STATE OF THE WATERSHED REPORT:

ETOBICOKE AND MIMICO CREEK WATERSHEDS

THE TORONTO AND REGION CONSERVATION AUTHORITY

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December 1998

THE TORONTO AND REGION CONSERVATION AUTHORITY

The Toronto and Region Conservation Authority
5 Shoreham Drive
Downsview, Ontario
M3N 1S4
Tel: (416) 661-6600
Fax: (416) 661-6898
http://www.trca.on.ca

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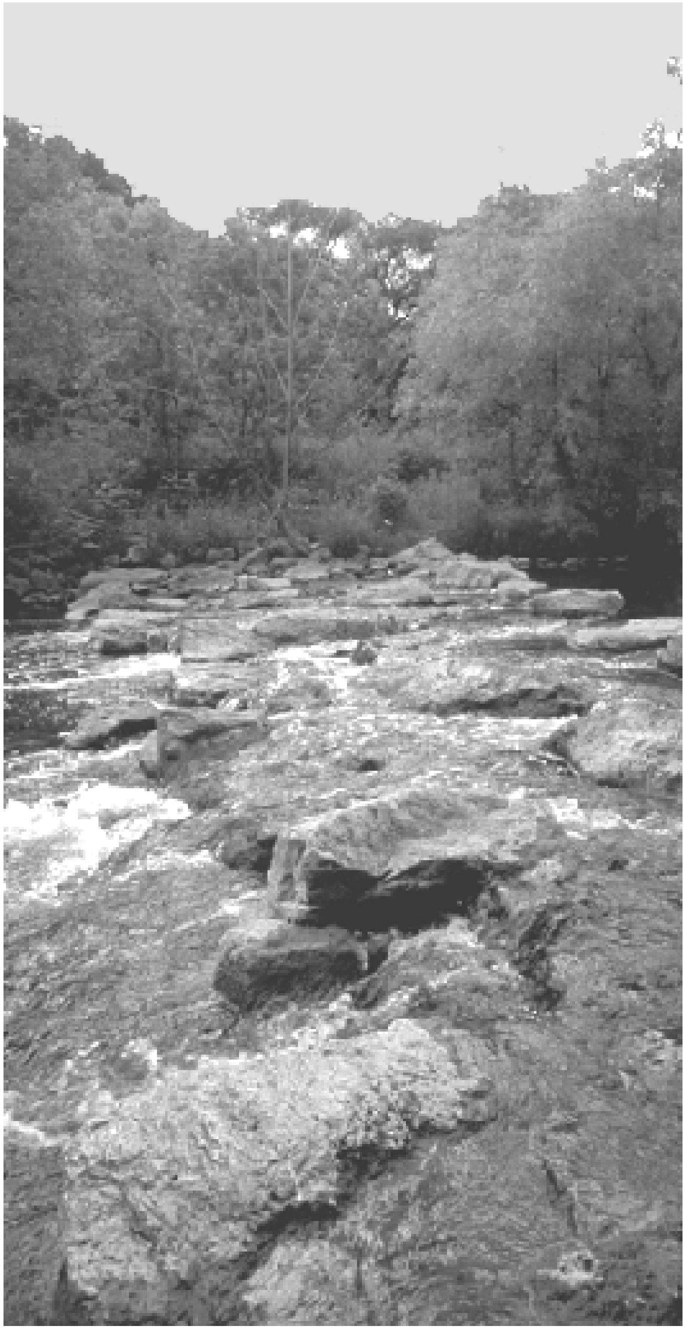

The *State of the Watershed Report: Etobicoke and Mimico Creek Watersheds* has been produced by staff of The Toronto and Region Conservation Authority. It is intended to provide background information for the preparation of a watershed management strategy for these two watersheds. An ecosystem approach was used to guide the development of the report. As such, it describes the environmental, social, and economic conditions in the watersheds, with the primary focus being environmental.

The state of the Etobicoke and Mimico Creek watersheds is presented in four parts. Part I is an introduction to the watersheds and the report. Part II, *Human Use of the Watersheds*, describes cultural heritage resources, recreational opportunities, urban development, and resource use in the watersheds as they have been affected by and, in turn, affect the natural heritage system of the Etobicoke and Mimico Creek watersheds. Part III, *Natural Heritage*, describes the current conditions of air, land, water, and living things within the watersheds. It also describes the interactions among these components of the natural heritage system. Part IV, *Directions for Management*, summarizes some key issues and regeneration initiatives to be considered by the task force when developing the watershed management strategy.

