 2007b (Section 4.0)]. These comments not only reflect the goals and the objectives of the NPCA under the *Conservation Authorities Act* in terms of "*a program designed to further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals"* (R.S.O. 1990, c. C.27, s. 20.), but also reflect the requirements of Niagara Region's environmental policies. The policies for NPCA's regulated areas are administered under the *Ontario Regulation 155/06: Development, Interference with Wetlands and Alteration to Watercourse Regulation.* The policies apply to all "*watercourses, floodplains, valleylands, hazardous lands, wetlands, the shoreline of Lake Ontario, Lake Erie and the Niagara River, and lands adjacent to each of these features/functions, within NPCA's jurisdiction"* (NPCA 2007b).

Municipal Tier

In the Beaverdams and Shriners Creek watershed, the *GGH* identified the areas surrounding the built-up areas adjacent to the Welland Canal in Welland, Thorold and western Niagara Falls as designated greenfields areas, making them the focus area of future intensification with an overall minimum density target of 50 jobs and residents per hectare. The remainder of the Beaverdams and Shriners Creek watershed consists of Built-up Areas and Good General Agricultural Areas.

Accordingly, the RMN in partnership with the province and local municipalities commissioned a study to develop an action plan for the implementation of the *Niagara Gateway Economic Zone and Centre* (GKH 2008) in Niagara Region. The Gateway Economic Zone and Centre in the Beaverdams and Shriners Creek watershed includes all the settlement areas within Welland and Niagara Falls, the Welland Canal and the linkages between the Urban Growth Centre in St. Catharines, Thorold, and Welland, and existing port infrastructure.

City of Thorold

Approximately 37 percent of the Beaverdams and Shriners Creek watershed falls within the municipal boundary of the City of Thorold. Land use in this portion of the municipality is predominantly residential with a mix of agriculture, vacant lands and light-medium industrial. It is the intent of the City of Thorold to designate land uses that are compatible to each other and to encourage new development which conforms to the land use designations and policies of the *Official Plan of the City of Thorold Planning Area* [City of Thorold 2000 (Section 2.1.2)]. It is also the intent of the Official Plan to preserve

agricultural lands for existing and future farming operations by restricting land use activities in these areas to activities that area directly related to agriculture and farming operations, forestry and conservation of plant and wildlife (Section 4.6.1).

In terms of future urban development, the focus is primarily directed towards the Confederation Heights district and infilling in existing urban areas such as Allanburg, Thorold and Thorold South (Section 3.3). In addition, the City of Thorold is currently in the process of preparing a secondary plan for the Port Robinson West area. The secondary plan study area is bounded by Port Robinson to the north, the Thorold municipal boundary to the west and south, and the old and new Welland Canal to the east (Totten Sims Hubicki Assoc. 1999). A subwatershed study was completed for the area. The purpose of the subwatershed study was to develop a management strategy that will direct future land use and activities that would affect the environmental and resource conditions in Port Robinson West subwatershed and Singers Drains (Totten Sims Hubicki Assoc. 1999). The Official Plan indicates that an increased demand for a range of commercial uses will be generated by the community of Port Robinson West. The primary types of commercial facilities to serve the residents will "*largely be of a neighborhood commercial and service commercial nature"* (Section 4.9.1).

The City of Thorold recognizes the importance of open space, recreational facilities and parks to the community. It is the intent of the Official Plan to maintain current lands designated as Parks and Open Space for activities such as recreational facilities, wildlife management, open space nature and conservation uses (Section 4.5). Examples include the areas around the Welland Canal, Lakes Gibson and Moodie and urban parklands that are currently designated Parks and Open Space.

In terms of industrial lands, the Zoning By-Laws will establish various industrial zones with respective provisions such as setbacks from property lines, outside storage, buffering landscapes and so forth (Section 4.3.1).

City of Niagara Falls

Thirty-one percent of the Beaverdams and Shriners Creek watershed study area lies within the municipal boundary of the City of Niagara Falls. Land use in this area is predominantly residential with some agriculture and vacant lands. It is the intent of the *City of Niagara Falls Official Plan* (City of Niagara Falls 2009) to encourage a mix of dwelling types in all community planning districts providing for a variety of housing types suitable for different age groups, household sizes and incomes (Section 1.6). Land uses permitted in areas zoned as Residential are limited to dwelling units and ancillary uses such as, but not limited to, schools, recreational and community facilities, parks and open space.

In terms of Rural/Agricultural lands, it is the intent of the Official Plan to "*protect the continuation of farming operations, restrict the establishment of non-farm uses and minimize land use conflicts in favour of agriculture wherever possible, while protecting the natural environment"* (Section 7). It is also the intent of the City of Niagara Falls to promote continued agricultural pursuits and continued utilization of Rural lands for farming purposes, for example, efforts will be made to retain large farm units (Section 8.2). In addition, the establishment of farm help dwellings will not require a severance subject to appropriate amendment to the Zoning By-law (Section 8.3).
There is one quarry operation in the Beaverdams and Shriners Creek watershed located within Niagara Falls. It is recognized that operations as such are an important industry

and valuable to the local and regional economy. It is the intent of the Official Plan to ensure that these operations are compatible with adjacent properties and rehabilitated to suitable after-uses (Section 10).

City of St. Catharines

Ten percent of the Beaverdams and Shriners Creek watershed falls within the municipality of the City of St. Catharines. The portion of St. Catharines that falls within the study area is primarily along the Welland Canal. Land use in this strip is a small mix of residential, light-medium industrial, agriculture and open space. Like other Official Plans, the *City of St. Catharines Official Plan* (City of St. Catharines 1999) intends to provide a settlement pattern that offers of range of housing types; supports ample employment opportunities and adequate tax base; provides optimum leisure facilities and open space while catering to its own needs for commercial and cultural services (Section 2.1.1). The eastern side of the Welland Canal in the study area has been designated „Unique Agricultural Areas' under the *Regional Policy Plan*. These areas are highly suited for tender fruit and grapes. The City of St. Catharines recognizes the significant tourist potential of these areas in addition to their importance for food production, therefore, it is the intent of the St. Catharines *Official Plan* to preserve these lands for agricultural purposes and promote further agricultural development in these designated areas (Section 9).

Currently the City of St. Catharines is updating their Official Plan; therefore this section will be updated when complete.

City of Welland

Another 10 percent of the Beaverdams and Shriners Creek watershed falls within the municipality of the City of Welland. The land use in this portion of the municipality is predominately residential and commercial. In 2007 the City of Welland adopted a *Brownfield Community Improvement Plan* (CIP) (RCI Consulting) to address the municipality's high number of brownfield areas. The *CIP* provides incentive programs, strategies and actions that will promote brownfield remediation, rehabilitation and redevelopment in the City of Welland (RCI Consulting 2007). Currently it is estimated that over 200 hectares of brownfield sites exist along the canal and throughout the city (City of Welland 2007).

In terms of land use designations in the City of Welland, the municipality is currently updating their Official Plan from 1975; therefore once complete, this section will be updated to reflect the new Official Plan.

Town of Niagara-on-the-Lake

Approximately 7 percent of the Beaverdams and Shriners Creek watershed falls within the Town of Niagara-on-the-Lake municipal boundary. Land use in this area is primarily agriculture consisting of orchards and vineyards. This area has been designated as a „Unique Agricultural Area' under the *Regional Official Plan.* Like the *Official Plan* for the City of St. Catharines, the intent of the *Town of Niagara-on-the-Lake Official Plan* (1999) is to preserve agricultural lands, both present and the potentially agriculturally productive land with highest priority to „Good Tender Fruit/Grape Lands' (Section 7).

Town of Pelham

The final 5 percent of the Beaverdams and Shriners Creek watershed study area falls within the municipality of the Town of Pelham. Land use in this portion of the study area consists of a mix of residential (Fonthill) and agriculture. Like other official plans, the *Draft Official Plan for the Town of Pelham* (Meridian Planning Consultants Inc. 2007) outlines a number of goals, objectives and strategies for future land use in the municipality. Over the next 20 years, Pelham is forecasting a population increase between 4000 and 8000 residents [(Section A1) Meridian Planning Consultants Inc. 2007]. The goal of the *Official Plan* is to encourage intensification of the forecasted growth to the current urban areas where full servicing (water and sewer) already exists; Fenwick and Fonthill. Strategies to achieve this goal include for example, prioritizing residential applications for existing urban areas; limit the amount of rural residential development; and provision of a range of housing types to accommodate a broad range of income levels (Section A2.2.2). The agricultural lands in the study area are designated as „Good General Agriculture'. It is the intent of the Official plan to ensure the long-term viability of the agricultural industry in Pelham by limiting activities permitted on lands designated as Good General Agricultural or Specialty Agricultural. For example, land uses permitted in these zones must not detract from the primary role of agriculture or farm –related uses (Section B2.1.2).

Natural Heritage Resources

"One of the most fundamental principles of conservation is that there should be a system of natural corridors across the landscape, interspersed with large core natural areas" (Federation of Ontario Naturalists No Date). Not only does a natural heritage network provide a web of natural habitats that is crucial to the long-term survival and sustainability of biological diversity but this natural complex is critical in the maintenance of a healthy functioning ecosystem.

In southwestern Ontario, the Carolinian Life Zone is a rich and diverse network of cores and corridors that stretch from Toronto to Grand Bend extending southward to Lake Erie. Also known as the Eastern Deciduous Forest Region, this unique ecosystem boasts roughly one-third of Canada's rare and endangered species. Even though the Carolinian Life Zone makes up less than one percent of Canada's total land area, it contains a greater number of species than any other ecosystem in Canada and many of these species are not found anywhere else in the country (Johnson 2005). As part of its *Big Picture* project, Carolinian Canada identified considerable lands within the Beaverdams and Shriners Creek watershed as a „Carolinian Core Natural Area' (Figure 8).

A core natural area is defined as: "*an intact natural area with larger habitat blocks; regions with a high overall percentage of natural vegetation cover; viable occurrences of globally rare species and vegetation community types, and concentrations of rare species and vegetation; should exceed 200 hectares where possible with smaller high-quality sites in areas with lower amounts of natural vegetation cover; as well as having minimum corridor widths of 200 metres plus any adjacent areas of natural cover"* (Riley et al 2003).

Corridors provide an increase in functionality of core areas, even smaller or fragmented areas, by not only facilitating in the movement of larger mammals between natural areas, but "*they are also essential for the movement and maintenance of genetic*

diversity for virtually all species regardless of size or species-pollen and seeds and other genetic material are passed along corridors" (Pim No Date).

In Ontario the *PPS* (MMAH 2005) calls for the wise use and management of resources, accordingly Section 2.1.2 of the *PPS* states: "*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".*

As previously indicated, Regional Niagara's *Policy Plan: Regional Strategy for Development and Conservation* (RMN 2007a) includes objectives for a healthy landscape in the environmental policies. For example, Policy 7.A.1 b) calls upon planning authorities to employ an ecosystem approach that address "*The health and integrity of the broader landscape, including impacts on the natural environment in neighboring jurisdictions"* when making decisions regarding planning and development or conservation.

The Beaverdams and Shriners Creek Watershed Plan will acknowledge and address linkages and potential corridors that extend outside of the study area when creating a restoration strategy for the Beaverdams and Shriners Creek study area. Large core areas that are present within and outside of the study area will play an integral role in the formation or enhancement of corridors.

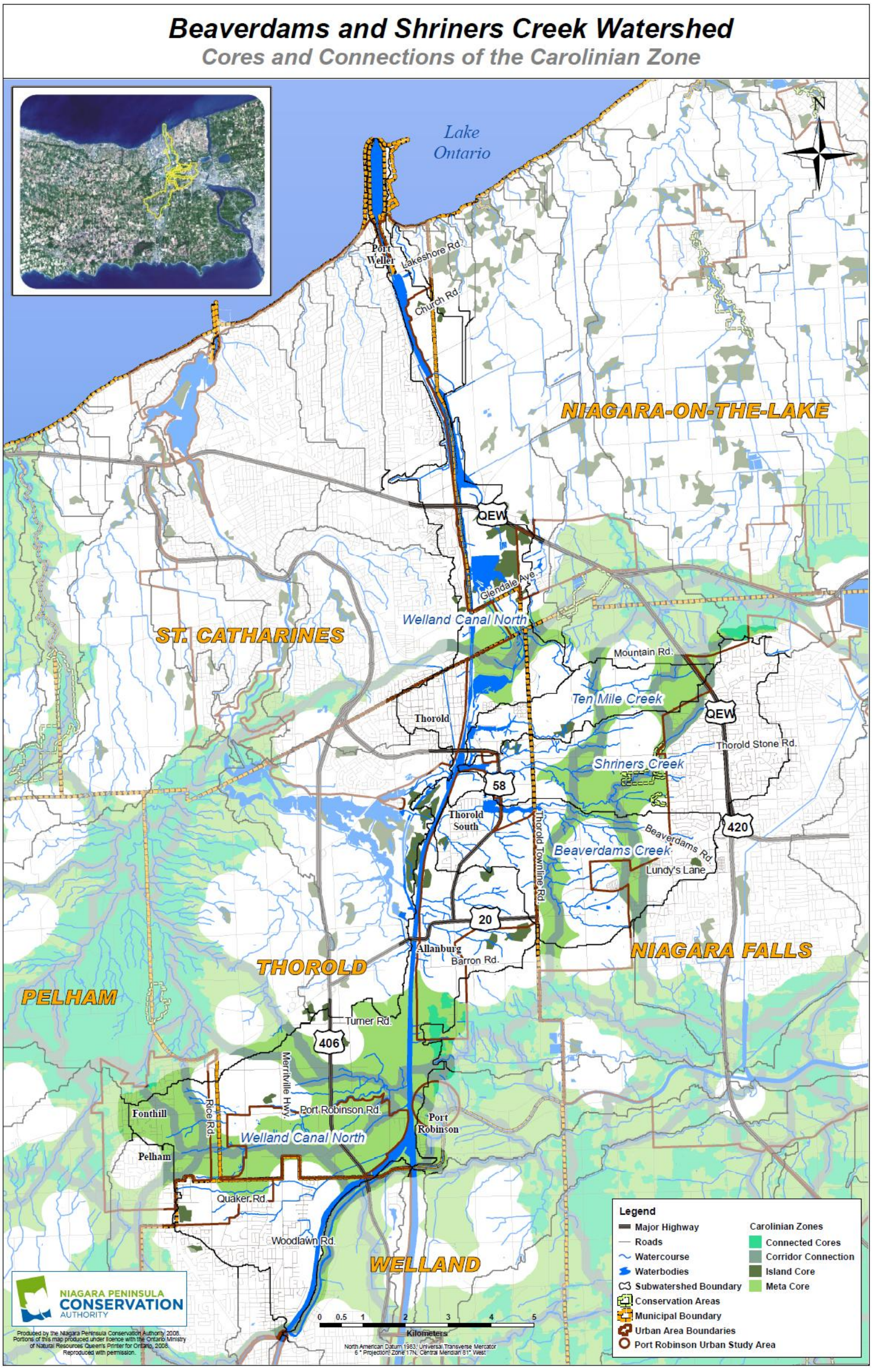

Figure 8: Carolinian Canada

Beaverdams and Shriners Creek Watershed Study Area Natural Heritage Resources

The percentages of upland forest cover, wetlands, and riparian habitat in the Beaverdams and Shriners Creek watershed are recorded in Table 1. These figures will be assessed based on the guidelines set by Environment Canada (2004c) as part of the restoration strategies in the watershed plan.

Table 1: Natural Heritage Resources

Natural Heritage Resource	Current %	Guideline (minimum) %
Upland Forests	6	30
Wetlands	6	10
Riparian Habitat	21	75

All of the natural heritage areas including wetlands, woodlots, Areas of Natural and Scientific Interest (ANSI) and Environmentally Sensitive/Significant areas are illustrated on Figures 10 and 11 respectively, and described below. This information was compiled as a joint initiative by the Ministry of Natural Resources, Regional Municipality of Niagara and the Niagara Peninsula Conservation Authority.

Life Science and Earth Science Areas of Natural and Scientific Interest

An Area of Natural and Scientific Interest "*is an area of land and water containing natural landscapes or features that have been identified as having life science or earth science values related to protection, scientific study or education*" (MMAH 2005). The following natural area is a candidate *ANSI* in the Beaverdams and Shriners Creek watershed.

Kunda Park Forest Candidate Life Science ANSI

The regionally significant Kunda Park Forest is located at the base of the Fonthill Kame slopes. The 23 acres of poorly drained sand plain houses a variety of native ferns and Carolinian tree species (Macdonald 1980).

Wetlands

The Ontario Wetland Evaluation System (OWES) is a science-based ranking system used by the MNR to assess wetland functions and societal values. Wetlands are evaluated and assigned a status as „provincially significant' or „locally significant'. The MNR is currently revising the boundaries of existing wetlands and identifying new wetlands in the Beaverdams and Shriners Creek watershed. This information will be updated and mapped in the Beaverdams and Shriners Creek Watershed Plan as it becomes available. To date, almost 40 percent of the wetlands have been designated as provincially significant, approximately 1 percent are designated as locally significant and the remaining 59 percent are awaiting evaluations.

The following wetlands have been designated as Provincially Significant Wetlands (PSWs) in the Beaverdams and Shriners Creek watershed:

The **Niagara Street-Cataract Road Woodlots-Wetland** is a provincially significant wetland complex composed of four individual wetlands consisting of 92.5 percent swamp and 7.5 percent marsh (Harnden and Hudson 1987). Numerous wetland vegetation communities have been noted by Harnden and Hudson (1987), including for example, robust emergents such as cattails; free-floating plants such as duckweed; low shrubs such as meadowsweet and highbush blueberry; and deciduous trees such as red maple and bur oak.

The **Port Robinson Woodlot** is over 45 hectares of provincially significant wetland. This wetland complex is composed of marsh and swamp. In 1987, Kwicinski and Tae identified numerous vegetation communities in the Port Robinson Woodlot including for example, submerged plants such as waterweed; robust emergents such as cattail and burreed; tall shrubs such as willow and dogwood; and deciduous trees such as red oak, elm and popular.

The **Welland Canal Turn Basin and Reservoir** provincially significant wetland complex extends along the eastern side of the canal from the Lock 3 reservoir to the southern side of Beaverdams Road; extending through the subwatershed boundaries of Welland Canal North, Ten Mile Creek, Shriners Creek and Beaverdams Creek. According to Santarella and Thomas (1986) this wetland complex is composed of 6.9 percent swamp and 93.1 percent marsh. Santarella and Thomas (1986) also noted numerous vegetation communities throughout the wetland complex, including for example, robust emergents such as cattail, bur-reed, bulrush and blueflag; free-floating plants such as duckweed; tall shrubs such as willow; and deciduous trees such as black ash.

The **Lake Gibson, Moodie Lake and Welland Canal** provincially significant wetland complex skirts the exterior of the western boundary of the study area with only a small portion of the complex crossing into the Welland Canal subwatershed. According to Chipman and Yarosh (1985) this complex is made up of over 100 individual wetlands composed of 3 percent swamp and 97 percent marsh. Chipman and Yarosh (1985) also noted numerous vegetation communities including for example, robust emergents such as cattail and bulrush; floating plants such as water lily and duckweed; and deciduous trees such as willow and red maple.

The **South Allanburg Slough Forest** is a provincially significant wetland composed of swamp. A description of this natural area will be provided once the Natural Areas Inventory conducted by the NPCA has been completed for this area.

Identified Old Growth

The Ministry of Natural Resources characterizes an old growth ecosystem "*by the presence of old trees and their associated plants, animals, and ecological processes. They show little or no evidence of human disturbance"* (MNR 1994). During an old growth forest survey conducted by the Bert Miller Nature Club during 2002 and 2003, the definition of an old growth forest used for purposes of their field work was "*a natural community that has been continuously forested since before European Settlement, and that forest's canopy must be dominated by trees with ages of 150 years or older. Most old-growth forests have 8 or more trees per acre that are 150 years old or greater"* (Bert Miller Nature Club 2004).

Although the Bert Miller Nature Club did not note any old growth forests in the Beaverdams and Shriners Creek Watershed during this survey, several massive old

growth heritage trees were identified on the border of the study area. In the 1850's numerous sugar maple and horse chestnut trees were planted adjacent to the Welland Canal near the Victoria Lawn Cemetery in St. Catharines; today 17 of these trees still stand. The diameters of the remaining trees range from 3 feet to 5.5 feet.

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Conservation Areas

Shriners Creek Conservation Area

Shriners Creek Conservation Area located in the headwaters of Shriners Creek in the municipality of Niagara Falls is a stormwater management project. This conservation area is made up of six parcels bound by Garner Road to the west, Beaverdams Road to the south, Kalar Road to the east and the hydro corridor to the north. The primary goal of this conservation area is to reduce the impacts of flooding by providing for the containment of stormwater and runoff from the upstream urban development. Storm sewer outlets channel water from the upstream residential area to Shriners Creek, which then outlets to the Welland Canal. Improvements to the channel and the creation of sediment traps and dams help facilitate in the drainage of the stormwater to the containment basins.

No recreation facilities or public access is available at this conservation area. This conservation area acts a stormwater management area and a wildlife refuge.