There are many reasons for producing the State of the Watershed Report and initiating the development of a watershed management strategy. Primarily, it is The Toronto and Region Conservation Authority's Greenspace Strategy (1989) and the Canada - United States Great Lakes Water Quality Agreement that have spearheaded the production of this report and the future development of the management strategy.

INTRODUCTION

BACKGROUND

CHAPTER 1

In 1989, The Metropolitan Toronto and Region Conservation Authority[1] completed a strategic planning exercise to establish long-term management goals to fulfill its mandate. *The Greenspace Strategy for the Greater Toronto Region* provided direction for the conservation of the Lake Ontario waterfront, the river valleys, and the Oak Ridges Moraine. The Greenspace Strategy identified the need for greater cooperation to achieve more integrated natural resource planning and management. It proposed that the Authority establish planning task forces for each major watershed within the Conservation Authority's jurisdiction.

Watershed management strategies are developed to provide context and recommendations for natural systems protection, restoration, environmental education, recreation, and cultural and heritage planning activities. To date, the TRCA has established planning task forces and completed watershed management strategies for three of the nine watersheds within its jurisdiction. In 1990, the first watershed management strategy, *The Comprehensive Basin Management Strategy for the Rouge River Watershed*, was produced. In 1994, *Forty Steps to a New Don,* was completed by the Don Watershed Task Force. In 1997, *Legacy: A Strategy for a Healthy Humber* and its companion document *A Call To Action: Implementing Legacy: A Strategy for a Healthy Humber*, were produced by the Humber Watershed Task Force as an integrated watershed management strategy for the Humber River. Each of these documents has been adopted by the Authority.

For the TRCA, developing and implementing watershed management strategies is typically a three-phase process (TRCA, 1998g):

Phase I A State of the Watershed Report (or its equivalent) is produced. The report identifies issues and describes key environmental, social, and economic conditions in the watershed(s), with the primary focus being environmental.

Phase II A multi-stakeholder watershed task force is established to oversee development of a watershed management strategy.

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1 In January 1998, The Metropolitan Toronto and Region Conservation Authority changed its name to The Toronto and Region Conservation Authority.

Typically, watershed residents, interest groups, municipal elected representatives and staff, and other agency staff are asked to join the task force. The SOW Report and community consultations provide a knowledge base for the task force to develop the strategy. The strategy recommends actions needed to protect, regenerate, and celebrate the watershed(s).

Phase III Implementation of the watershed management strategy and monitoring progress toward regeneration is guided by a committee of watershed stakeholders.

Publication of the *State of the Watershed Report: Etobicoke and Mimico Creek Watersheds* completes Phase I of the watershed management strategy development process.

1.1 PURPOSE OF THE REPORT

The *State of the Watershed Report: Etobicoke and Mimico Creek Watersheds* will contribute to the production of a joint management strategy for the watersheds using an ecosystem-based approach. The report's purpose is to provide information on the state of the Etobicoke and Mimico Creek watersheds to the future task force and others to help focus and coordinate planning, management, consultation, regeneration, and monitoring efforts.

To fulfill this purpose, the report describes environmental, social, and economic conditions and issues in the watersheds. The report also provides some direction for the future management of the watersheds to be considered by the task force.

1.2 STUDY AREA

The geographic area described in this report is the Etobicoke and Mimico Creek watersheds. A watershed is the total area of land drained by a river and its tributaries. The watersheds are located within the Greater Toronto Area which, in turn, is a part of the larger Great Lakes Basin Ecosystem (Figure 1).

Both watersheds are highly urbanized and include portions of the Cities of Toronto, Mississauga, and Brampton within their boundaries. The Etobicoke Creek watershed extends further north, and the headwaters of its main branch begin in rural areas within the Town of Caledon (Map 1).

The Etobicoke Creek watershed drains a total area of 211 square kilometres and flows 60 kilometres before discharging into Lake Ontario. The creek has three distinct branches: the Main Branch, Little Etobicoke Creek, and Spring Creek.

Draining a total area of 77 square kilometres, Mimico Creek has two distinct branches: the Main and the West. The Mimico Creek flows 33 kilometres from its headwaters in the City of Brampton.

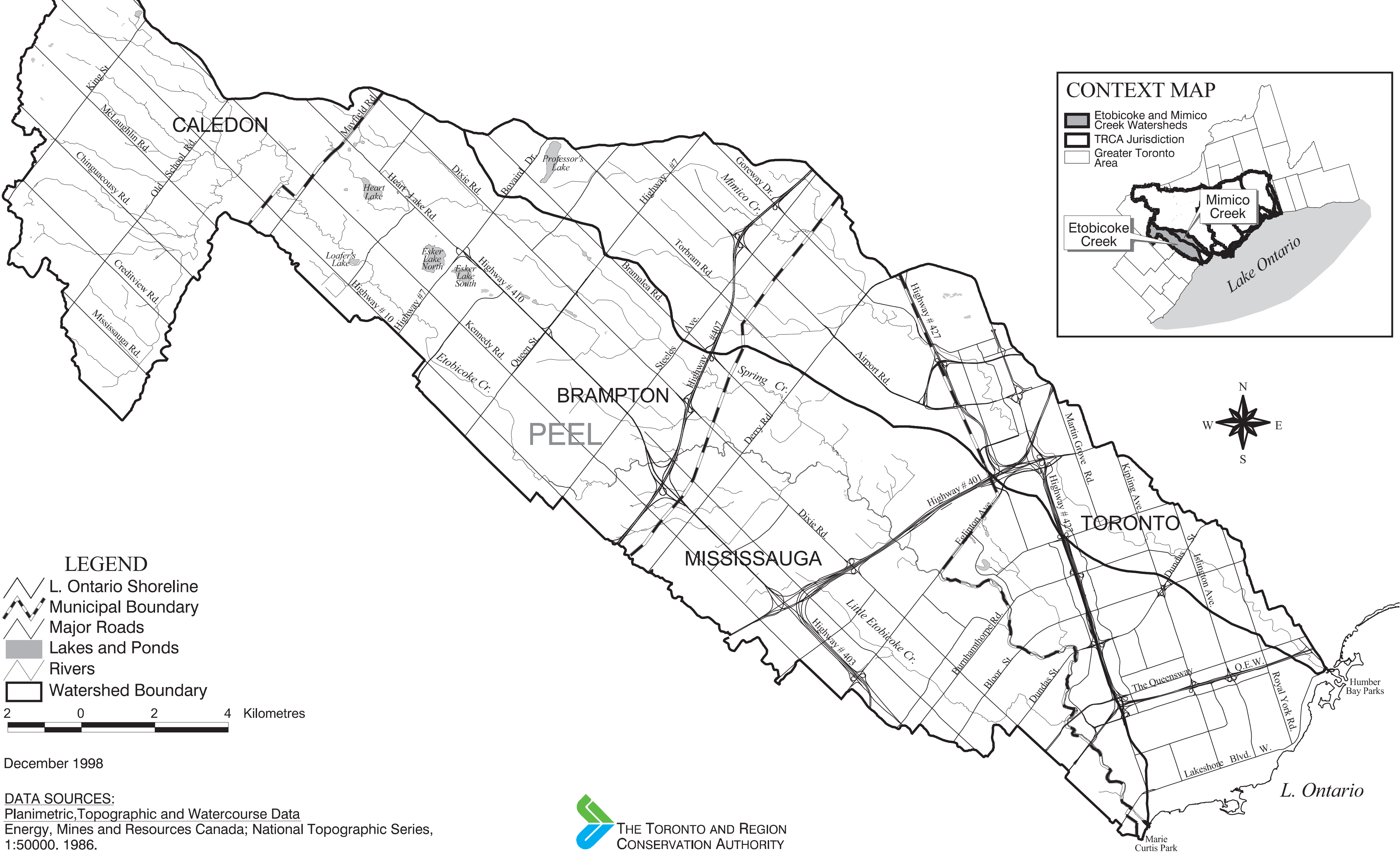
The watersheds are distinct areas, characterized by the movement of water, and were considered separate when collecting background information for this report. However, a joint State of the Watershed Report was produced for the following reasons:

- The key environmental, social, and economic issues in, and characteristics of, the watersheds are similar;
- The municipalities in which they are located are the same. Other than the Etobicoke Creek watershed also extends into the Town of Caledon; and
- Due to the small size of the watersheds in comparison to others within the TRCA's jurisdiction (e.g., the Humber, Don, or Rouge River watersheds), it was considered more cost effective to prepare a joint report.