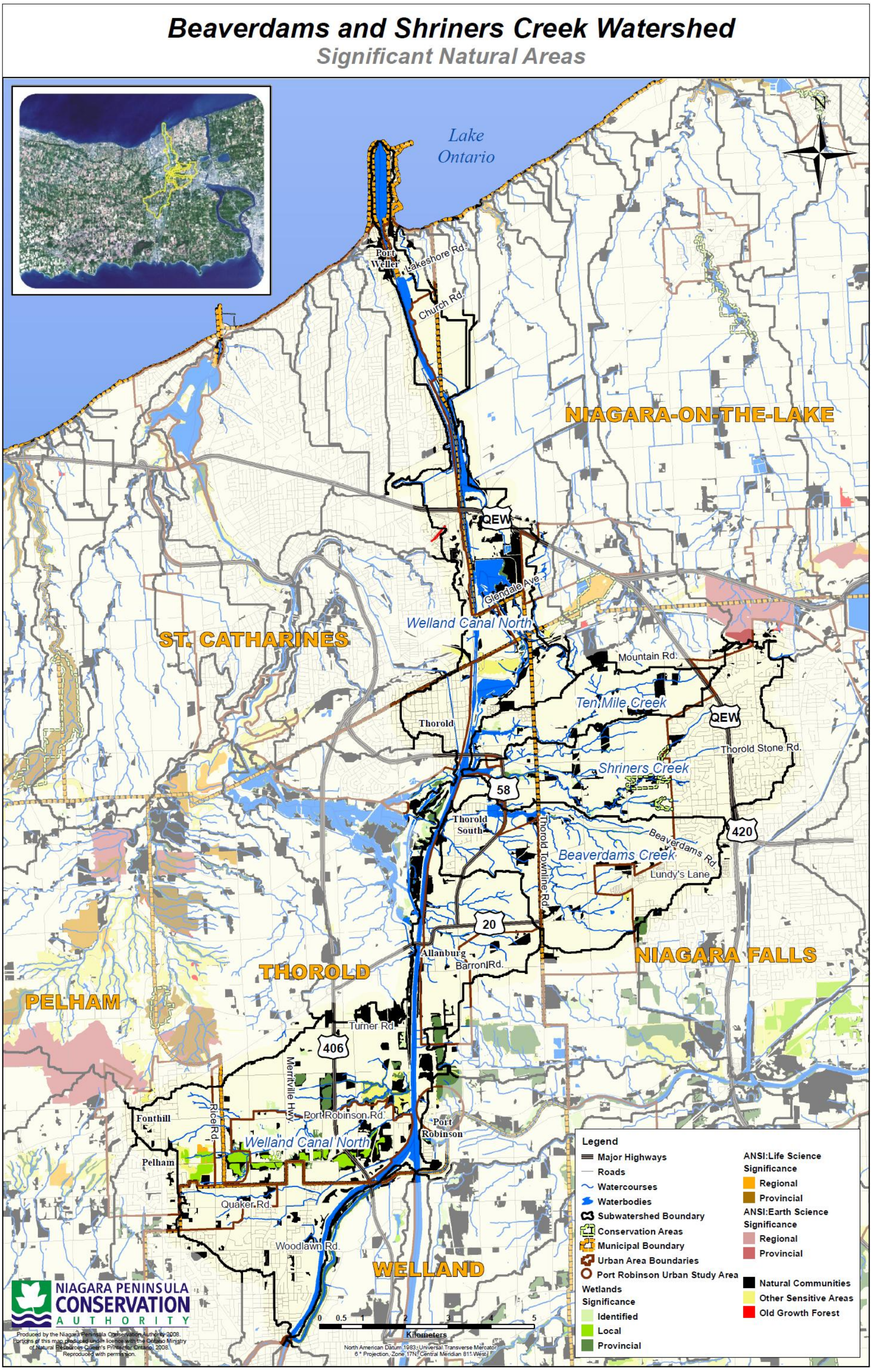

Figure 9: Significant Natural Area

NPCA Natural Areas Inventory Sites

In 2006, the Niagara Peninsula Conservation Authority initiated a comprehensive Natural Areas Inventory that was completed in partnership with the Regional Municipality of Niagara, local municipalities, Peninsula Field Naturalists and numerous other partners. The goal of the project was to use industry standard, scientifically-defensible protocols to inventory the natural areas in the NPCA watershed. The updated inventory will provide a solid resource of information to aid in planning decisions, policy development, and the prioritization of restoration opportunities. Four major aspects comprise the Natural Areas Inventory project, these include a Community Series Ecological Land Classification (ELC) Mapping; field verifications of vegetative communities to Vegetation Type (ELC); faunal inventories of for example birds, lepidoptera and odonata, herpetofauna, and lichens; and education. In total, over 500 properties were visited for ELC vegetation type assessments.

The following descriptions of natural areas have been derived directly from the NPCA Natural Areas Inventory Report. For more information regarding the faunal inventories conducted during this study, please refer to the NPCA NAI Report.

Name: Fireman's Park
Formerly: Fireman's Park/ St. David's Waterworks (Brady, et al., 1980)
Site I.D.: NL-01-00-00-00-00 **Municipality**: Niagara Falls
Approximate Size: 187 hectares
Subwatershed: The drainage of this site is complex. It drains south to the Welland Canal subwatershed, south and west to Six Mile Creek/ Airport Drain, and north and east to Four Mile Creek.
General Summary: This study site is bound on the north by Highway 405, south by Mountain Road, east by Stanley Avenue, west by QEW. Only a very small portion of this site falls within the Beaverdams and Shriners Creek Watershed Plan study area.

The dominant community in this study site was described as a Sassafras Deciduous Forest with fresh to moist characteristics in some areas and drier in others. Other areas within the confines of Fireman's Park were very complex due to the diversity of topography found in the area making it very difficult to classify into communities. The site contains a complex of toe slope, mid slope, upper slope and crest communities which represent different moisture regimes depending on their position. The driest communities found at the upper reaches were composed of Black Oak, or Bitternut Hickory dominated forests with a mix of other oak species, and Black Cherry. The middle of the slopes are areas of the dominant Sassafras community and the lower slopes were composed of largely Bitternut Hickory with associated Black Walnut, and Green Ash with some mixing in the transition areas between communities.

The presence of prairie and savanna species such as Big Bluestem Grass, Hairy Bush clover, Butterfly Milkweed, and Black Oak (one of the dominants in some areas) would indicate a historical presence of prairie and savanna communities. A look at 1934 air photos confirmed the absence of forest in this area. In areas of the study site where the mowing along the creek has stopped, there were wet Meadow Marsh communities mixed with dry meadow communities. The Meadow Marshes were dominated by Spotted Touch-me-nots and Green Ash. There were also some pockets of Cattails throughout. The drier Meadow communities noted were a mix of Raspberries, Pointed-leaved Tick-trefoil, Hairy Bush-clover, Goldenrods, and Asters with Black Walnut throughout.

Another interesting community noted for this study site was found on the talus slope of the Niagara Escarpment. The parent material was right at the surface making it impossible to determine the soil characteristics. The slopes were steep with many boulders of all shapes and sizes right at the surface. The NAI team did their best to classify this site although it did not meet the characteristic talus community as outlined in the ELC manual. There are a total of 320 recorded taxa for this study site.

This site is also in part designated as Locally Significant Wetland; **Fireman's Park Wetland Complex**

Name: Wood End (Brady, et al., 1980)
Site ID: NL-04-00-00-00-00 **Municipality**: Border of Niagara Falls and Niagara-on-the-Lake
Approximate Size: 95 hectares
Subwatershed: The drainage of this study site mainly goes north east to Six Mile Creek/ Airport Drain. There is a small portion that drains north and west to Eight Mile Creek/ Airport Drain and a small portion that drains south to Ten Mile Creek.
General Summary: This study site is bound on the west by Taylor Road and on the east by the Queen Elizabeth Way. The northern boundary is just north of Warner Road and the southern boundary is just south of Mountain Road. Only a very small portion of this site falls within the Beaverdams and Shriners Creek Watershed Plan study area.

The Deciduous Forest communities of this study site are dominated by Shagbark Hickory, Red Oak, and Sugar Maple. The understory is largely regenerating canopy species with Hop Hornbeam, Green Ash, and Poison Ivy. The successional areas were classified as Meadow Marshes dominated by Reed-canary Grass and Beggar-ticks species. The wetter depressions in these successional fields support stands of Common Reed, or Cattails. Some areas of secondary growth were also classified as Deciduous Thickets characterized by Gray Dogwood and Staghorn Sumac. The understory of these areas is largely Grass-leaved Goldenrod, Timothy, and Kentucky Blue Grass. There are a total of 105 recorded taxa (unique plant records) for this study site.

Name: Garner Road Woods
Site I.D.: NF-22-00-00-00-00 **Municipality**: Niagara Falls
Approximate Size: 454 Hectares
Subwatershed: The majority of this study site flows to Beaver Dams Creek, however there is a very small portion in the south west that drains to Thompson's Creek.

General Summary: This study site includes a number of small urban forests fragmented throughout the area between Thorold Townline Road to the west and Dorchester Road, just east of the 420 interchange to the east. It extends from Beaverdams Road in the north to McLeod Road in the south. A very small percentage of this study site was visited by the NAI teams during the course of this project.

The Deciduous Forests were mostly Red Oak and Red Maple with Green Ash, Sugar Maple, and American Beech. The understory was mostly regenerating canopy species with Spicebush and a ground cover of False Solomon's Seal, Climbing Poison-ivy, Canada Enchanter's Nightshade, and Garlic Mustard. The Deciduous Swamp communities were dominated by Red Maple and Swamp Maple, with associated Green Ash and White Elm. The ground cover in these areas was mostly Sensitive Fern and Canada Enchanter's Nightshade. A Meadow Marsh community was also noted for this

site. It was characterized by Reed Canary Grass, False Nettle, and Motherwort. There are a total of 167 recorded taxa for this study site.

This site is also in part designated both as Locally and Provincially Significant Wetland; **Beavers Dam Creek Wetland Complex, Welland Canal Turn Basins Provincially Significant Wetland, and Warren Creek Wetland Complex.**

Name: Shriner's Creek
Site I.D.: NF-23-00-00-00-00 **Municipality**: Niagara Falls
Approximate Size: 207 Hectares
Subwatershed: The majority of this study site drains to Shriner's Creek, however there is a portion in the north that drains to the Ten Mile Creek subwatershed.
General Summary: This study site extends from Mountain Road in the north to Beaverdams Road in the south. The western boundary is Taylor Road/ Thorold Townline Road and it is bound on the east by the QEW.

The drier Deciduous Forests noted were dominated by Red Oak, American Beech, White Ash, Black Cherry, and Sugar Maple.The understory was characterized by regenerating canopy species with, Hop Hornbeam and Dogwood species. The herbaceous layer was a mix of Common Strawberry, Asters, and Goldenrods. The wetter Deciduous Forests were dominated by Green Ash or Black Walnut, with Pin Oak and Willow Species. The understory of these forests was mostly Beggar-tick species, Spotted Touch-me-not, and Avens.

The Meadow Marshes within and between the larger forested patches were characterized by Reed Canary Grass, with Sedges and Cow Vetch. Large areas of early successional meadow were noted but were not classified since it is possible that they could return to agricultural uses at any time. They were characterized by fallow fields of Asters and Goldenrods with Gray Dogwood, and Red-osier Dogwood. There are a total of 191 recorded taxa for this study site.

This site also encompasses **Shriner's Creek Conservation Area**

Name: Port Robinson Duck Ponds
Formerly: Port Robinson Duck Ponds (Brady et al., 1980)
Site I.D.: TH-02-00-00-00-00
Municipality: Thorold
Approximate Size: 329 Hectares
Subwatershed: The majority of this study site drains south/ east to the Welland Canal North subwatershed, however there is a small area to the north that drains to the Lake Gibson system.
General Summary: This Study site is located between Niagara St./Merrittville Highway to the west, Welland Canal to the east, Highway 20 to the north and Port Robinson Road to the south.

Deciduous Swamp communities in this study site were dominated by Red Oak, Green Ash, White Elm and, Pin Oak with a few stands of Eastern White Pine on the driest ridges. The understory was largely Glossy Buckthorn, Grey Dogwood, Silky Dogwood and, Common Buckthorn. The herbaceous layer was a mix of Sedges, Avens, Goldenrod and, Asters.

This bottomland and riparian areas supported a floodplain community with dense thickets of Glossy Buckthorn. An open canopied riparian Green Ash swamp with expansive marshes, along the creek channel and adjacent floodplain was noted. This community was dominated by Reed Canary Grass, Panicled Aster or One-sided Aster and Moneywort.

Also noted was the community for which this study site was originally named. Most of this study site is located on old canal excavation material. A railroad line prevents drainage creating large ponds. NAI teams did not visit the site however it was noted through air photo interpretation that the inundated valley wetlands were likely Duckweed ponds, Buttonbush, Thicket Swamps, and Bur-reed and Cattail marshes in a reoccurring pattern.

Steep and well drained valley slopes supported the drier Deciduous Forest communities dominated by Red Oak, Shagbark Hickory and White Oak. Occassionally, Sugar Maple or American Beech were also present. The understory was largely Hop Hornbeam, Black Cherry, Blue Beech and Downy Serviceberry. The herbaceous layer was a mix of Goldenrods and Asters with some Wild Leek. There are a total of 83 recorded taxa for this study site. This site is also in part designated as **Port Robinson Woodlot Provincially Significant Wetland.**

Name: Rose Little Woods – Merritt Road Swamp
Formerly: Rose Little Woodlot (Brady et al., 1980)
Site I.D.: PL-10-00-00-00-00 **Municipality**: City of Thorold
Approximate Size: 548 hectares
Subwatershed: The majority of this study site drains to the north/ east to the Welland Canal North subwatershed, however, there is a small portion that drains to the south/ west to Draper's Creek.
General Summary: This study site is located mostly within the municipality of Thorold; however there are some significant sites that are within Pelham that are connected to this site. This site is located between the Welland Canal to the east, Haist Street to the west, Highway 20 to the north and Woodlawn Road to the south.

The majority of the areas visited within this study site were dominated by Deciduous Swamps. It was common throughout this site to have dry meadows occurring along the rims and crests of slight sandy ridges alternating with standing water pools, or slough ponds. The Deciduous Swamps were characterized by Green Ash, Swamp Maple, and Red Maple in the canopy. The understory was largely Spicebush and Glossy Buckthorn. The ground layer was a mix of Spotted Touch-me-not, Fowl Manna Grass, Climbing Poison-ivy, and Rough Goldenrod. On the drier ridges, Mixed Meadow dominated by Little Bluestem was present. Red Oak, White Elm and, Green Ash were found on the slopes.

The wetland-terrestrial interface supported a mix of Foxglove Beard-tongue, Brown-eyed Susan, and Early Goldenrod. The interface of upland and lowland then graded into a typical Meadow Marsh community consisting of mainly Alpine Rush with a mix of Sedges. The deeper open water slough ponds were dominated by Bebb's Willow and Narrow-leaved Cattail with Purple Loosestrife, Sensitive Fern, Sedges and, Soft Rush. In disturbed areas it was noted that Glossy Buckthorn was the dominant species. There are a total of 211 recorded taxa for this study site.
This site is also in part designated as **Niagara Street – Cataract Road Wetland Complex and Kunda Park Forest Life Science ANSI.**

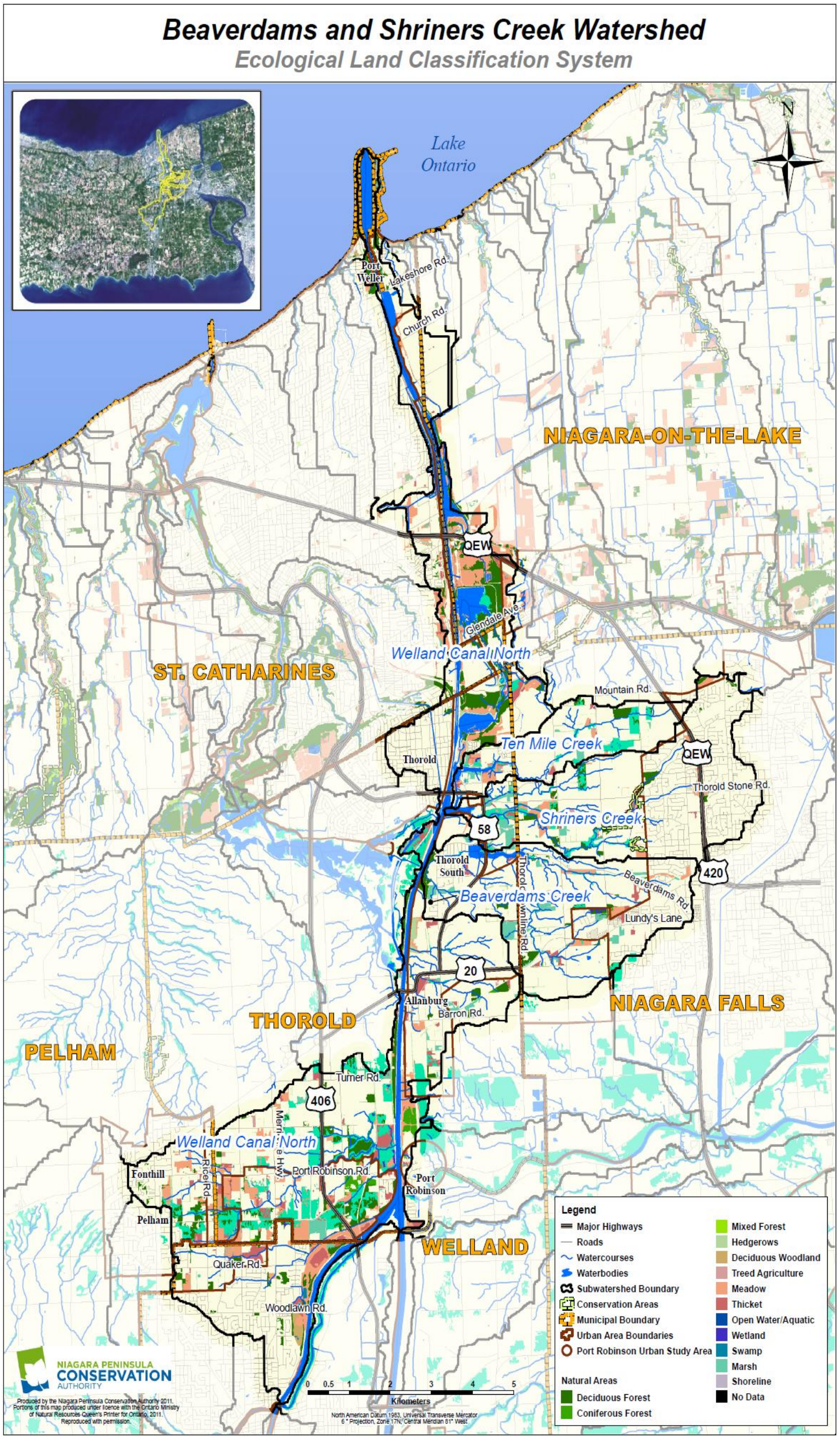

Figure 10: Ecological Land Classification System

Species at Risk

A Species at Risk is "*any plant or animal threatened by, or vulnerable to extinction"* (MNR No Date). In Ontario, species at risk are governed by two bodies; *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC) and the *Committee on the Status of Species at Risk in Ontario* (COSSARO).

COSEWIC is an independent body responsible for identifying species that are considered to be at risk in Canada. COSEWIC reports their findings to the federal government. The federal government then determines which at-risk species qualify for protection under the *Species At Risk Act* (EC 2003). COSSARO is an independent review body made up of up to 11 members from the public and private sectors; at least 5 of the members must be non-OMNR members. A species status designation may differ from COSEWIC and COSSARO because their vulnerability changes depending on the geographic scale. All species status designations given by COSEWIC will also be given an equal or greater status designation by COSSARO; a higher status indicates that there is a greater concern for a species province-wide than nation-wide. In addition, a species may have been given a status designation by COSSARO and not from COSEWIC because there may only be a province-wide vulnerability.

In Ontario, over 185 native species have been given official status designations by the OMNR (OMNR No Date). Currently, several legislative and policy tools protect species at risk in Ontario. For instance, the *Provincial Policy Statement* (MMAH 2005) under Ontario's *Planning Act* affords habitat protection by stating "*Development and site alteration shall not be permitted in: significant habitat of endangered species and threatened species"* (Section 2.1.3).

In May 2007, *Bill 184,* Ontario's new *Endangered Species Act, (*Ontario Ministry of Natural Resources 2007) made it to Royal Ascent in Ontario. It replaced Ontario's previous *Endangered Species Act* (1971) in June 2008. *Bill 184* states:

"*If a species is listed on the Species at Risk in Ontario List as an endangered or threatened species, the Bill prohibits damaging or destroying the habitat of the species. This prohibition also applies to an extirpated species if the species is prescribed by regulations. The regulations may specifically prescribe an area as the habitat of a species but, if no habitat regulation is in force with respect to a species, „habitat' is defined to mean an area on which the species depends, directly or indirectly, to carry on its life processes*".

The OMNR status definitions for species designations range from extinct (no longer exists anywhere) to data deficient (insufficient information for status recommendation). In the Beaverdams and Shriners Creek Watershed Plan study area, endangered, threatened and species of special concern have been documented by the OMNR and the NPCA (Table 2).