As shown on all maps in this report, there is a triangle of land between the Etobicoke and Mimico Creek watersheds, bordering Lake Ontario, which does not drain into either the Etobicoke or Mimico Creeks. In this report, this land is referred to as the Lake Ontario Drainage Area and is not a part of the study area (Map 1). This land will be considered when an integrated shoreline management plan is developed in the future.

Figure 1: Etobicoke and Mimico Creek Watersheds in the Great Lakes Basin Ecosystem

MAP 1: ETOBICOKE AND MIMICO CREEK WATERSHEDS



1.3 REPORT STRUCTURE

An ecosystem approach was used to guide the development of the State of the Watershed Report. In taking this approach, the ecosystem was defined broadly as including environmental, social, and economic components, and their respective interactions. The goal of watershed health is achieved when environmental, social, and economic needs are met through the integrated management of these ecosystem components (Figure 2).

The report is a description and analysis of the watersheds' condition and is based principally on an extensive literature and data search. Municipal, regional, provincial, federal, and other sources of information were compiled and analysed for each of the Etobicoke and Mimico Creek watersheds. Recognizing that it was not possible to study everything within the watersheds, focus was placed on the ecosystem components most relevant for watershed management.

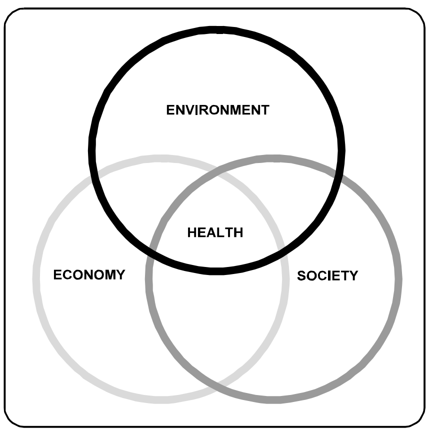


Figure 2: Components of the ecosystem and their relationship

Environment: *Air, Land, Water, Life;*
Society: *Cultural Heritage and Recreation; and*
Economy: *Urban Development and Resource Use.*

During 1997 and 1998, technical background reports were produced by TRCA staff in support of the State of the Watershed Report and to provide more detailed information for task force members. Separate reports were produced that describe and assess surface water quality, heritage, fish communities, and terrestrial habitat in the Etobicoke and Mimico Creek watersheds.

Environmental, social, and economic conditions in the watersheds are discussed in Parts II and III of this report: *Human Use of the Watersheds* and *Natural Heritage*. Part IV, *Directions for Management*, provides a summary of key issues (identified in Parts II and III) that will need to be addressed in future efforts to regenerate the watersheds to a healthy state.

Traditionally, the location of human settlement has been largely determined by the presence of water. Lakes, rivers, and streams provided a stable water supply, transportation potential, and food resources. The Etobicoke and Mimico Creeks are no exception, as shown by the many heritage resources that have been found within the watersheds. These resources are integral to developing and implementing watershed management strategies as they demonstrate the importance of past peoples and their environments relative to the condition of the watershed today.

The evolution of the natural heritage system is related to changes in the populations of the watersheds that have occurred over the past 10,000 years. To place the cultural history of the watersheds into context, Chapter 2 describes the Aboriginal and Euro-Canadian historical periods. This chapter is based on work completed for the *Etobicoke and Mimico Creek Watersheds Heritage Study* (TRCA, 1998a).

The remaining chapters in Part II focus on current social and economic conditions in the Etobicoke and Mimico Creek watersheds. Chapters 3 and 4 provide an overview of current population characteristics and a description of existing outdoor recreational opportunities as they are important to consider in the future management of the watersheds. Chapter 5 provides an overview of urban development in the watersheds including current land use patterns and infrastructure. Chapter 6 describes agriculture, forestry, and aggregate extraction as they affect the natural heritage system.

HUMAN USE OF THE WATERSHEDS

CULTURAL HERITAGE

CHAPTER 2

For more than 10,000 years, the Etobicoke and Mimico Creek watersheds have been home to Aboriginal hunters and farmers; European explorers, traders, soldiers, surveyors, farmers, and holiday makers; and finally city dwellers and suburbanites. To place the cultural history of the Etobicoke and Mimico Creek watersheds into proper context, this chapter briefly describes the Aboriginal and Euro-Canadian historic cultural periods of these watersheds.

2.1 PREHISTORIC SETTLEMENT

Prehistoric settlement refers to the Aboriginal populations who inhabited the Etobicoke and Mimico Creek watersheds prior to the coming of Europeans. Archaeological evidence reveals native settlement in the Etobicoke and Mimico Creek watersheds. The first inhabitants were the Palaeo-Indians who moved into the Toronto area from approximately 10,000 to 7,000 B.C., after the glaciers retreated northward from the region. Next was the Archaic period, which lasted from approximately 7,000 to 1,000 B.C. The Woodland period extended from 1,000 B.C. to A.D. 700. Table 2.1 provides a summary of the number of archaeological sites that have been located to date and which are registered with the Ministry of Citizenship, Culture and Recreation. Map 2 in section 2.2 shows the location of archaeological sites and other heritage resources.

2.1.1 Palaeo-Indian 10,000 to 7,000 B.C.

As the glaciers retreated from southern Ontario, nomadic peoples gradually moved into the areas recently vacated by the massive ice-sheets. These Palaeo-Indians lived in small family groups and likely hunted caribou and other fauna associated with the cooler environment of this time period. As the glaciers melted at the end of the last ice age, 12,000 years ago, the landscape of southern Ontario was very much like the tundra of today's eastern sub-arctic. Based on the location of a single toe bone of a caribou at a site in Detroit and the presence of arctic hare, arctic fox, and a large ungulate at the Udora site (a Palaeo-Indian encampment) near the south shore of Lake Simcoe, this theory is substantiated.

During this time, the water levels and shoreline of Lake Ontario were fluctuating due to runoff from the melting glaciers. Traditionally, the Palaeo-Indian occupation of southern Ontario has been associated with these glacial lake shorelines. However, recent investigations in the vicinity of Toronto indicate that these peoples also exploited interior locations away from the glacial lakes.

TABLE 2.1: Archaeological Sites in the Etobicoke and Mimico Creek Watersheds

CULTURAL AFFILIATION	ETOBICOKE	MIMICO	TOTAL
Archaic			**5**
Middle	1	1	
Late	3	-	
Woodland			**4**
Early	1	-	
Middle	1	1	
Late Iroquoian	1	-	
Historic Euro-Canadian	11	2	**13**
Multi-Component*	-	1	**1**
Undetermined	22	7	**29**
Total	40	12	**52**

* Includes Late Archaic and Euro-Canadian Components.

At present, there is no evidence of Palaeo-Indians in the Etobicoke and Mimico Creek watersheds. However, there are several sites known to the east (the Humber River watershed) and to the west suggesting that future discoveries could be made in these watersheds.

2.1.2 Archaic 7,000 to 1,000 B.C.

As the climate in southern Ontario warmed, Aboriginal populations adapted to these new environments. Many new technologies and subsistence strategies were introduced and developed by the Archaic peoples. Wood working implements such as groundstone axes, adzes, and gouges (implements used in dug out canoe construction) begin to appear, as do net-sinkers (for fishing), numerous types of spear points, and items made from Native copper, which was mined from the Lake Superior region. The presence of Native copper on archaeological sites in southern Ontario and adjacent areas suggests that Archaic groups were involved in long-range exchange and interaction with one another. The trade networks established at this time persisted between Native groups until European contact.

To harvest the new riches of the warming climate, the Archaic bands of southern Ontario followed an annual cycle which exploited seasonably available resources in differing areas within watersheds. For example, from the spring through the fall, bands joined together and inhabited sites in lakeshore environments where abundant foodstuffs such as fish, waterfowl, and wild rice enabled the establishment of larger multi-season occupations (Ellis et al., 1990). As the seasons changed and aquatic resources became scarce, these bands split into smaller groups and moved inland to exploit other resources which were available during the fall and winter such as deer, rabbit, squirrel, and bear which thrived on the forest margins of these areas.