The definitions for these status designations by the OMNR are as follows:

- **Extirpated:** *A native species that no longer exists in the wild in Ontario, but still exists elsewhere*
- **Endangered (Regulated)**: *A species facing imminent extinction or extirpation in Ontario which has been regulated under Ontario's Endangered Species Act*

- **Endangered (Not Regulated)**: *A species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's Endangered Species Act*
- **Threatened:** *A species that is at risk of becoming endangered in Ontario if limiting factors are not reversed*
- **Special Concern:** *A species with characteristics that make it sensitive to human activities or natural events*

Table 2: Listed Species at Risk in the Beaverdams and Shriners Creek Watershed

COSEWIC Status (Federal)	COSSARO Status (Provincial)	Name	Scientific Name
Endangered	Endangered	Barn Owl	*Tyto alba*
Endangered	Endangered	Butternut	*Juglans cinerea*
Endangered	Endangered-R	Cucumber Tree	*Magnolia acuminata*
Special Concern	Endangered	American Eel	*Anguilla rostrata*
Endangered	Special Concern	Redside Dace	*Clinostomus elongatus*
Endangered	No Status	Flowering Dogwood	*Cornus florida*
Threatened	Threatened	Common Hoptree	*Ptelea trifoliata*
Threatened	Threatened	Deerberry	*Vaccinium stamineum*
Threatened	Threatened	Grey Fox	*Urocyon cinereoargenteus*
Threatened	Threatened	Round-leaved Greenbrier	*Smilax rotundifolia*
Threatened	Threatened	White Wood Aster	*Eurybia divaricata*
Special Concern	Special Concern	Broad Beech Fern	*Phegopteris hexagonoptera*
Special Concern	Special Concern	Milk Snake	*Lampropeltis triangulum*
Special Concern	Special Concern	Swamp Rose-mallow	*Hibiscus moscheutos*
Special Concern	Special Concern	Yellow-breasted Chat	*Icteria virens*

As a result of Niagara's southern location and varied habitats (e.g. Great Lakes, escarpments, and physiography), Niagara is home to a diversity of flora that is considered nationally significant. To date, nearly 1700 taxa have been documented in Niagara Region, 1398 in Haldimand-Norfolk, and 1410 in Hamilton. In Niagara Region, over 170 of these taxa are considered a provincial conservation concern, 158 in Haldimand-Norfolk, and 83 in Hamilton (Oldham 2010).

A list of provincially rare species documented by the OMNR and NPCA in the Beaverdams and Shriners Creek Watershed Plan study area can be reviewed in Table 3and a list of regionally rare species can be reviewed in Table 4.

Table 3: Provincially Rare Species in the Beaverdams and Shriners Creek Watershed

Name	Scientific Name
A Hawthorn	*Crataegus dissona*
Bayberry	*Myrica pensylvanica*
Black Cohosh	*Actaea racemosa*
Black Gum	*Nyssa sylvatica*
Devil's-bit	*Chamaelirium luteum*
Hickory Hairstreak	*Satyrium caryaevorus*
Pawpaw	*Asimina triloba*
Pin Oak	*Quercus palustris*
Prostrate Tick-trefoil	*Desmodium rotundifolium*
Smith's Club-rush	*Schoenoplectus smithii*
Southern Tickseed	*Bidens coronata*
Tufted Titmouse	*Baeolophus bicolor*
Virginia Yellow Flax	*Linum virginianum*
Wild Lupine	*Lupinus perennis*

Table 4: Regionally Rare Species in the Beaverdams and Shriners Creek Watershed

Common Name	Scientific Name
American Hazelnut	*Corylus americana*
Butterfly Weed	*Asclepias tuberosa*
Pignut Hickory	*Carya glabra*
Purple-stem Angelica	*Angelica atropurpurea*
Sweetflag	*Acorus americanus*
Tulip Tree	*Liriodendron tulipifera*

As indicated earlier a comprehensive NAI study was completed for the NPCA jurisdiction using the provincial Ecological Land Classification (ELC). The ELC comprises six nested levels; from largest to smallest scale these are: Site Region, System, Community Class, Community Series, Ecosite, and Vegetation Type (Lee et al 1998). The NAI study typically collected data at the Community Series level, however, data was collected at a few sites to the Ecosite and Vegetation Type. Bakowsky (1996) defined Ecosite and Vegetation Type as follows:

"*Ecosite is a mappable landscape unit defined by a relatively uniform parent material, soil and hydrology, and consequently supports a consistently recurring formation of plant species which develop over time (vegetation chronosequence).The Vegetation Type is part of an ecosite, and represents a specific assemblage of species which generally occur in a site with a more uniform parent material, soil and hydrology, and a more specific chronosequence".* Additionally, Vegetation Type is the basic plant community unit that is ranked in Ontario for conservation purposes (Bakowsky 1996).

Within the Beaverdams and Shriners Creek Watershed study area, 2 rare Vegetation Types were identified through the NAI study. The descriptions are taken directly from the „*Rare Vegetation Types (Goodban and Garofalo)*' section of the NAI Report:

- *Dry-Fresh Oak-Maple-Hickory Deciduous Forest Ecosite (FOD2):*
  Dry-Fresh Oak- -Hickory Deciduous Forest Type [(FOD2-2): Regionally Rare Vegetation Type] This community typically occurs on upper to middle slopes on silty clays and silty very fine sands. Three examples were noted during the NAI; one of these examples was found along the rolling hills and valleys of Fireman's Park.
- *Fresh-Moist Lowland Deciduous Forest Ecosite*
  Fresh-Moist Black Walnut Lowland Deciduous Forest Type [(FOD7-4) Regionally Rare Vegetation Type]: This Vegetation Type occurs on alluvial silts and clays, and rarely on sands, along floodplains. Large Black Walnut trees with spreading crowns dominate these semi-open canopied floodplain communities. Assciates include Green Ash, White Elm, Shagbark Hickory, Basswood, and oaks.

Aquatic Habitat

In Canada, the *Fisheries Act* (Department of Fisheries and Oceans R.S. 1985, c. F-14) was established to protect and manage Canada's fisheries resources. The Act applies to all fishing zones; territorial and inland waters. As federal legislation, should a conflict arise between the *Fisheries Act* and provincial legislation, the *Fisheries Act* takes precedence. Although management of fish habitat falls under the authority of the federal government, the federal government has "*essentially no control over the use of inland waters, beds of watercourses or shorelines which fall under provincial jurisdiction. Alternatively, the provinces cannot make regulatory decisions concerning fish habitat"* (DFO No Date).

Section 35 of the Fisheries Act is the prime focus of the Fisheries Act. This section is a *"general prohibition of harmful alteration, disruption or destruction (HADD) of fish habitat"*. Therefore, any project, work or undertaking that results in a HADD situation would result in a breach of this section of the Act and could result in a fine up to one million dollars, imprisonment or both.

Fish Community Studies

The fish community in the Beaverdams and Shriners Creek watershed is representative of a tolerant warm water fishery, which includes different species of fish that have varying tolerances to environmental change. Therefore, they are considered valuable indicators of environmental and ecosystem health (Nottawasaga Valley Conservation Authority 1995).

Fish sampling studies were conducted in the Beaverdams and Shriners Creek watershed on numerous occasions by the Ministry of Natural Resources and numerous partners. Through these surveys, numerous fish species were identified in the study area. The results of these studies are reported below and in Table 4.

Beaverdams Creek

Fish sampling surveys were conducted by the Ministry of Natural Resources in Beaverdams Creek during 1988 and again on 3 occasions in June of 1990. Fish species that were commonly found during the surveys include numerous fish from the minnow and perch families, horneyhead chub and the listed Species at Risk American eel. A total of 15 different fish species were recorded during the surveys in Beaverdams Creek (Table 4).

Shriners Creek

Fish sampling surveys that were conducted in Shriners Creek during 1993 and 1994 identified 5 different fish species including spottail shiner, bluntnose minnow and common carp (Table 4).

Ten Mile Creek

Fish sampling surveys that were conducted in Ten Mile Creek during 1988 and 1991 by Gartner Lee (2001) identified a total five species of fish (Table 4).

Welland Canal North

Fish sampling surveys were conducted during 1993, 1994, 1996 and 1999 at a number of stations throughout the Welland Canal North subwatershed by several organizations. Examples of fish species found during the surveys include spottail shiner, white perch, northern pike and common carp. A total of 12 different fish species were recorded during the surveys in Welland Canal North (Table 4).

Significant Fish Species

One of the fish species identified in the Beaverdams and Shriners Creek watershed is considered "at risk"; American eel. The American eel has been designated as „endangered' by the *Committee on the Status of Species at Risk in Ontario* (COSSARO) and as „*special concern'* by the *Committee on the Status of Endangered Species in Canada.*

Fish Habitat

Fish habitat falls into 1 of 3 categories in Niagara: Type 1, Type 2 or Type 3 (MNR 2000). Habitat type is based on the sensitivity and significance of current or potential habitats in a water body. Type 1 habitat is the most sensitive habitat of the 3 types. As a result, it requires the highest level of protection. Examples of Type 1 habitat include critical spawning and rearing areas, migration routes, over-wintering areas, productive feeding areas and habitats occupied by sensitive species. Type 2 habitat is less sensitive and requires a moderate level of protection. These areas are considered „*ideal for enhancement or restoration projects*' and include feeding areas for adult fish and unspecialized spawning habitat. The third habitat type is considered marginal or highly degraded and does not contribute directly to fish productivity. Examples of Type 3 habitat include channelized streams and artificially created watercourses (MNR 2000).
Fish habitat type in the Beaverdams and Shriners Creek watershed has been delineated according to the Ministry of Natural Resources stream classification data. These areas are depicted on Figure 11 as critical habitat (Type 1), important habitat (Type 2) and marginal habitat (Type 3). As illustrated, the main channels and the larger tributaries of Ten Mile Creek, Beaverdams Creek and Shriners Creek have all been classed as important fish habitat; and the Welland Canal is classed as marginal fish habitat.

Table 4: Fish Species Identified in the Beaverdams and Shriners Creek Watershed				
	Beaverdams Creek	**Shriners Creek**	**Welland Canal North**	**Ten Mile Creek**
American eel	●			
Blacknose Dace			●	
Bluegill		●	●	
Bluntnose Minnow		●		
Brown Bullhead		●	●	
Brown trout	●			
Catfish family	●		●	
Central Mudminnow				●
Common Carp		●	●	●
Creek Chub	●		●	
Fallfish	●			
Fathead Minnow				●
Hornyhead Chub	●			
Iowa Darter				●
Longnose Dace	●			
Minnow family	●			
Northern Hog Sucker	●		●	
Northern Pike			●	
Perch family	●			
Rock Bass	●			
Shorthead Redhorse	●			
Spottail Shiner		●	●	●
Stonecat	●			
Sucker family	●			
Threespine Stickleback			●	
Trout-Perch Family			●	
White Perch			●	
White sucker	●			
Total Species	***15***	***5***	***12***	***5***

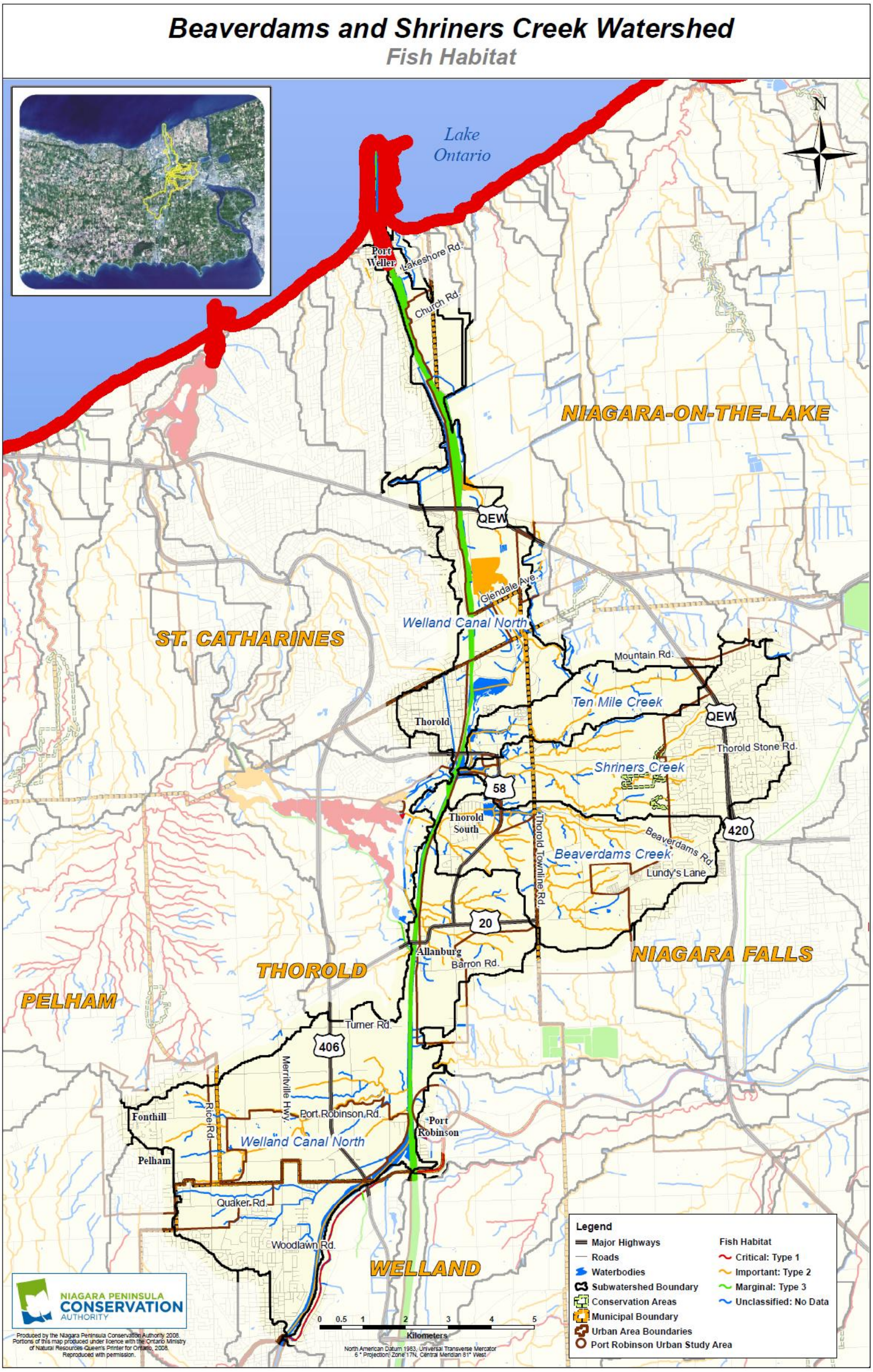

Figure 11: Fish Habitat

Municipal Drains

Under the Ontario Drainage Act (R.S.O. 1990, Chapter D.17) drainage works "*include a drain constructed by any means, including the improving of a natural watercourse, and includes works necessary to regulate the water table or water level within or on any lands or to regulate the level of the waters of a drain, reservoir, lake or pond, and includes a dam, embankment, wall, protective works or any combination thereof*".

There is only one municipal drain in the Beaverdams and Shriners Creek watershed; Singers Drain (Figure 12). Even though the purpose of municipal drains is to remove excess water from the land, municipal and agricultural drains do contain fish habitat. To better manage these drains, Fisheries and Oceans Canada has developed a classification system that identifies municipal drains as Types A through F using variables such as flow conditions, temperature, fish species present, and the length of time since the last clean out (Fisheries and Oceans Canada No Date). For example, a Class A drain has permanent flow with cold or cool water temperature and no presence of trout or salmon present. A Type E drain also has a permanent flow with warm water temperatures and top predators (e.g., largemouth bass, northern pike, muskellunge and crappie) present in the drain. Type F drains are characterized by intermittent flow (Fisheries and Oceans Canada No Date). This classification system has been created for use by municipal drainage superintendents for the purpose of drain maintenance. Singers Drain is located on the west side of the Welland Canal and has been classed as a Type E municipal drain.

Figure 12: Municipal Drains

Water Quality

The Ontario Ministry of the Environment has established a set of *Provincial Water Quality Objectives* [PWQO (MOE1994)] that are intended to be used to guide respective agencies when making water quality management decisions. The surface water quality management goal is "*To ensure that the surface waters of the province are of a quality which is satisfactory for aquatic life and recreation"* (MOEE Section 3.1). Table 5 summarizes indicator parameters that are the most useful in assessing relative water quality. They include: total phosphorus, nitrate, copper, lead, zinc, *Escherichia coli*, chloride, suspended solids and benthic invertebrates (NPCA 2010b). The PWQO are useful indicators but other non-chemical factors such as for example, loss of habitat, sedimentation, and indigenous species must also be considered when assessing ecosystem health.

Table 5: Water Quality Parameters (as modified from NPCA 2010b)

Category	Indicator Parameter	Objective	Reference
Nutrients	Total Phosphorus	0.03 mg/L	PWQO (MOE 1994)
Nutrients	Nitrate	13 mg/L	CWQG (CCME 2007)
Metals	Copper	0.005 mg/L	PWQO (MOE 1994)
Metals	Lead	0.005 mg/L	PWQO (MOE 1994)
Metals	Zinc	0.02 mg/L	PWQO (MOE 1994)
Microbiological	*Escherichia coli*	100 counts/100mL	PWQO (MOE 1994)
Other	Chloride	100 mg/L	CWQG (CCME 2005)
Other	Suspended Solids	25 mg/L	BC MOE (2001)
Biological	Benthic Invertebrates	Unimpaired	BioMAP (Griffiths1999)

Surface water quality is monitored at 6 stations by the NPCA in the Beaverdams and Shriners Creek watershed study area; 2 stations are located in Shriners Creek subwatershed and 4 stations in Beaverdams Creek subwatershed. Samples are collected on a monthly basis during the ice-free season and are analyzed for several parameters including nutrients, metals, bacteria, suspended solids, and general chemistry (Figure 13). Sampling stations are located throughout their respective watershed to identify water quality impacts. Sampling was initiated at all stations throughout the study area in April of 2008.

The 2009 water quality data reports a marginal rating for both stations in Shriners Creek (SH002 and SH003); however there is limited data for these stations since they were added to the network in 2008. These index ratings are expected to change over time as additional data is collected [Table 6(NPCA 2010b)].

The water quality monitoring stations in Beaverdams Creek [BE001 to BE003 (BE004 not in study area)] were also added to the monitoring network in 2008 and as a result there is limited data available for these stations as well. Index ratings range from *poor to fair*, however, these ratings are expected to change over time as additional data collected [Table 6 (NPCA 2010b)].

Biological Monitoring and Assessment Program

Benthic macroinvertebrate sampling has been completed at surface water quality monitoring stations using the BioMAP (Biological Monitoring and Assessment Program) protocol. Benthic macroinvertebrates are defined as the larger organisms inhabiting the substrate of waterways for at least part of their life cycle. Benthic macroinvertebrate species that are commonly found in the Niagara Peninsula include clams, snails, leeches, worms, and the larval stages of dragonflies, stoneflies, caddisflies, mayflies and beetles. At sites where water quality is impaired, the organisms found are less sensitive and therefore more tolerant to environmental stresses than organisms that would have historically occurred. The benthic population at an impaired site would typically be dominated by these more tolerant species, and as a result, biodiversity at the site would be quite low.

Benthic invertebrate sampling was also initiated in 2008 at the Beaverdams Creek stations in 2008. All stations achieved BioMAP ratings of impaired [Table 6 (NPCA2010b)].

Table 6: Water Quality Data Monitored by the NPCA in 2009

Station	Water Quality Index	BioMAP Rating	Factors Affecting Water Quality
Shriners Creek SH002	Marginal	Impaired	• Exceedances of chloride, total phosphorus, and *E. coli* • Located immediately downstream of NPCA constructed wetland designed for storm water management • Algae observed during summer months • Vulnerable to contaminants from upstream urban areas
Shriners Creek SH003	Marginal	n/a	• Exceedances of chloride, total phosphorus, *E. coli* and suspended solids • Adequate upstream forest and riparian buffer in some reaches • Vulnerable to contaminants from upstream urban and agricultural areas
Beaver Dams Creek BE001	Marginal	Impaired	• Exceedances of chloride, total phosphorus, and *E. coli* • Algae observed during summer months • Vulnerable to contaminants from upstream agricultural areas
Beaver Dams Creek BE002	Marginal	n/a	• Exceedances of total phosphorus and *E. coli* • Stream channel flows into large on-line pond at this station resulting in dilution • Vulnerable to contaminants from upstream agricultural areas and gold course
Beaver Dams Creek BE003	Poor	Impaired	• Exceedances of chloride, total phosphorus, *E. coli*, suspended solids and metals • Lack of adequate riparian buffer • Algae observed during summer months • Vulnerable to contaminants from upstream urban areas
Beaver Dams Creek BE004	Marginal	Impaired	• Exceedances of total phosphorus and *E. coli* • Adequate riparian buffer • Vulnerable to contaminants from upstream industrial areas

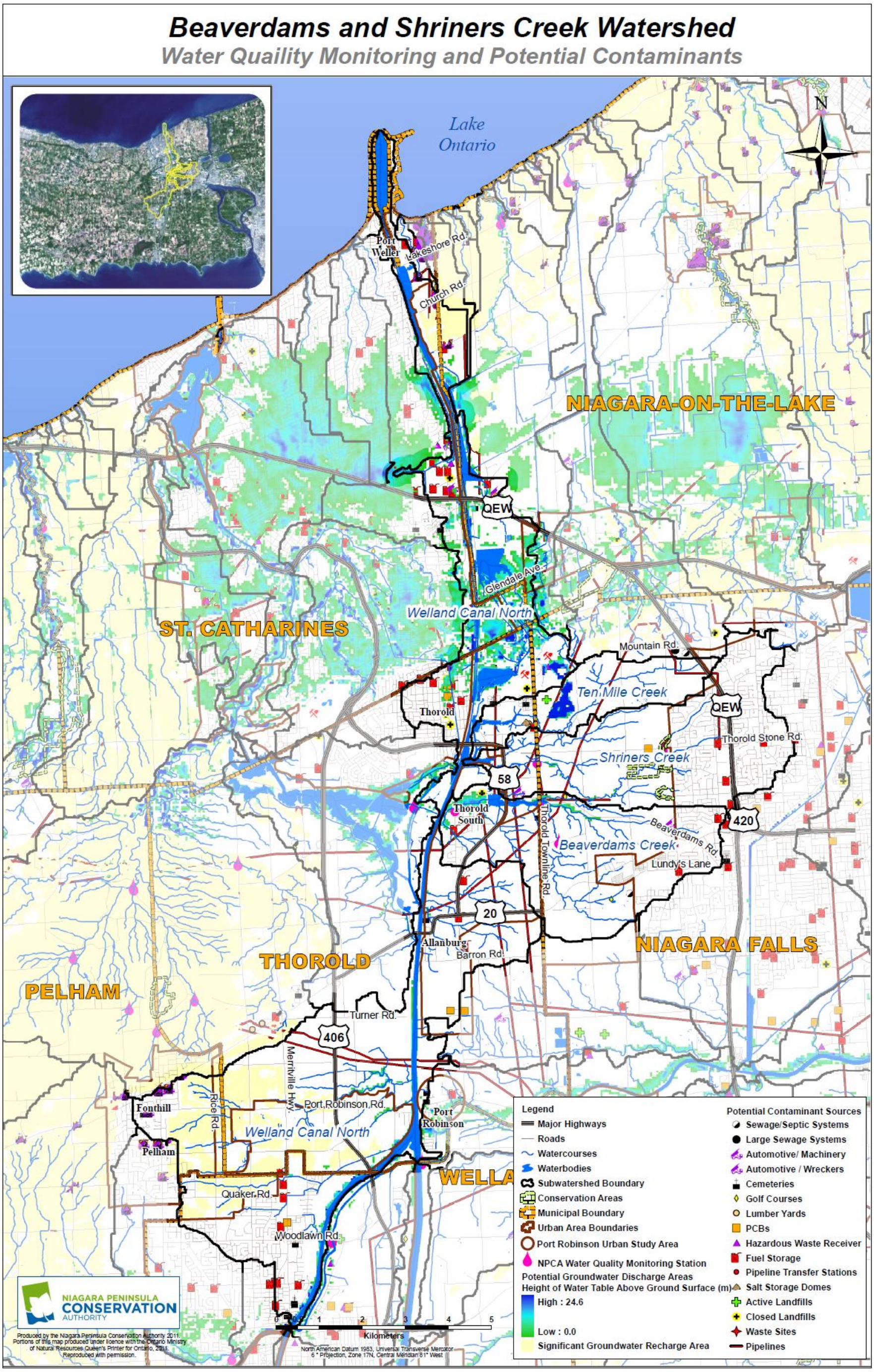

Figure 13: Water Quality

Groundwater Resources

In 2005, a *Groundwater Study* [Waterloo Hydrogeologic Inc. (WHI) 2005] was completed for the land area within the jurisdiction of the NPCA. This study was a key component for planning and implementing measures to protect the sources of water for use by the residents of the Niagara Peninsula.

The *Groundwater Study* provides baseline data that outlines threats, potential threats and impacts to the areas groundwater resources. The study includes a series of maps illustrating recharge/discharge areas, well locations, overburden thickness, bedrock types, groundwater use, contaminant sources, and groundwater susceptibility to contamination.

In addition, the identification of vulnerable areas from possible threats is also critical to protecting our drinking water; accordingly this mapping exercise was also conducted through the Source Water Protection program. The delineation of vulnerable areas produced through the Source Water Protection program is comparable to the mapping produced through the 2005 Groundwater Study for the Beaverdams and Shriners Creek watershed, aside from the addition of shallow bedrock vulnerability and transport pathways. Transport pathways that were considered to increase groundwater vulnerability include private water wells (including unused wells needing decommissioning), „unknown' status oil and gas wells, aggregate operations, and construction activities along the Welland Canal (outside of study area) (NPCA 2010a).

Potential Groundwater Discharge and Significant Groundwater Recharge areas (SGRA's) are illustrated on Figure 14 as identified through the Niagara Peninsula Source Protection Area *Assessment Report* (NPCA 2010). Discharge areas are locations where groundwater leaves the aquifer and flows to the surface. Groundwater discharge occurs where the water table (or potentiometric surface) intersects the land surface. Potential discharge areas in the Beaverdams and Shriners Creek watershed have been identified in areas along and below the Niagara Escarpment and along the west side of the Welland Canal. The potential height of the water table ranges between 0 and 5 metres below the ground surface at these sites.

Groundwater recharge areas are locations where water is transmitted downward to an aquifer. The amount of water that infiltrates to the water table depends on, for example, vegetation cover, slope, soil composition, surficial geology, and depth to the water table. SGRA's are identified where the groundwater is recharged by a factor of 1.15 or more than the average recharge rate for the whole NPCA watershed. The average recharge rate for NPCA is 46 mm/year and the criterion 53 mm/year. The estimates of recharge were determined through HEC-HMS continuous surface water modelling. HEC-HMS catchment recharge results were distributed using infiltration factors that are a function of topography, land cover and soil texture (Campbell 2011). In the Beaverdams and Shriners Creek watershed, the area around the Fonthill Kame-Delta Complex has a "*recharge greater than 150mm/yr, which is comparatively high for this source protection area* [Niagara Peninsula*]. Areas of recharge greater than 40% of the water surplus (precipitation minus evapotransoiration) are almost entirely limited to this area*" (NPCA 2010).

Water that infiltrates to the water table may carry contaminants with it. Therefore, these areas are considered groundwater sensitive. Additionally, the *Clean Water Act (MOE 2006)* requires the delineation and protection of these vulnerable areas. Under *The*

Clean Water Act-Ontario Regulation 187/07 a SGRA is defined as "*an area within which it is desirable to regulate or monitor drinking water threats that may affect the recharge of an aquifer*". As described earlier, recharge areas are classified as „significant' when they supply more water to an aquifer used as a drinking water source that the surrounding area. Once SGRA's are delineated, they are further subdivided by areas of groundwater vulnerability (NPCA 2010).

In the Beaverdams and Shriners Creek watershed, the areas along the Lake Ontario shoreline, Fonthill Kame-Delta, Niagara Escarpment, and Sand Plan along eastern edge of study area, have been delineated as Highly Vulnerable Aquifers (HVA) through the NPCA *Groundwater Study* and the *Assessment Report* and therefore have high groundwater vulnerability due to the high permeability of the overburden with little to no low conductivity layers overlying the aquifer. Areas along the Niagara Escarpment where there are bedrock outcrops have been delineated as having a highly susceptibility due to the thin overburden and fractured bedrock of the Niagara Escarpment; openings in fractured bedrock allow for the direct passage of surface water and contaminants to groundwater resources. Under *The Clean Water Act-Ontario Regulation 187/07* an HVA is defined as *"an aquifer on which external sources have or are likely to have a significant adverse effect, and includes the land above the aquifer*". Highly Vulnerable Aquifers are illustrated in red on Figure 14.

Areas of medium groundwater vulnerability are found in the central portion of the study area. These areas typically coincide with areas where the overburden thickness ranges from only 5 to 10 meters above the bedrock. These areas are illustrated in orange on Figure 14.

The remainder of the study area has been delineated as low groundwater vulnerability due to the thick deposits of clay and silt of the Haldimand Clay Plain. This material restricts the downward movement of infiltrating surface water, making the underlying groundwater much less susceptible to associated contamination (WHI 2005). These areas are illustrated in green on Figure 14.

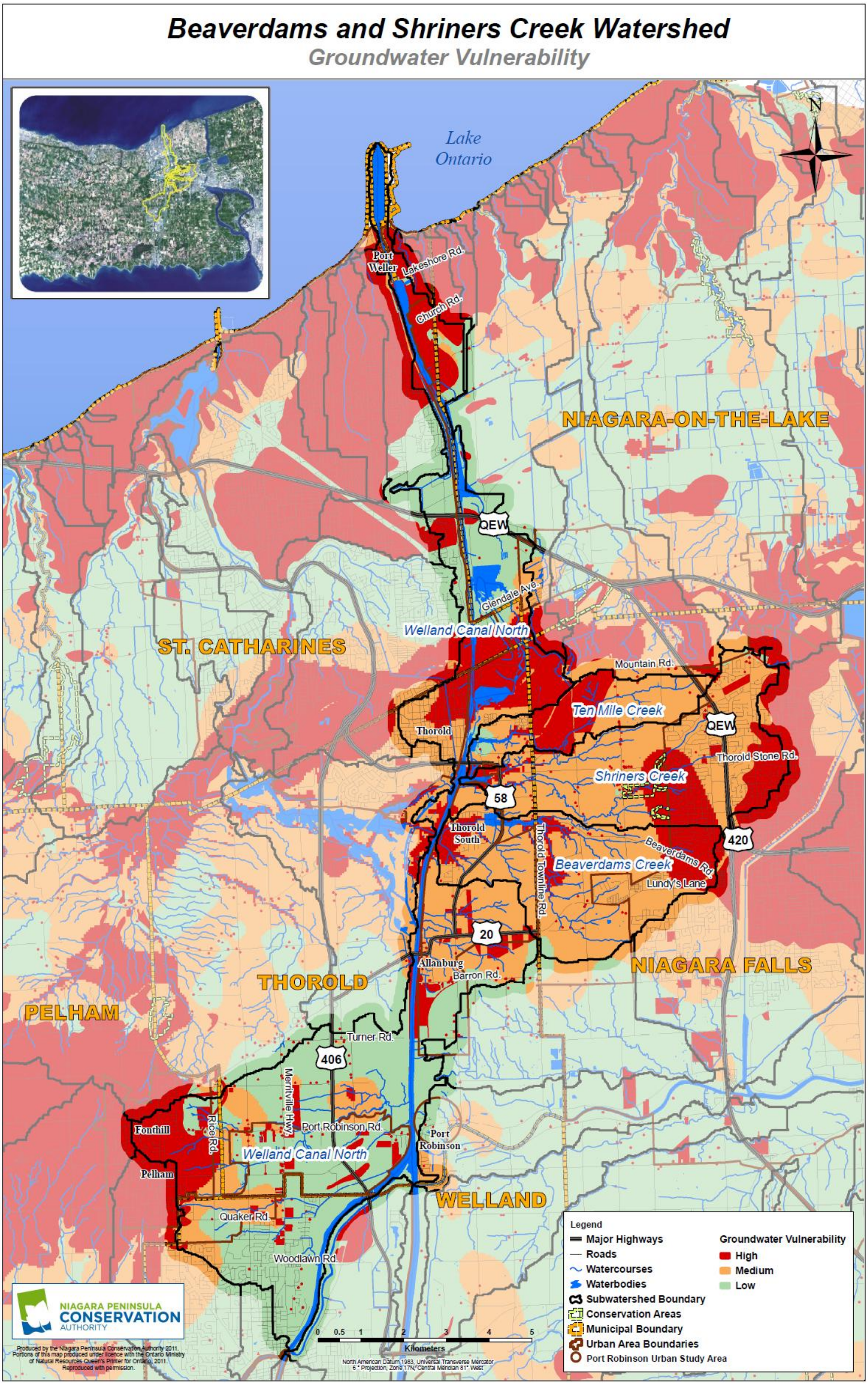

Figure 14: Groundwater Vulnerability

Intake Protection Zone Study

All Ontarians have the right to clean water, not only for recreational purposes but also for bathing, drinking and cooking. In Ontario over 80 percent of the population receives their drinking water from municipal sources (O'Connor 2002). In Ontario, the provincial government launched a *Source Water Protection* program to address the need for better protection of water resources from contamination or overuse. A facet of source water protection was the passage of the *Clean Water Act* (CWA) in 2006 by the provincial government. The purpose of the *CWA* (MOE 2006b) is to protect existing and future sources of drinking water supplies.

Accordingly, the Regional Municipality of Niagara has completed a *Surface Water Vulnerability Study* for each of its 6 municipal Water Treatment Plant (WTP) intakes; the Decew Falls Intake Protection Zone falls partially within a small portion of the Beaverdams and Shriners Creek Watershed Plan study area. The Decew Falls WTP is located north of Thorold and is supplied by a complex series of open channels, supply canals, lakes and reservoirs (Stantec 2009).

The main focus of the *Surface Water Vulnerability Study* was to characterize the aquatic and upland features of the area surrounding the WTP intake, delineate the Intake Protection Zone (IPZ) around the intake, and assess the vulnerability of this intake to drinking water threats that are located within the IPZ.

The *Clean Water Act (2006b)* required the Conservation Authorities across Ontario to establish source protection committees under the guidance of the provincial government with the Chairman of the committee being appointed directly by the province. There are 19 Source Protection Regions/Areas established in Ontario, each with a respective Source Protection Committee. The work of the committee includes mapping vulnerable areas around municipal drinking water sources, identifying and assessing risks to municipal drinking water, and ultimately developing and implementing plans for safeguarding rivers, creeks and other sources of surface and ground water for municipal drinking water supplies within their geographic jurisdictions. Therefore, all 6 *Surface Water Vulnerability Study[s]* are being used by the Niagara Peninsula Source Protection Committee (NPSPC) to prepare an *Assessment Report* and a *Source Protection Plan* which are required under the *Clean Water Act* (MOE 2006b).

The purpose of the *Assessment Report* (NPCA 2010) is to assess the quality and quantity of municipal drinking water supplies across the source protection area. The *Assessment Report* identifies significant threats including potential future threats that could impact our drinking water sources (NPCA 2010). Based on the analysis for the Decew IPZ areas, 3 significant threats were found within the Main IPZ-1, 3 within Lake Gibson IPZ-1, and 2 within the Highway 406 Control Structure (NPCA 2010). All threat circumstances "*apply to each parcel and refer to the potential presence of pathogens in surface water from threat categories*": 1. application of agricultural source material to land; 2. Storage of agricultural source material; and 3. Use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm animal yard (NPCA 2010).

Upon approval of the *Proposed Assessment Report* by the MOE, the report will be used to prepare a Source Protection Plan (SPP). The purpose of the *Source Protection Plan* is to eliminate or reduce significant threats to municipal drinking water sources that are identified in the Assessment Report (NPCA 2010). The *Source Protection Plan,* which

should be completed by 2012, may require municipalities to restrict future land use activities within the area of the Intake Protection Zone, in order to protect the municipal drinking water source (Wright 2007). The SPP "*could use various types of policies ranging from outreach and education to incentive plans to risk management plans or even prohibition of certain activities"* (NPCA 2010).

The *Clean Water Act* (MOE 2006b) also requires that decisions made under the *Planning Act* or the *Condominium Act* (MMAH 1990, 1998) shall conform to the significant threat policies and designated Great Lakes policies set out in the source protection plans; the source protection plan „prevails' in the case of a conflict with official plans and zoning by-laws, although subject to "*the provision that provides the greatest protection to the quality and quantity of any water that is or may be used as a source of drinking water prevails"* (MOE 2006b, CWA Section 39). Therefore, while no policies are in place yet, once the Source Protection Plan is approved, it could restrict future land uses within the areas of the Intake Protection Zones.

Water Quantity

Water Budget

Under the *Clean Water Act* (MOE 2006b), one of the requirements of the Assessment Report Technical Rules is that each Source Protection Region/Area must complete a Tier 1 Water Budget. The purpose of the Tier 1 Water Budget in Niagara Peninsula is to:

- Estimate the hydrologic stress of each watershed planning area in order to screen out areas that are unstressed with respect to water quantity
- Highlight areas where the reliability of water supplies is questionable
- Delineate significant groundwater recharge areas

The Niagara Peninsula Tier 1 Water Budget and Water Quantity Stress Assessment (NPCA 2009c) contains an analysis of the water inflows and outflows within each watershed planning area, for example, the Beaverdams and Shriners Creek Watershed Plan study area. The inflows include precipitation, lateral groundwater inflows, surface water inflows from upstream catchments, and water diversions (such as those from Welland Canal). Outflows include evapotranspiration, surface water discharges (e.g. Beaverdams Creek into Lake Gibson), water takings by industry, residences and agriculture, and lateral groundwater outflow.

A *Water Availability Study* (WAS) (AquaResource Inc 2009) was completed for each watershed planning area by analyzing the inflows and outflows using computer models. The purpose of the *WAS* was to determine the water available for surface water flow, groundwater recharge and evapotranspiration on a monthly basis for the time period 1991 to 2005. This time period was chosen to best suit available datasets and meet the minimum World Meteorological Organization climate normal criterion of fifteen years.

Once the *Water Availability Studies* were completed, the Tier 1 Water Budget focused on anthropogenic water takings and water consumption, to determine if the watershed planning area is stressed hydrologically. *The Tier Water Budget and Water Quantity Stress Assessment* (NPCA 2009c) ties in the *Water Availability Study* and a Stress Assessment. The report includes a watershed characterization (climate, topography, geology, physiology, land cover, soils, streamflow), watershed modelling (model set-up,

calibration, verification, sensitivity, results, and uncertainty), water taking analysis and stress assessment, as well as conclusions and recommendations. The Stress Assessment was completed for both surface water systems and groundwater systems; these assessments were conducted separately. A system is considered moderately or significantly stressed if the demand exceeds a provincial benchmark threshold value Table 7 (NPCA 2010).

The Niagara Peninsula Tier 1 Water Budget and Water Quantity Stress Assessment (NPCA 2010b) identified the Beaverdams and Shriners Creek watershed as having a significant surface water stress level based on provincial benchmark threshold values (Table 9). A significant stress level is assigned to surface water systems where the maximum monthly water demand exceeds 50% of the surface water supply. The Beaverdams and Shriners Creek watershed was also identified as having a low groundwater stress level. A low stress level is assigned to groundwater systems where the demand for monthly maximum is between 0 to 25% or the average annual is between 0 to 10% of the groundwater supply (NPCA 2010b).

Table 7: Provincial Benchmark Threshold Values

Potential for Surface Water Stress Thresholds		
Stress Level Assignment	**Maximum Monthly % Water Demand**	
Significant	> 50%	
Moderate	20% to 50%	
Low	< 20%	
Potential for Groundwater Stress Thresholds		
Stress Level Assignment	**Average Annual**	**Monthly Maximum**
Significant	> 25%	> 50%
Moderate	> 10%	> 25%
Low	0 to 10%	0 to 25%

Additional benefits that will result from the completion of the *Tier 1 Water Budget* include; this project will satisfy one of the Niagara Water Strategy objectives which is to prepare water budgets for watersheds within Niagara Region; and the project will aid the NPCA when commenting on Permit-To-Take-Water (PTTW) applications (Wright 2009).

In Ontario, water takings (both surface and ground) are governed under the Ontario Water Resources Act (MOE 1990) and the Water Taking and Transfer Regulation. Under the Ontario Water Resources Act "*a person shall not take more than 50,000 litres of water on any day by any means except in accordance with a permit issued by the Director"* (section 34.3). Currently in the Beaverdams and Shriners Creek Watershed Plan study area there are 26 PTTW.

Geomorphic Study

NPCA Geomorphic Study of Beaverdams and Shriners Creeks

In 2010 NPCA staff conducted fluvial geomorphic assessments along reaches of Welland Canal North, and Beaverdams and Shriners Creeks (Figure 15). The purpose of the assessments was to identify geomorphic processes occurring in the respective watercourses.The following information is derived from this report: *Beaverdams and Shriners Creek Geomorphic Study, including Thompson Creek* (NPCA 2010e).

A geomorphic assessment provides historical and current conditions on the physical state of the stream in order to assess its stability and to prioritize restoration and protection. Three phases of assessment were conducted which began in the spring of 2010. The first phase of the assessment provides general physical information about specific reaches within the watershed. The second phase involves site specific geomorphic studies, which also includes the third phase of carrying out a stream visual assessment.

The format for the first two phases of the geomorphic assessment is closely based on the phases developed by the Vermont Agency of Natural Resources (2005). The Stream Visual Assessment Protocol has been taken from the National Water and Climate Center Technical Note 99-1 (1998) by the United States Department of Agriculture and the Natural Resources Conservation Service.

Methodology

Initially, the watershed was delineated using a drainage basin of 1.25km^2 or greater, which is the size of the drainage basin the NPCA uses for floodplain regulation. The stream was then broken down into smaller reaches based on physical characteristics of the stream and the surrounding landscape. The reaches were defined by stream confinement (or valley width), valley slope, geologic materials, and joining tributaries, which should result in the reaches having similar hydraulic properties and morphology. This criteria was taken from the Vermont Stream Geomorphic Assessment Phase 1 Handbook (2005) and was determined using various digital layers in the GIS program ArcMap. Once the reaches were identified they were given a unique code in order to distinguish it from the other reaches. The procedure used to collect information for the three phases of the assessment will be described in the preceding sections.

Phase One Data Collection

The first phase in this assessment determined the physical characteristics of the defined reaches for each of the sub-watersheds, and involved the collection of historical data. The types of data gathered for every reach within the Beaverdams & Shriners Creek study area, as well as Thompson Creek watercourse are listed below. These characteristics were determined using various digital layers in ArcMap (Land-use, Soils, and Quaternary Geology), 2006 Ortho photography, as well as aerial photographs from 1934.

Reach Characteristics:

- The valley and channel lengths were measured and used to determine the valley and channel slope, as well as channel sinuosity (the amount of bending in a stream).
- Surficial geology and soil properties were identified.
- Unstable valley side slopes were listed for those reaches that contained them.
- The length of bank that contains a treed riparian buffer was measured and is listed as a percentage of the total reach.

Historical Characteristics:

- The present and historical land uses were determined for the watershed and along the stream corridor. Any changes to the channel planform (the outline

of an object when viewed from directly overhead) as based on the 1934 aerial photographs were also identified.

This data was collected for Welland Canal North, and Beaverdams and Shriners Creek and can be found in the *Beaverdams and Shriners Creek Geomorphic Study, including Thompsons Creek report* (NPCA 2010e).

Phase Two Data Collection

The second phase of the investigation required site visits in order to gather physical and hydraulic information from site specific reaches within the watershed. The data collected during this phase was based on the Vermont Stream Geomorphic Assessment Phase 2 and Phase 3 Handbook (2005). Letters were mailed out to property owners living along the streams in the watershed and site locations were based on landowner permission. The site characteristics collected from the field were separated into five categories which are listed below.

Channel Bed and Planform Changes:

- Identify whether or not riffle and steps were present.
- The composition of the streambed and the average size of the largest particle were identified. Pebble counts were completed at field sites that consisted of a mixture of particle sizes and not just sand sized or smaller.
- Bar types found along the bed were also identified.
- The type and number of planform changes (i.e. flood chutes, neck cut-offs, channel avulsions, and braiding) within the field site were listed.
- Animal crossings along the field site were identified.

Valley and River Corridor:

- Encroachments parallel to the stream (berms, roads, or paths) which may not allow flood waters to overflow onto its floodplain were identified and measured.
- The gradient and texture of adjacent terraces or hills was recorded.
- It was noted whether or not the stream bank was continuous with the valley slope or greater than one bankfull width away.
- Grade controls were identified along the channel and their height was measured.

Flow Modifiers:

- Channel constrictions present within the stream were noted.
- Springs, seeps, small tributaries and adjacent wetlands were identified due to their influence on water storage and habitat.
- Debris jams present within the channel were recorded.
- Inputs from stormwater drains were identified and it was noted whether or not the flow is regulated upstream.
- The amount of water presently flowing within the channel was also recorded.

Stream Banks, Buffers, and Corridors:

- Bank slope and sediment type present within the bank were identified. Slope was identified as either shallow (<30%), moderate (30-50%), or steep (>50%).
- The presence of bank erosion and revetments were noted.

- Type of bank vegetation and approximate width was identified for the near bank, buffer, and riparian zones. The degree of canopy across the channel was also identified.

Channel Cross Sections:

- Measurements on bankfull width, bankfull maximum depth, floodprone width, and estimated present flow status were recorded.
- Calculations on mean bankfull depth, cross sectional area, wetted perimeter, entrenchment ratio, hydraulic radius, width/depth ratio, average water depth, and the estimated discharge and velocity for bankfull were also determined.

This data was collected for Welland Canal North, and Beaverdams and Shriners Creek and can be found in the *Beaverdams and Shriners Creek Geomorphic Study, including Thompsons Creek report* (NPCA 2010e).

Phase Three Data Collection

Each field site was analyzed using the "Stream Visual Assessment Protocol" taken from the National Water and Climate Center Technical Note 99-1 (1998) by the United States Department of Agriculture and the Natural Resources Conservation Service. Using visual indicators, this form helps to determine the stability of the watercourse. There are 15 possible categories that a score out of 10 is assigned to, but two of the categories were not used during this assessment. The macroinvertebrate category was not used because this information is captured as part of the water quality program, and the salinity category was not used because it is not applicable to any of the sites. The 13 categories and their descriptions used in this assessment are listed below.

Channel condition:

- A low score for this category would indicate that the channel has been structurally altered and is no longer in its natural form. A low score would also be assigned if the channel is incised and can no longer access the floodplain. Streams that have been channelized or straightened would result in a lower score as well.

Hydrologic Alteration:

- A low score for this category would indicate that flooding occurs rarely or never. This would be due to deep incision or structures that prevent floodplain access. Known water withdrawals from the area would also result in a low score.

Riparian Zone:

- If the bank vegetation adjacent to the stream is non-existent or barely present then a low score is assigned to this category. The lack of structural components from a variety of vegetative types (i.e. aquatic plants, sedges, grasses, shrubs, understory and overstory trees) will result in a lower score as well.

Bank Stability:

- A low score for this category would indicate that bank erosion is present throughout the majority of the site. Bank erosion includes areas where bare soil is extending up the bank, fallen vegetation is present, and slumped soil is found at the base of the bank.

Water Appearance:

- Contributors to a low score in this category would include the presence of cloudy or turbid water, visible pollutants within the water, or odours.

Nutrient Enrichment:

- Low scores indicate that an excessive amount of nutrients are present within the stream. Dense macrophyte beds and algal blooms can be sources of serious problems for the system.

Barrier to Fish Movement:

- A low score for this category means that there is a barrier to fish movement present. Natural barriers, such as waterfalls are also considered in this category.

Instream Fish Cover:

- The score in this category depends on the number of suitable habitat and cover types available. The cover types include: logs/large woody debris; deep pools; overhanging vegetation; boulders/cobble; riffles; undercut banks; thick root mats; dense macrophyte beds; isolated/backwater pools; and other cover types.

Pools:

- A low score for this category indicates that the majority of pools present are shallow or there are no pools present at all.

Insect/Invertebrate Habitat:

- The score in this category depends on the number of suitable habitat types present. The cover types include: fine woody debris; submerged logs; leaf packs; undercut banks; cobble; boulders; coarse gravel; and other habitat types.

Canopy Cover:

- Based on a warm water system a low score for this category means that less than 25% of the water surface is shaded in the reach.
-

Manure Presence (if applicable):

- A low score for this category indicates that livestock have access to the riparian zone and that manure is present.

Riffle Embeddedness (if applicable):

- If particles along the stream bed are completely or partially embedded then a low score is assigned to this category.

This data was collected for Welland Canal North, and Beaverdams and Shriners Creek and can be found in the *Beaverdams and Shriners Creek Geomorphic Study, including Thompsons Creek report* (NPCA 2010e)..

Site Characterizations

As indicated earlier, during the summer months of 2010 field sites were assessed along Welland Canal North, and Beaverdams and Shriners Creeks (Figure 15). The results of

the field work, as well as possible restoration alternatives are recorded for each site in the following section.

Beaverdams Creek

1. Ontario Street (BdCMb): The riparian buffer along this field site basically consists of a manicured lawn in the downstream section; therefore habitat and shading over the watercourse will be impacted. There is relatively deep unconsolidated sediment deposited along the channel bed in some areas. A number of small tributaries or possibly rills/gullies exist along the watercourse. The presence of algae and duckweed were noted during a site visit in 2010. The invasive vegetation species, Phragmites was also present along the watercourse. Recommendations for this site include not mowing the grass to the edge of the watercourse. Increasing the variety and diversity of native plant species in the buffer zone will provide cover and habitat for fish, insects, and invertebrates. Excessive sediment deposition can cause problems in the watercourse, such as lateral channel adjustments, increased turbidity, filling in of pools, and impacting fish habitat. Monitoring the accumulation of sediment along the channel bed can be done by the creation of a permanent cross section at this field site. Re-surveying this cross section over a period of time will provide information on channel dimensions and will indicate if excessive sediment deposition is occurring (United States Environmental Protection Agency, 2010). Projects to prevent and limit further development of rills adjacent to the watercourse should be implemented to avoid excessive amounts of sediment entering the watercourse. Some examples include grassed waterways, chute spillways, tile drainage outlets, and proper tillage and cropping practices (OMAFRA, 1997a), (OMAFRA, 1997b). Water quality should continue to be monitored in this watershed due to the presence of algae. Due to the fact that Phragmites is classified as an invasive species further research should be conducted to determine whether it should be removed from this location.

2. Beaverdams Road (BdCMd): The presence of algae was noted during a site visit in 2010. The Beaverdams Creek Wetland is located at this site. Recommendations for this site include continuing to monitor water quality due to the presence of algae.

3. Beaverdams Road (BdCMd-2): There is a lack of vegetation types present in the riparian buffer zone impacting habitat and cover over the channel. Tractor marks are present through the channel but no crossing with a culvert exists here. The presence of algae and in-channel vegetation were noted during a site visit in 2010. The Beaverdams Creek Wetland is located at this site. Recommendations for this field site include the creation of a proper crossing with a culvert. This will allow vehicles to cross the channel without creating bed and bank erosion which would provide additional sediment to the channel. Water quality should continue to be monitored in this watershed due to the presence of algae.

4. Nichols Lane (BdCTb2): The channel seems to have been altered through this field site due to high stream banks and straightness of the channel. A number of small tributaries or possibly rills/gullies exist along the watercourse. The presence of algae was noted during a site visit in 2010. Projects to prevent and limit further development of rills adjacent to the watercourse should be implemented to avoid excessive amounts of sediment entering the watercourse.

Some examples include grassed waterways, chute spillways, tile drainage outlets, and proper tillage and cropping practices (OMAFRA, 1997a), (OMAFRA, 1997b). Water quality should continue to be monitored in this watershed due to the presence of algae.

Shriners Creek

1. Kalar Road (SC-Headwaters): The channel seems to have been altered through this field site due to high stream banks and straightness of the channel. A number of small tributaries or possibly rills/gullies exist along the watercourse. Bank instability is present in the form of slumping and there is a lack of large woody vegetation adjacent to the channel. This field site is within a Conservation Area. The presence of bank slumping usually indicates that vegetative roots are too shallow to stabilize the banks or that the bank slopes are over steepened. Slumping is common in clay textured soil and over steepened slopes. Due to the fact that this field site is within a Conservation Area, bank instability can be left alone allowing the stream banks to stabilize themselves. The bank instability can be monitored by the use of erosion pins inserted into the bank. Projects to prevent and limit further development of rills adjacent to the watercourse should be implemented to avoid excessive amounts of sediment entering the watercourse. Some examples include grassed waterways, chute spillways, tile drainage outlets, and proper tillage and cropping practices (OMAFRA, 1997a), (OMAFRA, 1997b).

2. Garner Road (SCMd): Bank instability is present in the form of bare soil extending up the bank, fallen vegetation, and slumped soil. Some of this instability is present on both sides of the channel at the same location. Quite a few debris jams were present along this field site and some are causing notable bank erosion. A number of small tributaries or possibly rills/gullies exist along the watercourse. The presence of bank slumping usually indicates that vegetative roots are too shallow to stabilize the banks or that the bank slopes are over steepened. Slumping is common in clay textured soil and over steepened slopes. This bank instability can either be left alone allowing the stream banks to stabilize themselves over time or depending on the velocities and shear stresses within this area possible bioengineering restoration choices could include brush layers or vegetated geogrids. Bank instability can also be monitored by the use of erosion pins inserted into the bank. Excessive amounts of sediment entering the channel can cause problems in the watercourse, such as lateral channel adjustments, increased turbidity, filling in of pools, and impacting fish habitat. Additional sediment may be entering the channel through bank erosion at the numerous debris jams present along this field site. If these debris jams are causing more sediment to enter the channel then they should be removed. Projects to prevent and limit further development of rills adjacent to the watercourse should be implemented to avoid excessive amounts of sediment entering the watercourse. Some examples include grassed waterways, chute spillways, tile drainage outlets, and proper tillage and cropping practices (OMAFRA, 1997a), (OMAFRA, 1997b).

3. Garner Road (SCMd-2): Bank instability is present in the form of bare soil extending up the bank, fallen vegetation, and some slumped soil. Quite a few debris jams were present along this field site. A number of small tributaries or possibly rills/gullies exist along the watercourse. There is relatively deep

unconsolidated sediment deposited along the channel bed in some areas. Garbage was noted in the channel during a site visit in 2010. The presence of bank slumping usually indicates that vegetative roots are too shallow to stabilize the banks or that the bank slopes are over steepened. Slumping is common in clay textured soil and over steepened slopes. Due to the fact that this field site is within a Conservation Area, bank instability can be left alone allowing the stream banks to stabilize themselves over time. The banks can also be monitored by the use of erosion pins inserted into the bank. Projects to prevent and limit further development of rills adjacent to the watercourse should be implemented to avoid excessive amounts of sediment entering the watercourse. Some examples include grassed waterways, chute spillways, tile drainage outlets, and proper tillage and cropping practices (OMAFRA, 1997a), (OMAFRA, 1997b). Excessive sediment deposition can cause problems in the watercourse, such as lateral channel adjustments, increased turbidity, filling in of pools, and impacting fish habitat. Monitoring the accumulation of sediment along the channel bed can be done by the creation of a permanent cross section at this field site. Re-surveying this cross section over a period of time will provide information on channel dimensions and will indicate if excessive sediment deposition is occurring (United States Environmental Protection Agency, 2010).

4. Thorold Stone Road (SCMe): Bank instability is present in the form of bare soil extending up the bank, and fallen vegetation. Quite a few debris jams were present along this field site. Garbage was noted in the channel during a site visit in 2010 (including what looks to be a furnace oil tank). This field site is within a Conservation Area. Recommendations for this site include monitoring bank erosion to ensure the banks are adequately stabilized. This can be done by the use of erosion pins inserted into the bank. Due to the fact that this field site is within a Conservation Area, bank instability can be left alone allowing the stream banks to stabilize themselves over time. Additional sediment may be entering the channel through bank erosion at the numerous debris jams present along this field site. If these debris jams are causing more sediment to enter the channel then they should be removed. Garbage should be removed from the watercourse, especially large items like the oil tank.

5. Thorold Stone Road (SCMe-2): This field site is within a Conservation Area and the channel has been altered for the creation of a flood control project. Garbage, a film on the water surface, and macrophytes were noted during a site visit in 2010. There is a lack of large woody vegetation adjacent to the channel at this field site because no trees are planted near the flood control works in order to maintain its structural integrity. Garbage should be removed from the watercourse and water quality monitoring should continue due to the presence of a film on the water surface.

6. Beechwood Road (SCTa): No pools were identified at this field site but this is probably due to the fact that surrounding land is flat and that the channel is not well defined at this location. No issues were identified with the riparian buffer, bank stability, nutrient enrichment or water appearance therefore no recommendations for this site are suggested.

7. Kalar Road (SCTc): This field site is within a Conservation Area and the channel has been altered by the creation of two on-line ponds for stormwater management. Turbid water, algae, and possible rot were noted in the

watercourse during a site visit in 2010. Water quality should continue to be monitored in this watershed.

8. Kalar Road (SCTd): This field site is within a Conservation Area. Bank instability is present in the form of bare soil extending up the bank in the downstream section. Numerous debris jams were noted. Recommendations for this site include monitoring bank erosion to ensure the banks are adequately stabilized. This can be done by the use of erosion pins inserted into the bank. Additional sediment may be entering the channel through bank erosion at the numerous debris jams present along this field site. If these debris jams are causing more sediment to enter the channel then they should be removed. Excessive sediment deposition can cause problems in the watercourse, such as lateral channel adjustments, increased turbidity, filling in of pools, and impacting fish habitat.

Welland Canal North

1. Rice Road (WCN-Headwaters): Few to no deep pools were identified at this field site but this is probably due to the fact that surrounding land is flat and that the channel is not well defined in some areas. No issues were identified with the riparian buffer, bank stability, nutrient enrichment or water appearance therefore no recommendations for this site are suggested.

2. Port Robinson Road (WCNTd2): The channel along this field site is classified as a municipal drain named Singer's Drain. There is relatively deep unconsolidated sediment deposited along the channel bed in some areas. Turbid water was noted during a site visit in 2010. Old concrete abutments are present at this field site and would cause a constriction in the channel. Cattails were included as canopy cover for this site. Excessive sediment deposition can cause problems in the watercourse, such as lateral channel adjustments, increased turbidity, filling in of pools, and impacting fish habitat. Monitoring the accumulation of sediment along the channel bed can be done by the creation of a permanent cross section at this field site. Re-surveying this cross section over a period of time will provide information on channel dimensions and will indicate if excessive sediment deposition is occurring (United States Environmental Protection Agency, 2010). The old concrete revetments should be removed from the channel. This is due to the fact that constrictions can cause water to dam up and deposit sediment, they can also cause debris jams. Water quality should be monitored in this watershed. All recommendations should be discussed with the Drainage Superintendent.

3. Merrittville Highway (WCNTd3): The channel along this field site is classified as a municipal drain named Singer's Drain. Near the road there are gabion baskets on both sides of the channel and there is concrete on the channel bed. The buffer width is small in some areas and there is bank instability present. At the upstream end there is a fence that is falling into the channel. Recommendations for this site include stabilizing the section of bank where the fence is falling. Proper bank stabilization methods should be installed to prevent erosion and should be discussed with the Drainage Superintendent. Options for erosion control and bank stabilization, such as planting bigger buffers, can be found in "The Drain Primer, Ontario Edition" (Evanitski, 2008).

4. Hurricane Road (WCNTdTa): This field site is within the Provincially Significant Wetland, Port Robinson Woodlot. Bank instability was present in the form of bare

soil extending up the bank. Turbid water was noted during a site visit in 2010. Recommendations for this site include monitoring bank erosion to ensure the banks are adequately stabilized. This can be done by the use of erosion pins inserted into the bank. Water quality should be monitored in this watershed.

5. Merrittville Highway (WCNTdTb): There is a lack of vegetation types present in the riparian buffer zone impacting habitat and cover over the channel at this field site. The size of the buffer is small in some areas. Algae and duckweed were noted during a site visit in 2010. Some bank instability was noted in the form of slumping. Recommendations for this field site include increasing the variety and diversity of native plant species in the buffer zone so that it will provide more cover and habit for fish, insects, and invertebrates. The presence of bank slumping usually indicates that vegetative roots are too shallow to stabilize the banks or that the bank slopes are over steepened. Slumping is common in clay textured soil and over steepened slopes. Monitoring bank erosion to ensure the banks are adequately stabilized can be done by the use of erosion pins inserted into the bank. Water quality should be monitored in this watershed.

6. Cataract Road (WCNTdTb-2): Few to no deep pools were identified at this field site but this is probably due to the fact that surrounding land is flat and that the channel is not well defined in some areas. Landowner stated that roadside ditch which flows into the watercourse floods out onto Cataract Road. A tree planting project was completed here in the spring of 2010 by the Niagara Peninsula Conservation Authority. Recommendations for this field site include ensuring that culverts are adequately sized and also are not blocked by debris so they are not causing water to back up. The surrounding land is fairly flat in this area and may be contributing to channel flooding.

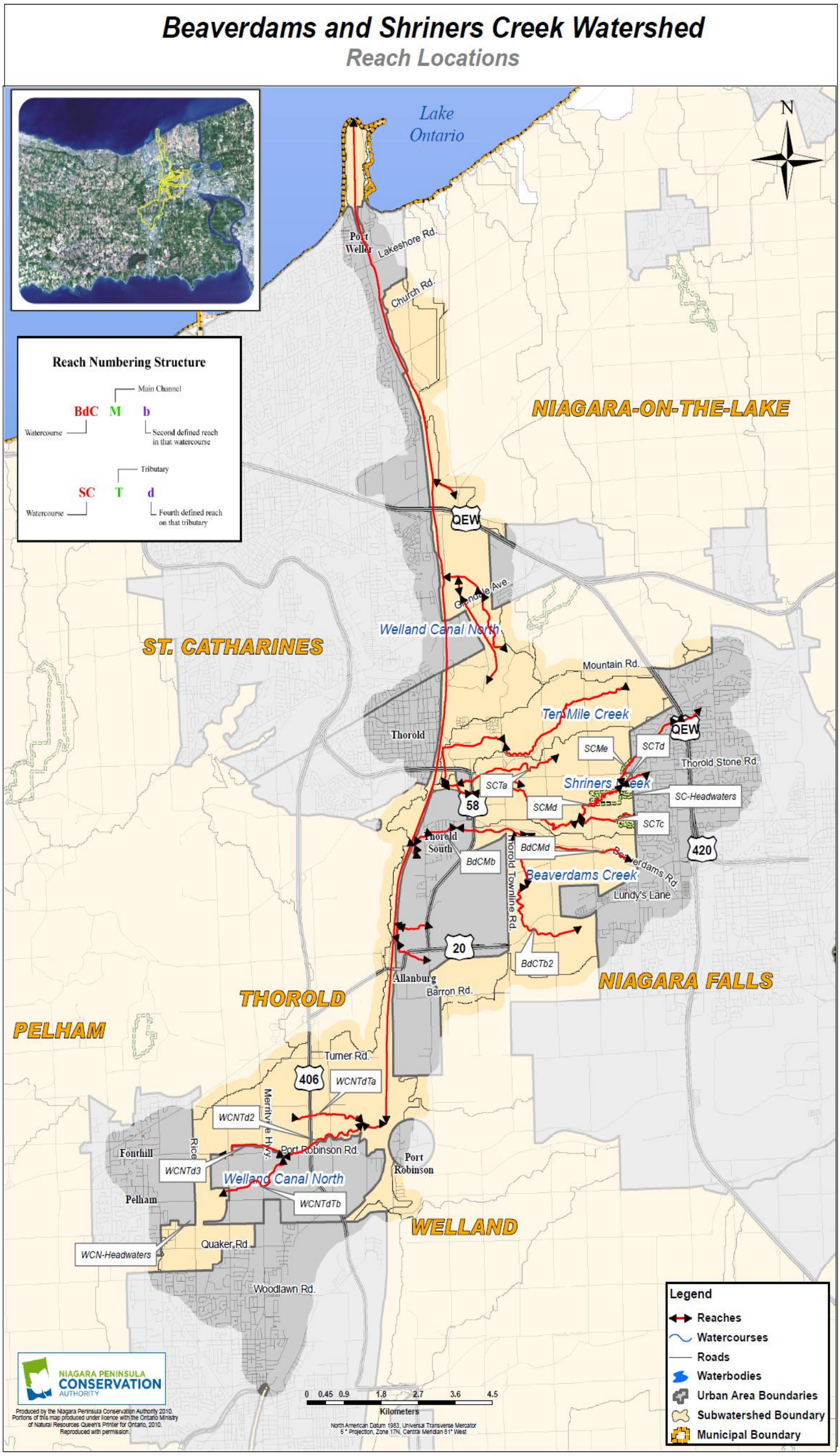

Figure 15: Geomorphic Assessment Reach Locations

Preliminary Identification of Challenges and Opportunities in the Beaverdams and Shriners Creek Watershed

The *Groundwater Study* (Waterloo Hydrogeologic Inc. 2005) and *NWS* (RMN 2006a) summarized a list of key water protection issues in the Beaverdams and Shriners Creek watershed. Additional issues will be identified by residents living in the watershed via public open houses and workshops scheduled for the spring and fall of 2009. A *Land Management and Agricultural Best Management Practice* survey (NPCA 2006) (Appendix A) helped to identify land and water management issues in rural areas of the watershed. A description of the challenges facing the Beaverdams and Shriners Creek watershed are reported here.

Landfill Sites

Seven closed dump/fill sites in the Beaverdams and Shriners Creek watershed were identified in the *Groundwater Study*. Landfill sites labelled as „old dump/fill sites' are areas that were once used as a dump or landfill. The subwatersheds where these sites are located are as follows; six in Welland Canal North and one in Beaverdams Creek. The *NWS* has identified concern that potential leachate could be discharging from these old dump/fill sites. Leachate is created as precipitation percolates through the waste material.

One active landfill was identified in the study area: Walker Industries on Thorold Townline Road in the Ten Mile Creek subwatershed. Recognizing that the current landfill has a limited capacity and that a new site will be required in the near future, the City of Niagara Falls is currently underway with St. Catharines, Thorold and Niagara-on-the-Lake to "*establish a progressive approach to solid waste management with the emphasis placed on reducing, reusing and recycling program"* [City of Niagara Falls 2009 (Part 3 Section1)].

Quarry Operations

The *Groundwater Study* has identified concerns that the local quarries may be posing a potential threat to groundwater quality since extraction removes any overlying protection of soil and overburden, exposing the bedrock or shallow overburden deposits.

As previously indicated, there is one major quarry operation in the Beaverdams and Shriners Creek study area located in the Welland Canal North subwatershed in Niagara Falls. It is the intent of the *Official Plan for the City of Niagara Falls* (2009) to ensure that these operations are compatible with adjacent properties and rehabilitated to suitable after-uses (Section 10).

Septic Systems

A well designed septic system can function properly for years. The basic design of a septic system includes a septic tank and a drainage field. Wastewater from toilets, bathtubs, sinks and other drains flow into the tank where bacteria that is naturally found in the wastewater breaks down any solid material. The liquid effluent travels through the perforated distribution pipes to the leaching bed. The water is then absorbed and filtered by the ground in the drainage field. Problems with septic tanks often stem from improper

use and maintenance. Faulty septic systems can create serious local contamination problems with the potential to contaminate groundwater wells (Pollution Probe 2004).

Faulty or improperly maintained septic systems have been reported as a moderate concern in the *Land Management Issues and Agricultural Best Management Practices* survey (NPCA 2006). In addition, the *Groundwater Study* in consultation with the Region of Niagara Public Health Department identified areas where septic systems have been reported to have negatively impacted the quality of the groundwater. These areas are illustrated on Figure 13.

A septic system maintenance and education program could improve local septic system operation and well water quality for groundwater users in the watershed. The watershed strategy will put forth a set of recommendations for this type of watershed initiative.

Combined Sewer Overflows

Five Combined Sewer Overflows (CSO) and 13 CSO pumping stations have been identified in the Beaverdams and Shriners Creek watershed through the *NWS*. A combined sewer is designed to collect stormwater runoff and wastewater (sewage and used water) and transport it to the treatment plant. However, during heavy rain events or snow melts the wastewater in the sewer may reach capacity of the sewer system or possibly the treatment plant. When this occurs, the sewer system overflows and discharges the excess wastewater in to the nearby watercourse or waterbody. The overflows which contain sewage and stormwater are called Combined Sewer Overflows, and have been identified as a key issue in the Beaverdams and Shriners Creek watershed.

It is the intent of the *Official Plan for the City of Thorold* (2000) to construct sanitary and sewer systems separately and where feasible and economical separate present sewers from storm water connections (Section 5.3.1). The *Official Plan for the City of Niagara Falls* (2009) indicates that the City has developed a strategy to "*control and/or eliminate combined sewer overflows, provide consideration for storm water pollution control and then determine the requirements for future servicing and infrastructure rehabilitation in the City"* (Section1.1.2).

The strategies that Welland intends to implement in terms of combined sewer overflows will be included once the Official Plan is completed.

Urban Storm Water Management

A lack of stormwater management facilities to treat urban runoff in Thorold and Niagara Falls has been identified as a key issue in the *NWS*. Twenty-five storm outfalls and 2 industrial outfalls have been identified in the Beaverdams and Shriners Creek watershed. During a rain event, stormwater remains on the surface collecting contaminants instead of seeping into the ground as it would in a natural system. As a result, stormwater accumulates and runs off in great amounts, creating the potential for flooding and erosion (Pollution Probe 2004). Several strategies can be implemented to achieve stormwater management that aims to reduce stormwater runoff. One method involves storing excess water on or near the site, and releasing it slowly over a long period of time. Detention basins are used to slow the rate of delivery of stormwater by discharging the captured water at a specified rate to receiving water bodies. Another

method involves returning the excess water to the ground where it would have gone prior to development. Additional stormwater management methods will be identified as part of the watershed strategy.

Like most official plan documents, The *Official Plan for the City of Thorold* (2000) outlines numerous strategies to deal with stormwater management. For example, Section 5.4.4 specifies that measures such as water retention and siltation ponds shall be encouraged by Council to enable the control of surface water run-off and maintain the receiving watercourses in a more natural condition. Likewise, the *Official Plan for the City of Niagara Falls* (2009*)* also encourages the incorporation of naturalized overland systems into stormwater management plans. Section 1.2.5 states "*Naturalized off-stream ponds and wetlands are encouraged to properly regulate and control water quantity and quality flows going into natural watercourses. In addition, to controlling water quality and quantity, such systems shall be as natural as possible to create habitat areas and where applicable, will be used to provide linkages to other natural features"*.

The *Draft Official Plan for the Town of Pelham* (Meridian 2007) specifies that any major development must be supported by a Stormwater Management report that is prepared by a qualified professional, in accordance with the Stormwater Management Practices and approved by appropriate agencies, such as the Town of Pelham, Region of Niagara and the NPCA.

The strategies that Welland intends to implement in terms of stormwater management will be included once the Official Plan is completed.

The RMN and NPCA are currently developing policies to provide for a long- term plan for the safe and effective management of runoff in urban and urbanizing areas, while sustaining the health of local rivers and stream (TSH 2007). The report entitled *Stormwater Management, Erosion, and Sediment Policies and Criteria* will provide a consist approach to stormwater management for all municipalities in Niagara Region.

Road Salt

Originating from salt storage and snow disposal sites as well as from runoff, road salts are an environmental concern because they are known to have an adverse effect on freshwater ecosystems, soil, vegetation and wildlife (Environment Canada 2004a). In April 2004, Environment Canada produced a *Code of Practice for the Environmental Management of Road Salts*. The *Code of Practice* recommends that all road authorities prepare and implement salt management plans that incorporate the implementation of best management practices (BMP) for salt application, salt storage and handling, and snow disposal. The benefits of improved salt management include:

- a reduction in corrosive damage to salt application equipment, vehicles, and infrastructure such as concrete sidewalks and steps;
- a reduction in salt damage to vegetation and surrounding roads and walkways;
- reduced salt releases to surrounding waterways; and
- an overall, more efficient and effective service resulting in safer roads and sidewalks for users (Environment Canada 2004b).

The Regional Municipality of Niagara undertook a *Salt Vulnerability Study*, which was completed by Ecoplans Ltd (2005). The study identified vulnerable areas from road salt for land use, groundwater, surface water, and natural areas.

The Beaverdams and Shriners Creek watershed has been ranked as having a predominantly high runoff vulnerability to road salt due to the relatively flat topography above the Niagara Escarpment and the high number of roads in the study area. Land use vulnerability in the residential areas and built-up areas of the study area along the Welland Canal and above the Niagara Escarpment have been ranked as having a low and moderately low vulnerability to road salt, while the areas with highly vulnerable crops such as the tender fruit agricultural areas below the Niagara Escarpment have been ranked as having a moderately high salt vulnerability. Groundwater vulnerability has been ranked as high around the Fonthill Kame and Lake Ontario due to its high infiltration rate; the remainder of the study area has a relatively low and moderately low groundwater vulnerability to road salt. Surface water vulnerability to salt in the study area has primarily been ranked as moderately low due to the overall rural nature of the watercourses. One small section west of the Welland Canal has been ranked with a moderate vulnerability due to the urban setting of this area. The lack of wetlands and critical fish habitat in the study area results in the watershed having a relatively low salt vulnerability in terms of sensitive habitat However, the south-western portion of the study area includes large tracts of provincially and locally significant wetlands resulting in a moderate vulnerability to road salt.

It is important to note that the Regional Niagara *Salt Vulnerability Study* only assessed risk for Regional roads. Municipal roads should also be assessed to better identify salt vulnerable areas in the watershed.

Nutrient Management

Concerns over nutrient management were identified in the *NWS* and in the *Land Management and Agricultural Best Management Practices* survey distributed to agricultural land owners. Nutrients derived from manure and chemical fertilizers are necessary for farm production. However, the improper use of nutrients can result in soil-nutrient imbalances and it can impair water quality locally and downstream of a farm. In order to maintain soil and water quality, the Ontario government introduced the *Nutrient Management Act* in 2002. As of September 2003, new livestock farms that are over 5 Nutrient Units (NU) and existing livestock farms expanding to 300 NU or more are required to complete a nutrient management strategy (NMS) that includes information on its operation, how much nutrient is produced, how it will be stored, an analysis of its nutrient content, and where it will be used. A Nutrient Management Plan (NMP) must be completed for agricultural operations that apply nutrients to the land. The NMP includes information about the farm and its fields, an analysis of the nutrients to be applied, how much will be applied and at what rate, and how the nutrients will be stored (OMAFRA and OMOE 2003). The purpose of proper nutrient management is to protect surface and ground water from contamination.

Groundwater Sensitivity

The *NWS* and the *Groundwater Study* have identified areas in the Beaverdams and Shriners Creek watershed study area that have a high and medium susceptibility to groundwater contamination. The Fonthill Kame–Delta, Lake Ontario shoreline and the eastern portion of Niagara Falls were identified as areas highly susceptible to

groundwater contamination due to the high permeability of the overburden units with little or no low conductivity units. In addition, areas along the Niagara Escarpment have been identified as highly susceptible due to the thin overburden and bedrock outcrops. The thin overburden is unable to effectively provide the groundwater with sufficient protection from bacteria, sediment and other insoluble forms of contaminants that in a thick overburden would become trapped and filtered within the soil pores. In addition, the openings in the fractured bedrock allow for the direct passage of surface water and contaminants to groundwater resources. The central portion of the study area has a medium sensitivity to groundwater contamination. The overburden thickness ranges from 5 to 10 meters above the bedrock. Like the escarpment areas, the nature of the overburden may not provide sufficient protection from surface contamination.

The *PPS* in section 2.2.1(Ontario Ministry of Municipal Affairs and Housing 2005a) requires planning authorities to protect, improve or restore vulnerable and sensitive surface and ground water features, and their hydrologic functions. Likewise, it is the intent of the *Regional Niagara Policy Plan* (RMN 2007) to protect, improve or restore the quantity and quality of ground and surface water resources[section 7(A.2.2)]. Under the *Clean Water Act* (2006b), vulnerable groundwater areas that fall within an Intake Protection Zone will be protected under the *Source Protection Plan*.

Water Fluctuations in the Welland River

Concern regarding the reversal of flow and the fluctuations of the water level has been identified as a concern in the *NWS* (RMN 2006a). The lower Welland River has been severely modified for transportation and hydro operations. The original outlet of the Welland River was the Niagara River; however the lower reaches are now diverted upstream from the Niagara River toward the Chippawa Power Canal. Regulated fluctuations occur in the flow of the Niagara River due to hydro operations, which in turn result in fluctuations in the lower Welland River. The diversion has created a pattern of regular diurnal fluctuations in water levels that extend upstream to Port Robinson, roughly 60 kilometres upstream of the diversion. Concerns regarding the affect of the flow reversals and fluctuations on the Welland River ecosystem have been expressed.

In 2004, Phillips Engineering completed the *Draft Welland River Water Fluctuation Study* for the Niagara Peninsula Conservation Authority and the Ontario Power Generation. The study objective was to "*comprehensively evaluate opportunities to either mitigate the impacts on the Welland River ecosystem, due to the water level fluctuations, and/or moderate the extent/significance of the water level fluctuations*".

The study identified a decrease in impact on the inshore habitat the further upstream from diversion travelled. The impacts appeared minor to the habitat between the two siphons and nearly insignificant upstream of the siphons. The portion of the Welland River that falls within the Beaverdams and Shriners Creek watershed is the reach between the two siphons.

Urban Expansion

Future expansion of Thorold and Niagara Falls has been identified as a concern in the *NWS* in terms of affecting natural areas. In addition, this issue was also identified as a serious concern by the members of the agricultural community that participated in the *Land Management and Agricultural Best Management Practices* survey. Survey

participants were very concerned about the loss of agricultural land and the loss of natural areas to urban development.

In Niagara Falls, the lands in the Beaverdams and Shriners Creek Watershed Plan study area that are outside of the urban boundary are designated as Good General Agriculture. Niagara Falls Official Plan states that "*Uses of land and the creation of lots not related to agricultural uses are not permitted in the Good General Agriculture Area"* (Section 7.7.3).

In Thorold, as previously indicated, the Official Plan states that the Port Robinson West community will generate an increased demand for a range of commercial uses (Section 4.9.1), and accordingly as reported earlier, the City is currently in the process of preparing a secondary plan for the Port Robinson West area. In terms of future urban development the focus is primarily directed towards the Confederation Heights district and infilling existing urban areas such as Allanburg, Thorold and Thorold South (Section 3.3).

Currently the Town of Pelham is in the process of developing a secondary plan for East Fonthill. The study area is bounded by Rice Road on the east, Quaker Road on the South, Pelham Road on the west, and Canboro Road on the north. The secondary plan will establish the most "*appropriate urban structure and range and mix of land uses that would facilitate the development of a high quality community with the Town of Pelham"* (Totten Sims Hubicki Associates 2006). Key objectives of the secondary plan include the provision of a range of housing types, employment opportunities and the protection of the watercourses and existing natural areas.

Expansion of the 406 Highway between Thorold and Welland and the construction of a bridge at Merritt Road are initiatives that are a part of *Niagara's Transportation Strategy* (2002) to provide Niagara with an improved transportation network that will support economic growth and land use development in Niagara. Although, one of the strategic directions of *Niagara's Transportation Strategy* is to provide environmental stewardship (Section 2), the expansion of the 406 may impact surrounding natural areas.

A small portion of the Provincial Greenbelt falls within the Beaverdams and Shriners Creek watershed study area. *The Provincial Greenbelt Plan* (Ministry of Municipal Affairs and Housing 2005b) is a fundamental element of the provincial *Greater Golden Horseshoe Growth Plan*. The *Greenbelt Plan* has been created to provide permanent protection to the agricultural land base and the ecological features and functions by designating areas where urbanization should be limited. In the Beaverdams and Shriners Creek watershed, Provincial Greenbelt areas include Niagara Escarpment Commission (NEC) lands along the Niagara Escarpment and Protected Countryside lands on the east side of the Welland Canal in Niagara-on-the-Lake and the western edge of Thorold. The *Niagara Escarpment Plan* (NEP) applies to the lands of the NEC and includes policies for seven land use designations (natural, protection, recreation, rural, urban, minor urban and mineral resource extraction); provides development criteria; and establishes objectives for the Niagara Escarpment Parks System of 131 parks and protected areas (NEP 2005). The Protected Countryside lands are intended to enhance the spatial extent of agriculturally and environmentally protected lands within the *NEP* area as well as enhance linkages with surrounding major lake systems and watersheds. Only a small portion of the NEC and Protected Countryside lands fall within the Beaverdams and Shriners Creek watershed (Figure 16).

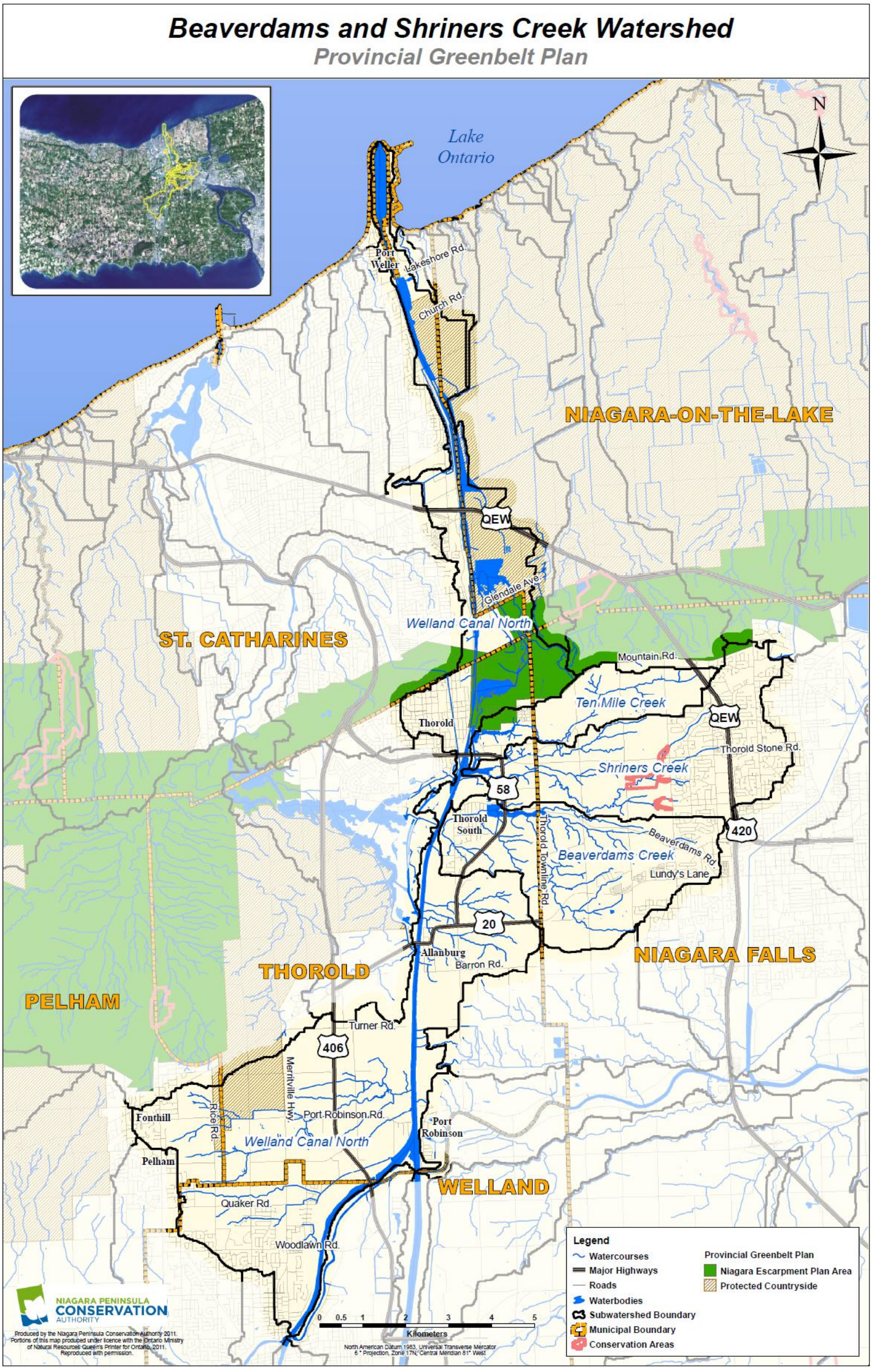

Figure 16: Provincial Greenbelt

Niagara Region's *Sustainable Community Policies* (Policy Plan Amendment 2-2009) outline numerous strategies to bring Niagara Region into conformity with the policies of the *GGH* and *PPS* and implement the strategic directions of the GMS. For example, it is the intent of the objectives of the Growth Management Policies to direct the majority of growth and development to Niagara's existing Urban Areas, direct intensification to existing Built-Up Areas and Locally Designated Intensification Areas, and preventing urban development in inappropriate areas (e.g. Greenbelt, Core Natural Areas) to contribute to the conservation of resources (Section 4.1).

Municipal Drain Maintenance

In addition to having a negative impact on aquatic and riparian habitat, drain maintenance has the potential to become quite costly. Naturalizing drains, especially through natural areas, is a recommendation that was made in the *NWS*. Naturalizing drains can potentially lengthen the time between maintenance events by reducing the amount of sediment entering the watercourse. Vegetating bare banks and maintaining a buffer strip; restricting cattle access; and allowing a slight meander to reduce bank erosion and flooding are a few measures that could potentially reduce the amount of sediment loading in the watercourse. In addition, when dredging does occur, ensure that the banks are not cut too steep as this will just make the banks more vulnerable to erosion.

There is one watercourse classified as a municipal drain in the Beaverdams and Shriners Creek watershed; Singers Drain. The last time Singers Drain under went maintenance was in 2003.

Singers Drain drains Port Robinson West which is currently undergoing a secondary plan process. Currently this area is predominantly agricultural, however as the land uses change this watercourse is subject to the pressures of development. For example, the centre reach along Port Robinson Road has "*significant flood potential*' and „*measures are necessary to reduce flood potential* "(Totten Sims Hubicki Assoc. 1999).

Niagara to GTA Corridor

By 2031, the Greater Golden Horseshoe is expected to grow by almost 4 million people (MTO 2010). From a transportation perspective, this level of growth poses significant challenges as during peak periods many of the transportation networks are already functioning at or near capacity, therefore unable to support the predicted level of growth associated with the increase in commuter, tourist and goods movement.

To address these issues the Ontario government initiated the Niagara to GTA Corridor Planning and Environmental Assessment Study. This study was initiated to "*explore all modes of transportation, including transit, freight rail, marine, air, freight inter-modal, and roads and highways*" (MTO 2010) and to address existing and future anticipated transportation capacity deficiencies, for instance problems and opportunities, within the Niagara to GTA corridor by providing additional capacity for a 30 year planning horizon and beyond.

Since the initiation of Phase One in January 2007, several studies have been completed and released including: *Overview of Environmental Conditions and Constraints Report* and *Overview of Transportation and Socio-Economic Conditions* (MTO 2007a; 2007b); *Factors Influencing Transportation Demand in the NGTA Corridor: Discussion Paper* and *Study Vision, Purpose, Goals and Objectives: Discussion Paper* (MTO 2008a; 2008b); *Draft Area Transportation System Problems and Opportunities Report* (MTO 2009); and *Area Transportation System Alternatives Report* (MTO 2010).

The latest report, *Area Transportation System Alternatives Report* (MTO 2010) serves as a "*critical stage in the study providing a foundation for further assessment, evaluation, and selection of Preliminary Planning Alternatives that will be incorporated in the ultimate Transportation Development Strategy for this phase of the NGTA Study*" (MTO 2010). One of the key findings of this study was that "*no single mode of transportation is capable of fully addressing all of the transportation problems and opportunities*". The report outlines four transportation group alternatives made up of a number of individual alternatives. Group #1 focuses on optimizing existing networks, Group #2 focuses on new/expanded non-road infrastructure and enhancements of Group #1, Group #3 focuses on widening and improving roads and improvements of Group #2, and Group #4 builds upon improvements provided in aforementioned 3 Groups plus new transportation corridors (MTO 2010).

Of the numerous transportation alternatives outlined in the four Groups, through Niagara and Hamilton widening of existing QEW is preferred and the monitoring of growth needs for the long term.

Natural Heritage and Resources

Although municipal official plans include the protection of environmentally significant areas, the loss of natural features still occurs with development. Natural features include, for example, wetlands, forests, and riparian stream cover, and they provide many ecological functions in the Beaverdams and Shriners Creek watershed in terms of protecting water quality, moderating water quantity and providing habitat. In natural areas stormwater is more or less infiltrated where it falls, allowing most of the pollutants to be filtered through soils. When these areas are lost, and their functions not replaced with infiltration, detention or restoration measures, receiving watercourses are negatively affected with increased flows and pollutant loads. The low extent of forest and wetland cover in addition to a lack of riparian buffers in areas of intensive cropland has been identified as issues in the watershed (RMN 2006a).

Wetland Habitat

Wetlands provide very important water quality and ecological functions in a watershed. Currently, the percent of wetland cover in the Beaverdams and Shriners Creek watershed is moderately low. Therefore in addition to wetland preservation, a means to increase wetland cover through enhancement of current wetlands and/or creation of new wetlands will be included in the watershed strategy because wetlands:

- naturally filter water resources thereby improving water quality,
- act like sponges, slowing the flow of water which reduces the impact of flooding and allows for groundwater recharge,
- help to prevent soil erosion, and
- augment low-flow by raising local water tables, which helps to maintain base flows.

Riparian Cover

Riparian cover in the watershed is very low with 21 percent of the watercourses having some vegetation along the watercourse. Therefore a means to improve the riparian habitat will be addressed in the restoration plan of the Beaverdams and Shriners Creek Watershed Plan. Like wetlands, riparian buffers also improve water quality. For example, riparian buffers:

- remove sediment and pollution such as chemicals, fertilizers, pesticides, bacteria and road salt before they reach surface water,

- reduce the impacts of flooding,
- prevent erosion,
- improve water clarity, and
- provide shade and cooler water temperatures for fish and other aquatic organisms (NPCA 2003).

Forest Habitat and Meadows

The amount of forest cover in a watershed determines its ability to support species diversity. The Beaverdams and Shriners Creek watershed has a far below adequate level of forest cover to protect water quality and provide habitat with 6 percent of the watershed in forest cover. Forest cover is beneficial because it:

- reduces flooding and high flow events by intercepting runoff thereby encouraging infiltration,
- improves water quality by slowing the rate of runoff to watercourses, and trapping, using or breaking down some of the pollutants and nutrients found in runoff water,
- improves water quality by lowering water temperatures and shading water courses,
- improves groundwater quality by increasing the amount of rainfall that percolates to the groundwater table,
- reduces soil erosion, and
- preserves and increases flora and fauna diversity.

In addition, meadows also play an important role in creating habitat diversity and foraging areas for wildlife. Therefore, they should be given consideration in habitat creation and restoration actions in the Beaverdams and Shriners Creek watershed.

Fish and Aquatic Habitat

The need for protection and improvement of important fish habitat was identified as a concern in the *NWS*. Fish habitat consists of areas that fish need, whether directly or indirectly in order to carry out their life processes including spawning grounds, nursery, rearing, food supply, and migration areas. Broadly defined, wetlands, groundwater recharge areas, aquifers, and the quantity and quality of groundwater and surface water are all important factors for maintaining the quality and quantity of fish habitat. Development activities, structures, changes in land use, and alteration to hydrology can all impact fish and fish habitat. Fish habitat can be damaged in numerous ways including:

- dredging and filling near spawning and nursery habitat,
- loss of riparian vegetation,
- stream alterations including fish barriers,
- poorly managed stormwater runoff,
- impaired water quality (e.g., sediment and nutrient loadings, increased temperature), and
- loss of groundwater recharge capability (*Fisheries Act, Section 34*).

The watershed strategy will suggest restoration alternatives to maintain and improve Type 2 fish habitat.

Climate Change

Most climatologists agree that climate change and warming of the Earth's atmosphere is occurring. In addition, there is also broad agreement that human activities are primarily responsible for the changes to global climate that have been observed during the last half of the twentieth century (de

Loë and Berg 2006). In 2007, the MNR released a report on climate projections for Ontario and how Ontario's climate could change during the 21st century. Climate models predict the effect of higher greenhouse gases based on increasing amounts of heat trapped in the atmosphere. Each modelled scenario has a different set of assumptions about future social and economic conditions "*since the amount of greenhouse gas in the future depends on highly variable factors such as global population, human behaviour, technological development and the carbon sink/source behaviour of land and water ecosystems"* (MNR 2007b).

For the Niagara region and westward to Windsor and Sarnia, the modeled projections calculate an increase in summer (April to September) average temperatures of 5 to 6 degrees Celsius and a 10% decrease in precipitation by 2071 (MNR 2007b). The winter climate for most of southern Ontario is projected to increase 1 to 2 degrees Celsius between 2011 and 2040, and could increase by 3 to 4 degrees by mid-century. In addition, most of southern Ontario could receive 10% less precipitation during the cold season (MNR 2007b). Although the projections for Ontario's future climate are not certain, it is reported by the MNR in this study that the projections are likely "*closer to future reality than assuming that the future climate will be similar to that of the past 30, 60, or 100 years"* (2007b).

The report also outlines possible impacts that climate change could have on Ontario's ecosystems, societal values and infrastructure. For example, impacts to the agricultural sector could include a possible change in crops grown, longer growing season and a reduced productivity where an increase of temperature without a compensatory increase in precipitation occurs (MNR 2007b). Examples of potential impacts to the environment include changes in biodiversity of species and ecosystems, and new species becoming „at risk' because of disequilibrium with climate (MNR 2007b). For the complete list of examples of key possible impacts that climate change could have on Ontario's ecosystems, societal values and infrastructure taken from this report refer to Appendix C.

In *Mainstreaming Climate Change in Drinking Water Source Protection Planning In Ontario*, de Loë and Berg (2006) report some of the predicted impacts climate change could have on the hydrologic cycle and water resources in the Great Lakes Basin. The hydrologic cycle is sensitive to changes in temperature, precipitation and evaporation which accordingly could result in significant changes to streamflows, lake levels, water quality, groundwater infiltration, and patterns of groundwater recharge and discharge (de Loë and Berg 2006). The following are examples of potential impacts that the predicted changes to the hydrologic cycle could have on water resources in the Great Lakes Basin as reported by de Loë and Berg (2006):

- Winter runoff is expected to increase, but total runoff is expected to decrease, thus summer and fall low flows are expected to be lower and longer lasting;
- Groundwater recharge is expected to decrease due to a greater frequency of droughts and extreme precipitation events. As a result, shallow aquifers will be more sensitive to these changes than deeper wells; and
- Water temperature in rivers and streams is expected to rise as air temperatures rise, and as summer baseflow is reduced.

These modeled or predicted impacts to water resources will affect society as well as ecosystems. Societal water use issues may arise because decreased runoff may lead to reduced water quality, resulting in increased water treatment costs and greater competition and conflict for water resources during low water or drought conditions. Ecologically, changes to wetland form and function may also experience change due to the impacts of climate change. For example, a reduction in groundwater discharge and an increase in surface water temperature will stress fish and fish habitat (de Loë and Berg 2006).

For the summary table of identified hydrological changes expected in the Great Lakes Basin identified in this report, refer to Appendix C.

Communication and Education

Watersheds often span numerous political boundaries. Therefore, agency, non-governmental partnerships, and citizen involvement is essential to the successful implementation of the Beaverdams and Shriners Creek watershed strategy. To facilitate communication between citizens and agencies in the watershed, a list of the major legislation and agencies governing land management in Ontario is provided in Appendix D. In addition to partnering on public and private lands, policy tools can be employed to foster environmentally responsible land and water management in the watershed.

Policy Tools and Incentive Programs

Policy tools addressing land use planning, significant natural heritage features and water quality and quantity protection can be implemented at the local or regional levels of government in the watershed. Designed to allow for continued development, these tools ensure that issues pertaining to the protection, improvement, and enhancement of our natural resources are taken into consideration throughout the development process. Policy tools might include municipal policies, incentive-based tools as well as other water conservation related tools. Specific examples of these policy tools are presented here.

- **Stormwater Management Policies** require the control and treatment of stormwater discharges to prevent flooding, minimize downstream channel erosion, and protect water quality.
- **Riparian Buffer Policies** protect watercourses and maintain aquatic habitat. Riparian buffer guidelines should take into account the amount of natural vegetation adjacent to a stream, the width of the vegetated buffer, total suspended solid concentrations, percent imperviousness in urbanizing watersheds, and fish communities (EC 2004c).
- **Sustainable Subdivision Design** encourage the development of subdivisions whereby houses are clustered and open space is protected. Conventional subdivisions spread development evenly throughout a parcel of land. However, conservation subdivisions are considered “density neutral”, which means that the same number of lots can fit on a parcel of land, but the arrangement of the houses are clustered.
- **Incentive-based Tools** such as **Water Conservation Programs** aid in the protection of water quality, quantity and aquatic habitat by maintaining instream flows. Thus, the natural hydrology of streams is protected during peak water demand.
- **Alternative Land Use Services (ALUS)** is a program whereby agricultural producers offer Canadians an environmental partnership opportunity by contributing the use of a portion of their land, plus labour, equipment, fuel, and money to produce environmental benefits, while encouraging investments from the rest of society to manage these benefits.
- **Land Securement Programs:** securing land into public ownership can help to protect water quality and natural heritage features. For example, maintaining the natural condition of land around watercourses is an ideal approach to enhance water quality protection. Land securement programs help protect greenspace, conserve biodiversity and promote stewardship and community involvement, e.g. **NPCA, Niagara Land Trust.**
- **Conservation Easements:** are agreements made between a landowner and a conservation groups whereby the landowner still owns the property but has agreed to restrict or prevent certain land uses in order to protect the natural features on the property.
- **Brownfield Redevelopment Incentives** encourage the rehabilitation, remediation and redevelopment of abandoned, underused or idle industrial and commercial properties. There are

several programs that can be implemented through the RMN and municipalities such as the **Brownfield Tax Grant Program, Brownfield Tax Assistance Program, Brownfield Tax Arrears Credit Program, Brownfield Development Charge Incentive Program,** and **Municipal Brownfield Leadership Program** (RMN 2007b)

- **Brownfield Financial Tax Incentive Program:** is a provincial funding initiative to encourage the remediation and redevelopment of brownfield properties. The program matches provincial education property tax assistance to municipal property tax assistance for eligible brownfield property owners for the cleanup of the brownfield property.
- **Environmental Assessment Grant Program:** This program will assist developers of brownfield sites in acquiring the environmental information needed to determine the financial viability of developing these sites (RMN 2007b).
- **Downtown/Commercial Area Redevelopment Incentive Programs:** these programs are designed to provide financial incentives to encourage the redevelopment and rehabilitation of downtown properties and commercial areas in the Region of Niagara. These programs include the **Downtown Redevelopment Grant Program**, **Building and Façade Improvement Loan/Grant Program,** and **Downtown Development Charge Incentive Program** (RMN 2007b).
- **Heritage Properties Tax Reduction Program:** this program is designed to help property owners defer the higher maintenance and repair costs of heritage properties (RMN 2007b).
- **Heritage Restoration and Improvement Incentive Programs:** these programs are designed to provide financial incentives to encourage restoration and improvement of heritage properties in the Region of Niagara. These programs include the **Heritage Grant/Loan Program, Professional Design Study Grant Program,** and **Heritage Development Charge Incentive Program** (RMN 2007b).
- **Special Multi-Residential Tax Rate:** encourages the construction of new medium and high density rental housing by providing a special property tax rate (RMN 2007b).
- **Residential Conversion and Intensification Incentive Programs:** these programs are designed to provide financial incentives to encourage residential conversion and intensification. These programs **Residential Grant/Loan Program, Convert-to-Rent Grant Program,** and **Residential Development Charge Incentive Program** (RMN 2007b).

These tools, in addition to a comprehensive public education program will continue the line of communication with participating stakeholders that has been developed through the watershed planning process.

Need for Additional Studies and Continued Monitoring in the Watershed

Several studies are currently underway by the NPCA in the Beaverdams and Shriners Creek watershed. These studies include:

- Water Quality: involves monthly grab samples and benthic invertebrate sampling at 6 stations in the watershed.
- Fluvial Geomorphology: involves documenting the creeks' morphology through a historic air photo analysis. In addition, general physical characteristics including valley and channel lengths, slope and sinuosity (amount of bending in a stream); surficial and soils properties; and angle and composition of valley side slopes is being recorded for each reach of the Beaverdams and Shriners Creek watershed. Additional information will be collected during the field season of 2010 to identify areas experiencing moderate to severe erosion and sedimentation.

- Floodplain Mapping: involves determining the necessary hydrologic and hydraulic analysis in order to generate 100 year return period floodlines for the watercourses in the Beaverdams and Shriners Creek watershed. In addition, regional floodlines which are based on Hurricane Hazel will be generated for the municipality of Niagara Falls. This study will also make recommendations for culvert upgrades that are undersized based on the 100 year and regional storm event.
- Fish Sampling Study: involves assessing existing fish communities and fish habitat conditions in the watershed. In addition, factors that limit the distribution (e.g., fish barriers) and abundance of healthy fish communities will be identified.
- Natural Areas Inventory: the data collected during this project will update existing natural heritage data, fill data gaps and confirm significance of known sites. In addition, this information will provide a scientifically-defensible baseline for use in planning decisions and policy development.
- Surface Water Vulnerability Study: the main focus is to characterize the aquatic and upland features of the area surrounding the Water Treatment Plants intake, delineate the Intake Protection Zone (IPZ) around the intake, and assess the vulnerability of this intake to drinking water threats that are located within the IPZ.
- Water Budget: the purpose of this study is to estimate the hydrologic stress of each watershed planning area in order to screen out areas that are unstressed with respect to water quantity; highlight areas where the reliability of water supplies is questionable; and delineate significant groundwater recharge areas

Conclusion and Next Steps

The Beaverdams and Shriners Creek watershed supports a unique environmental character and subsequent set of watershed issues. Contributing to the distinctiveness of this watershed are, for example, the Welland Canal, the diversity of natural heritages features including the Fonthill Kame, the wealth of endangered and threatened species, and the diversity of land use within the study area.

A wide-ranging set of watershed issues have been gathered resulting in a preliminary set of watershed objectives that includes water resources, fish and aquatic habitat, natural heritage and resources, urban development, and communication and education. Additional watershed issues are anticipated following the public events scheduled as part of the watershed planning process (Figure 2).

The next step in the Beaverdams and Shriners Creek watershed is a policy and program analysis and to identify restoration actions, priorities and programs. This component of the watershed planning process will build on the information compiled in this report to highlight areas requiring restoration, protection or possible acquisition (if lands become available). The watershed issues, and information derived from the on-going projects (see above) recorded in this watershed characterization and issues identification study will guide the next phase of the watershed plan. In addition, a framework for a restoration plan based on priority areas in the watershed will be created including a methodology for monitoring watershed projects and conditions, and reporting those findings to the public.

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Acronyms

ANSI: Area of Natural and Scientific Interest
BC MOE: British Columbia Ministry of Environment
BioMAP: Biological Monitoring and Assessment Program
BMP: Best Management Practice
CLTIP: Conservation Land Tax Incentive Program
COSEWIC: Committee on the Status of Endangered Wildlife in Canada
COSSARO: Committee on the Status of Species at Risk in Ontario
CWQG: Canadian Water Quality Guidelines
DFO: Department of Fisheries and Oceans
E. coli: Escherichia coli
ELC: Ecological Land Classification
GTA: Greater Toronto Area
GGH: Growth Plan for the Greater Golden Horseshoe
GMS: Regional Growth Management Strategy
HADD: Harmful Alteration, Disruption or Destruction
IPZ: Intake Protection Zone
LMA: Local Management Area
MFTIP: Managed Forest Tax Incentive Program
MMAH: Ontario Ministry of Municipal Affairs
MNR: Ministry of Natural Resources
MOE: Ministry of the Environment
MOEE: Ontario Ministry of Environment and Energy
MPIR: Ontario Ministry of Public Infrastructure Renewal
NAI: Natural Areas Inventory
NMP: Nutrient Management Plan
NMS: Nutrient Management Strategy
NPCA: Niagara Peninsula Conservation Authority
NPSPC: Niagara Peninsula Source Protection Committee
NU: Nutrient Unit
NWS: Niagara Water Strategy
OMAFRA: Ontario Ministry of Agriculture, Food and Rural Affairs
OMNR: Ontario Ministry of Natural Resources
OMOE: Ontario Ministry of the Environment
OWES: Ontario Wetland Evaluation System
PPS: Provincial Policy Statement
PSW: Provincially Significant Wetland
PTTW: Permit To Take Water
PWQO: Provincial Water Quality Objectives
RMN: Regional Municipality of Niagara
SAR: Species at Risk
WAS: Water Availability Study
WTP: Water Treatment Plant
WQI: Water Quality Index

Glossary

Area of Natural and Scientific Interest: Areas of land and water containing natural landscapes or features that have been identified as having life science or earth science values related to protection, scientific study or education (Provincial Policy Statement 2005).

Best Management Practice: A land management practice implemented to control sources or causes of pollution. The 3 types of Best Management Practices that treat, prevent, or reduce water pollution include: structural, vegetative and managerial.

Bioengineering: Combination of vegetative and structural practices to prevent erosion or stabilize slopes or streambanks

Biological Monitoring and Assessment Program: The use of benthic invertebrates as indicators of water quality.

Carolinian Life Zone: Also known as the Eastern Deciduous Forest Region, the Carolinian Life Zone stretches across southwestern Ontario from Toronto to Grand Bend. It is estimated that approximately one third of Canada's rare and endangered species are found within this zone.

Committee on the Status of Endangered Wildlife in Canada: Is an independent body responsible for identifying species that are considered to be at risk in Canada. Their findings are reported to the federal government who then determines which at-risk species qualify for protection under the Species At Risk Act (2003).

Committee on the Status of Species at Risk in Ontario: The provincial review body implemented by the Ontario Ministry of Natural Resources: also an independent body made up of non-OMNR members.

Ecological function: The natural processes, products, or services that living and non-living environments provide or perform within or between species, ecosystems and landscapes. These may include biological, physical and socio-economic interactions (Provincial Policy Statement 2005).

Endangered Species: A species facing imminent extinction or extirpation in Ontario which has been regulated under Ontario's Endangered Species Act (MNR No Date)

Entrenched Channel: A channel that has eroded downward or was constructed such that it no longer has access to its original floodplain during moderate flow events.

Fish Habitat: means spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes [Fisheries Act, Section 31 (5)].

Geomorphic: Relates to the physical properties of the rock, soil, and water in and around the stream.

Intake Protection Zone: Protected area (land and water) surrounding a surface water intake

Intrinsic Susceptibility: The vulnerability of the groundwater system to potential contamination from surface sources.

Local Management Area: As part of the Niagara Water Quality Protection Strategy, Niagara Peninsula Conservation Authority's district was divided into 32 Local Management Areas, each representing an ecologically valid and functioning water management unit derived from the over 140 subwatersheds in its jurisdiction.

Municipal Drain: Municipal drains can be either open watercourses or closed systems buried in the ground (i.e., tiles, pipes) designed and constructed to primarily improve drainage of agricultural lands, but also improve drainage of roads and rural lands.

Niagara Water Quality Protection Strategy: The strategy is part of a multi-stakeholder and multi-jurisdictional effort to work towards the common goal of management, restoration and protection of water resources across Niagara„s watershed.

Permeability: The measure of the ability of a material to transmit fluids through it.

Physiography: The natural configuration of the landscape.

Potentiometric Surface: The area where the ground surface intersects the water table

Provincial Significance: Important on a provincial scale; this may refer to a species; a habitat; or a natural area.

Provincially Significant Wetland: A Class I, II and III Wetland identified as provincially significant as defined in „An Evaluation System for Wetlands of Southern Ontario, South of the Precambrian Shield, Third Edition.'

Species of Special Concern: A species with characteristics that make it sensitive to human activities or natural events (MNR No Date).

Subwatershed: A subunit of a watershed; often defined as the drainage area of a tributary or watercourse (e.g. Wignell Drain).

Threatened Species: A species that is at risk of becoming endangered in Ontario if limiting factors are not reversed (MNR No Date)

Topography: The relief of the land surface.

Watershed: An area of land from which surface runoff (water, sediments, nutrients and contaminants) drain into a common water body (e.g. Lake Erie).

Watershed Management Plan: A proactive document created cooperatively by government agencies and the community to manage the water, land/water interactions, aquatic life and aquatic resources within a particular watershed to protect the health of the ecosystem as land uses change (Ministry of Environment and Energy and Ministry of Natural Resources 1993).

Wetlands: Lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. In either case the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic plants or water tolerant plants. The four major types of wetlands are swamps, marshes, bogs and fens (Provincial Policy Statement 2005).

Wildlife Habitat: Areas where plants, animals and other organisms live, and find adequate amounts of food, water, shelter and space needed to sustain their populations. Specific wildlife habitats of concern may include areas where species concentrate at a vulnerable point in the annual or life cycle; and areas which are important to migratory or non-migratory species (Provincial Policy Statement 2005).

Woodlands: Treed areas that provide environmental and economic benefits to both the private landowner and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products (Provincial Policy Statement 2005).

Appendix A:
Land Management Issues and Agricultural Best Management Practices Survey

(Sample Survey Form)

Land Management Issues and Agricultural Best Management Practices

Please complete the following survey and return in the self-addressed, stamped envelope.

"The Niagara Peninsula Conservation Authority collects and uses your personal information pursuant to Section 29(2) of the Municipal Freedom of Information Act 1991, and under the legal authority of the Conservation authorities Act R.S.O. 1990 as amended." Questions regarding the policy or its administration should be directed to: Niagara Peninsula Conservation Authority, 250 Thorold Rd. W., 3rd Floor, Welland, ON L3C 2W3, Attn. Privacy Officer.

Background Information

1. Please indicate the municipality in which you live.

O Fort Erie O Niagara Falls O Niagara-on-the-Lake O Thorold O Welland O_____

2. Please indicate, based on the map provided, the watershed in which you live?

O Fort Erie Creeks O Niagara-on-the-Lake O South Niagara Falls

3. Please indicate the title that best describes your situation.

- O Non-farm Landowner
- O Landowner / Farm Operator
- O Absentee Landowner
- O Tenant Farm Operator
- O Landowner / Farm Operator / Tenant Farm Operator
- O Other (specify): _____

4. How much agricultural land do you currently own in the watershed? _____

5. How much agricultural land do you currently rent in the watershed? _____

6. How much land do you have in production? _____
and/or how many livestock do you have? _____

7. What type of agricultural commodity(s) do you produce? _____

8. Are you a member of any agricultural associations?

O Yes O No

If yes, please specify the name of the organization(s):

_____

9. Do you make land management decisions for property that borders a stream or creek?

O Yes O No O Not Sure

10. What is the source of your drinking water (e.g., water well, cistern)? _____

11. Do you rely on a septic system for wastewater treatment?

O Yes O No

Land Management Issues and Concerns

12. Please rank your top three concerns related to your land.

A rank of 1 would represent your most important concern, a rank of 2 would represent your next most important concern, and a rank of 3 would represent the least of your top three most important concerns.

First Concern: _____
_____
_____

Second Concern: _____
_____
_____

Third Concern: _____
_____
_____

13. Please estimate how much of a problem you think each of the following issues will be in the next 5 to 10 years.

Issue	Not a Problem	Slight Problem	Moderate Problem	Serious Problem	Do Not Know
a. Nitrate, phosphate and bacteria levels in streams, rivers, and lakes	O	O	O	O	O
b. Nitrate, phosphate and bacteria levels in groundwater	O	O	O	O	O
c. Pesticide levels in streams, rivers and lakes	O	O	O	O	O
d. Pesticide levels in groundwater	O	O	O	O	O
e. Soil deposition in streams, rivers and lakes	O	O	O	O	O
f. Drinking water quality	O	O	O	O	O
g. Soil loss from agricultural fields	O	O	O	O	O
h. Rivers and streams with eroding banks	O	O	O	O	O
i. Smells, noise, or dust from livestock operations	O	O	O	O	O
j. Smells, noise, or dust from non-agricultural business	O	O	O	O	O
k. Seepage from septic tanks	O	O	O	O	O

Issue	Not a Problem	Slight Problem	Moderate Problem	Serious Problem	Do Not Know
l. Solid waste disposal	O	O	O	O	O
m. Frequency of flooding	O	O	O	O	O
n. Economic losses due to flooding	O	O	O	O	O
o. Economic costs of complying with land-use regulations	O	O	O	O	O
p. Loss of wetlands	O	O	O	O	O
q. Loss of forested or wooded areas	O	O	O	O	O
r. Loss of agricultural land to development	O	O	O	O	O
s. Loss of agricultural land to natural land	O	O	O	O	O
t. Loss of natural land to development	O	O	O	O	O
u. Loss of natural land to agricultural production	O	O	O	O	O
v. Wells drying up	O	O	O	O	O
w. Low surface water conditions (drought)	O	O	O	O	O
x. Other (please specify):_____	O	O	O	O	O

Best Management Practices and Restoration Resources

14. Which of the following Best Management Practices (BMPs) do you currently use? Please select all that apply and specify the specific BMP.

O Tillage and seeding practices: _____

O Erosion control: _____

O Crop rotations: _____

O Residue management: _____

O Nutrient management: _____

O Pest management and pesticides: _____

O Irrigation: _____

O Other (please specify): _____

15. In your opinion, how would you rate the availability of restoration/conservation resources in the watershed?

	Bad	Poor	Fair	Good	Excellent	Do Not Know
a. The availability of restoration/conservation funding programs	O	O	O	O	O	O
b. The availability of restoration/conservation technical assistance	O	O	O	O	O	O

16. List the restoration/conservation funding programs that you are aware of:

_____
_____
_____
_____

17. If funding was available, would you be interested in pursing a project on your property? If yes, please identify the type of project you would be interested in.

_____
_____
_____
_____

Communication

18. How do you prefer to obtain information about watershed planning in your watershed? Please select all that apply.

O Local newspaper (please indicate which newspaper) _____
O Direct mail newsletter
O Email
O Website
O Meetings of local groups and organizations
O Other (please specify): _____
O None

19. Please provide any additional comments:

_____
_____
_____
_____
_____
_____
_____

~ Thank you ~

NIAGARA PENINSULA CONSERVATION AUTHORITY

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Appendix B:
Natural Heritage Species Reference List

Common Name	***Scientific Name***
Alpine Rush	*Juncus alpinoarticulatus*
American Beech	*Fagus grandifolia*
Asters	*Aster sp.*
Avens	*Geum sp.*
Bebb's Willow	*Salix bebbiana*
Beggar-ticks species	*Bidens sp.*
Big Bluestem Grass	*Abdropogon gerardii*
Bitternut Hickory	*Carya cordiformis*
Black Cherry	*Prunus serotina*
Black Oak	*Quercus velutina*
Black Walnut	*Abdropogon gerardii*
Blue Beech	*Carpinus caroliniana*
Brown-eyed Susan	*Rudbeckia hirta*
Bur-reed	*Sparganium sp*
Butterfly Milkweed	*Asclepias tuberosa*
Buttonbush	*Cephalanthus occidentalis*
Canada Enchanter's Nightshade	*Circaea lutetiana ssp. canadensis*
Cattails	*Typha sp.*
Climbing Poison-ivy	*Rhus radicans ssp. negundo*
Common Buckthorn	*Rhamnus cathartica*
Common Reed	*Phragmites australis*
Common Strawberry	*Fragaria virginiana ssp. virginiana*
Cow Vetch	*Vicia cracca*
Dogwood species	*Cornus sp.*
Downy Serviceberry	*Amelanchier arborea*
Duckweed	*Lemna sp*
Early Goldenrod	*Solidago juncea*
Eastern White Pine	*Pinus strobus*
False Nettle	*Boehmeria cylindrica*
False Solomon's Seal	*Maianthemum racemosa ssp. racemosa*
Fowl Manna Grass	*Glyceria striata*
Foxglove Beard-tongue	*Penstemon digitalis*
Garlic Mustard	*Allaria petiolata*
Glossy Buckthorn	*Rhamnus frangula*
Goldenrods	*Soidago sp.*
Grass-leaved Goldenrod	*Euthamia graminifolia*
Gray Dogwood	*Cornus foemina ssp. racemosa*
Green Ash	*Fraxinus pennsylvanica*
Hairy Bush clover	*Lespedeza hirta*
Hop Hornbeam	*Ostrya virginiana*
Kentucky Blue Grass	*Poa pratensis ssp. pratensis*
Little Bluestem	*Schizachyrium scoparium*
Moneywort	*Lysimachia nummularia*
Motherwort	*Leonurus cardiaca ssp. cardiaca*
Narrow-leaved Cattail	*Typha angustifolia*
One-sided Aster	*Aster lateriflorus var. lateriflorus*
Panicled Aster	*Aster lanceolatus ssp. lanceolatus*
Pin Oak	*Quercus palustris*
Pointed-leaved Tick-trefoil	*Desmodium glutinosum*
Poison Ivy	*Rhus sp.*
Purple Loosestrife	*Lythrum salicaria*
Raspberries	*Rubus sp*
Red Maple	*Acer rubrum*

Red Oak	*Quercus rubra*
Red-osier Dogwood	*Cornus stolonifera*
Reed-canary Grass	*Phalaris arundinacea*
Rough Goldenrod	*Solidago rugosa ssp. rugosa*
Sassafras	*Sassafras albidum*
Sedges	*Carex sp*
Sensitive Fern	*Onoclea sensibilis*
Shagbark Hickory	*Carya ovata*
Silky Dogwood	*Cornus amomum sp. obliqua*
Soft Rush	*Juncus effusus ssp. solutus*
Spicebush	*Lindera benzoin*
Spotted Touch-me-nots	*Impatiens capensis*
Staghorn Sumac	*Rhus typhina*
Sugar Maple	*Acer saccharum ssp*
Swamp Maple	*Acer fremanii*
Timothy	*Phleum pratense*
White Ash	*Fraxinus americana*
White Elm	*Ulmus americana*
White Oak	*Quercus alba*
Wild Leek	*Allium tricoccum*
Willow Species	*Salix sp*

Appendix C:
Examples of key Ontario ecological, infrastructure, and social values likely to be affected by climate change

The following chart lists examples of key Ontario ecological, infrastructure, and social values likely to be affected by climate change. This chart is taken directly from a report published by the Ontario Ministry of Natural Resources entitled *Climate Change Projections for Ontario: Practical Information for Policymakers and Planners (2007b)*

Area	Climate Change Impacts
Agriculture	• Reduced productivity where temperature rises without a compensatory increase in precipitation • Change in crops that can be grown • Less suitable climate to produce ice wine in southern Ontario • Longer growing season • Expansion of agriculture into new areas of northern Ontario where soils are productive
Environment	• Changes in the biodiversity of species and ecosystems • Increased difficulties for species currently at risk to survive or maintain their status • New species at risk because of disequilibrium with climate • Increased opportunity for natural migration of invasive species to Ontario • Loss of plants and animals for which some protected areas were established
Forestry	• Increased frequency and more area burned by forest fires, placing stress on firefighting infrastructure and increasing the number and length of shutdowns of bush operations • Regional changes in timber supply (some may increase while others decrease) • Less access for forestry operations due to late freeze-up and mid-winter thaws • Opportunities to plant faster-growing, less cold hardy tree species • Migration of mountain pine beetle from Alberta threatening old-growth pine forests
Human Health	• Fewer winter cold alerts but more summer heat alerts • More SMOG days • Appearance of new insect-borne diseases • Increased water quality issues due to less total precipitation but more extreme rainfall events
Northern Communities	• Threats to northern communities by forest fires will be more frequent • Soil instability and shifting of houses and other structures due to melting permafrost • Increased community isolation and higher cost of living due to shortened winter road season
Power Generation	• Higher maximum summer power requirements due to increased summer temperatures • Lower winter maximum power requirements due to warmer winters • Reduced hydroelectric power generation due to lower stream/river flow and lower lake levels • More risk to power transmission lines from ice storms
Tourism and Recreation	• Fewer winter outdoor recreation opportunities in southern Ontario (e.g., less reliable skiing, snowmobiling, ice fishing, and outdoor ice skating) • Longer warm weather outdoor recreation season (e.g., boating, camping, and golf)
Transportation	• Shorter road snow-clearing season • Greater risk of freezing rain and need for de-icing in southern Ontario • Longer Great Lakes shipping season • More shipping disruptions and channel/harbour dredging due to lower Great Lakes water levels

The following table summarizes commonly identified changes to the hydrological cycle that are expected in the Great Lakes Basin resulting from climate change. This chart is taken directly from *Mainstreaming Climate Change in Drinking Water Source Protection Planning (de Loe and Berg 2006).*

Hydrological Parameter	**Expected Change in the 21st Century, Great Lakes Basin**
Runoff	• Decreased annual runoff, but increased winter runoff • Earlier and lower spring freshet (the flow resulting from melting snow and ice) • Summer and fall flows are lower and last longer • Increased frequency of high flows due to extreme precipitation events
Lake Levels	• Lower net basin supplies and declining levels due to increased evaporation and timing of precipitation • Increased frequency of low water levels
Groundwater Recharge	• Decreased groundwater recharge, with shallow aquifers being especially sensitive
Groundwater Discharge	• Changes in amount and timing of baseflow to streams, lakes and wetlands
Ice Cover	• Ice cover season reduced, or eliminated completely
Snow Cover	• Reduced snow cover (depth, area, and duration)
Water Temperature	• Increased water temperature in surface and water bodies
Soil Moisture	• Soil moisture may increase by as much as 80% during winter in the basin, but decrease by as much as 30% in summer and autumn

Appendix D:
Summary of Legislation Governing Management in Ontario

The following is not an exhaustive list of legislation governing management in Ontario. The purpose of the following chart is to provide insight into some of the management tools used in the province of Ontario.

SUMMARY OF LEGISLATION GOVERNING MANAGEMENT IN ONTARIO		
MANAGEMENT TOOL	**DESCRIPTION**	**GOVERNMENT AGENCY**
FEDERAL LEGISLATION		
Fisheries Act	Established to manage and protect Canada's fisheries resources. It applies to all fishing zones, territorial seas and inland waters of Canada and is binding to federal, provincial and territorial governments	Fisheries and Oceans Canada
Environmental Contaminants Act	Prevents dangerous contaminants from entering the environment.	Environment Canada
Canada Shipping Act	Controls water pollution from ships by imposing penalties for dumping pollutants or failing to report a spill.	Transport Canada
Canada Water Act	Authorizes agreements with provinces for the designation of water quality and quantity management.	Environment Canada
Canadian Environmental Protection Act	An Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development. The Act is intended to protect the environment and human health from the risks posed by harmful pollutants and to prevent new ones from entering the Canadian environment.	Environment Canada
Canadian Environmental Assessment Act	Requires federal departments to conduct environmental assessments for prescribed projects and activities before providing federal approval or financial support.	Canadian Environmental Assessment Agency
Pest Control Products Act	Regulates products used to control pests through a registration process based on prescribed standards.	Agriculture Canada
Navigable Waters Protection Act	Prohibits construction in navigable waters.	Transport Canada
International Rivers Improvement Act	Prohibits damming or changing the flow of a river flowing out of Canada.	Foreign Affairs and Environment Canada
Canadian-Ontario Agreement	Federal-provincial agreement that supports the restoration and protection of the Great Lakes Basin Ecosystem. The Agreement between the governments of Canada and Ontario outlines how the two governments will cooperate and coordinate their efforts to restore, protect and conserve the Great Lakes basin ecosystem.	Environment Canada & Ministry of the Environment
Agricultural & Rural Development Act	An Act to provide for federal-provincial agreements for the rehabilitation and development of rural areas in Canada	Ministry of Industry, Science and Technology
Migratory Birds Convention Act, 1994	The Act ensures the conservation of migratory bird populations by regulating potentially harmful human activities. A permit must be issued for all activities affecting migratory birds, with some exceptions detailed in the Regulations.	Environment Canada
Canada Wildlife Act	The Act allows for the creation, management and protection of wildlife areas for wildlife research activities, or for conservation or interpretation of wildlife.	Environment Canada
Species at Risk Act	To prevent wildlife species in Canada from disappearing and to provide for the recovery of wildlife species that are extirpated (no longer exist in the wild in Canada), endangered, or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened.	Environment Canada

PROVINCIAL LEGISLATION		
Ontario Water Resources Act	Protects the quality and quantity of Ontario's surface and ground water resources (includes Permits to Take Water).	Ministry of the Environment
Clean Water Act	Protects the natural sources of drinking water. Sources of drinking water are to be mapped by municipalities and conservation authorities, especially vulnerable areas that require protections.	Ministry of the Environment
Environmental Protection Act	Protects Ontario's land, water, and air resources from pollution (includes Certificates of Approval for landfills, sewage treatment, etc.).	Ministry of the Environment
Environmental Assessment Act	Requires an environmental assessment of any major public or designated private undertaking.	Ministry of the Environment
Sustainable Water and Sewage Systems Act	To ensure clean, safe drinking water for Ontario residents by making it mandatory for municipalities to assess the costs of providing water and sewage services and to recover the amount of money needed to operate, maintain, and replace them.	Ministry of the Environment
Pesticides Act	Protects Ontario's land, and surface and ground water resources from damage due to improper use of pesticides.	Ministry of the Environment
Endangered Species Act	The purpose of the Act is to Identify species at risk based on the best available scientific information, protect species that are at risk and their habitats, and promote the recovery of species that are at risk, and promote stewardship activities to assist in the protection and recovery of species that are at risk	Ministry of Natural Resources
Fish and Wildlife Conservation Act,1997	This Act enables the Ministry of Natural Resources to provide sound management of the province's fish and wildlife game	Ministry of Natural Resources
Nutrient Management Act	The purpose of the Act is to provide for the management of materials, containing nutrients in ways that will enhance protection of the natural environment and provide a sustainable future for agricultural operations and rural development.	Ministry of the Environment
Conservation Authorities Act	Ensures the conservation, restoration and responsible management of Ontario's water, land and natural habitats through programs that balance human, environmental and economic needs (includes floodplains).	Conservation Authorities
Lakes and Rivers Improvement Act	Ensures flow and water level characteristics of lakes and rivers are not altered to the point of disadvantaging other water users.	Ministry of Natural Resources
Beds of Navigable Waters Protection Act	Declares the beds of navigable waters as the Crown's responsibility.	Ministry of Natural Resources
Planning Act	Provides for and governs land use planning including the provision of statements of provincial interest to be regarded in the planning process.	Ministry of Municipal Affairs and Housing
Ontario Planning and Development Act	Authorizes Minister to establish development planning areas for promotion of the economic and environmental condition of areas	Ministry of Municipal Affairs and Housing
Development Charges Act	Empowers municipalities to impose development charges against land to be developed where the development will increase the need for municipal services.	Ministry of Municipal Affairs and Housing
Greenbelt Plan (Act)	Identifies where urbanization should not occur in order to provide permanent protection to the agricultural land base and the ecological features and functions occurring on this landscape.	Ministry of Municipal Affairs and Housing
Provincial Policy Statement	Issued under the Planning Act, it provides direction on matters of provincial interest related to land use planning and development, and promotes the provincial "policy-led" planning system.	Ministry of Municipal Affairs and Housing
Places to Grow Act	Ontario government's program to manage growth and development in Ontario in a way that supports economic prosperity, protects the environment and helps communities achieve a high quality of life	Ministry of Energy and Infrastructure
Public Lands Act	Protects and perpetuate public lands and waters for the citizens of Ontario.	Ministry of Natural Resources
Public Utilities Act	Empowers municipalities to acquire and operate water works and divert a lake or river for their purposes.	Ministry of Municipal Affairs and Housing
Drainage Act	Facilitates the construction, operation and maintenance of rural drainage works.	Ministry of Agriculture, Food and Rural Affairs
Tile Drainage Act	Provides for low interest loans to farmers from municipalities for tile drainage on their property.	Ministry of Agriculture, Food and Rural Affairs

Building Code Act	The Building Code regulates standards for the construction and demolition of new buildings	Ministry of Municipal Affairs and Housing
UPPER AND LOWER TIER LEGISLATION		
Municipal Act	Provides for the structure of single, upper and lower tier municipalities, and sets out their basic powers including the ability to regulate (e.g. licensing), provision of services, finances and roads..	Ministry of Municipal Affairs and Housing
Regional Municipalities Act	This Act puts forth the structuring and governance of municipalities in support of the Municipal Act	Ministry of Municipal Affairs and Housing
Regional Municipality of Niagara Act	This Acts puts forth the structuring and governance of municipalities in support of the Municipal Act and Regional Municipalities Act.	Ministry of Municipal Affairs and Housing
Town of Haldimand Act	Establishes a new single tier Town of Haldimand effective January 1, 2001. Establishes the composition of the Town council and sets out certain financial and other powers and duties of the new Town.	Ministry of Municipal Affairs and Housing
City of Hamilton Act	Establishes a new single tier city of Hamilton effective January 1, 2001. Establishes the composition of the new City council and sets out certain financial and other powers and duties of the new city.	Ministry of Municipal Affairs and Housing
Municipal Affairs Act	Give municipalities the power to be responsible and accountable governments with respect to matters within their jurisdiction and each municipality is given powers and duties under this Act and many other Acts for the purpose of providing good government with respect to those matters	Ministry of Municipal Affairs and Housing
Official Plans and Policy Plans	An official plan and/or policy plan describes your upper, lower or single–tier municipal council's policies on how land in your community should be used. It is prepared with input from you and others in your community and helps to ensure that future planning and development will meet the specific needs of your community	Regional or Municipal respective jurisdiction upon approval by the Ministry of Municipal Affairs and Housing
CONSERVATION AUTHORITIES		
Conservation Authorities Act	Ensures the conservation, restoration and responsible management of Ontario's water, land and natural habitats through programs that balance human, environmental and economic needs (includes floodplains).	Ministry of Natural Resources
Ontario Regulation 155/06- Development, Interference with Wetlands and Alterations to Shorelines and Watercourses	This regulation and associated policies are used by Conservation Authorities to regulate all watercourses, floodplains, valley lands, hazardous lands, wetlands, shorelines, and lands adjacent to these features/functions within their respective jurisdictions.	Ministry of Natural Resources