Due to the fluctuating water levels of Lake Ontario at the end of the ice age, the mouths of the Etobicoke and Mimico Creeks would have entered into Lake Ontario at a location currently 10 to 20 metres below the present lake level. Aboriginal groups of the era would have exploited the shoreline environments in these now submerged locations and any archaeological sites representing these seasonal activities are now under water. Consequently, understanding of the Archaic uses of the Lake Ontario shoreline in the vicinity of the Etobicoke and Mimico Creeks is poor.

There have been, however, five sites and findspots[2] located in the Etobicoke and Mimico Creek watersheds that can be attributed to the "inland" exploitation of the Archaic groups. Typically these sites or "interior camps" appear on the landscape as scatters of chert (flint) tools and flakes[3] in areas adjacent to where the particular resource would have been. Such is the case with the AkGw-8 site which is located on flat land 120 metres east of a relic stream bed. Artifacts recovered from the surface of this site include a biface fragment and a used flake suggesting that butchering activities were likely carried out here by Archaic peoples sometime around 2,000 B.C.

Although these five sites and findspots would indicate Archaic peoples hunted and camped in the Etobicoke and Mimico watersheds, few specifics can be written regarding their habitation. This is due to the lack of detailed excavation of these sites and to the changes in water levels discussed above. As well, archaeological sites representative of these activities are small and therefore often deemed as 'not significant.' As a result, they are being destroyed at a rapid pace as development occurs in the watersheds. Without protecting and investigating these small extraction/processing and habitation areas, our understanding of the Archaic use of the Etobicoke and Mimico Creeks, and Ontario, will remain incomplete.

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2 A findspot is also referred to as an isolated find. It is where a single artifact or small number of artifacts are located or found but which do not convey the idea of a purposeful occupation.

3 The term "flake" is used by archaeologists to describe the pieces of chert that are "flaked' off during the stages of stone tool manufacturing.

2.1.3 Woodland

Initial Woodland 1,000 B.C. to A.D. 700

Early in the Initial Woodland period (1,000 B.C.-A.D. 0), band size and subsistence activities were generally consistent with the groups of the preceding Archaic period. Early in this period, clay pots were introduced. Ceramic vessels enabled longer term storage of foodstuffs. With the ability to store foodstuffs during times of plenty, the stress of more meagre times was greatly reduced. Around A.D. 0 another revolutionary new technology, the bow and arrow, was brought into southern Ontario and radically changed the approach to hunting. These two technological innovations allowed for major changes in subsistence-settlement patterns. As populations became larger, camps and villages with more permanent structures were occupied longer and more consistently. Generally, these larger sites are often associated with the gathering of two or more band groups into what are referred to as 'macrobands.' Often these larger groups would reside in favourable locations and work cooperatively to take advantage of resources such as fish.

During this period, more elaborate burial rituals such as cremation, burial mound construction (as seen at the Serpent Mounds near Peterborough, Ontario), and the interment of numerous exotic grave goods with the deceased began to take place. These goods, which include large caches of well-crafted lithic blades, sheets of mica, marine shells, shark teeth, silver and copper beads, and artifacts such as platform smoking pipes and decorative ear ornaments, all indicated that the Initial Woodland period was one of increased trade and interaction between southern Ontario populations and groups as far away as the east coast and the Ohio Valley.

To date, three sites have been found in the Etobicoke and Mimico Creek watersheds that can be attributed to the Initial Woodland period. While these sites appear to represent short-term campsites, none have had detailed archaeological investigations and therefore little can be said regarding their function or possible settlement patterns. Due to the Initial Woodland peoples' exploitation of seasonally available resources (as seen with earlier Archaic and Palaeo-Indian groups), their habitation sites do not display evidence of substantial structures, lengthy occupations, or deep or extensive middens (garbage deposits) (Spence et al., 1990). Consequently, their visibility on the landscape is minimal, making them difficult sites for archaeologists to find. If these sites are properly investigated when they are happened upon, it will assist in our understanding of this crucial period of Aboriginal history.

Ontario Iroquoians (Late Woodland) A.D. 700 to A.D. 1651

Around A.D. 700, corn was introduced into southern Ontario from the south. With the development of horticulture as the dominant subsistence base, the Late Woodland period gave rise to a tremendous increase in population and the establishment of permanent villages (which were occupied from 5 to 30 years). These villages consisted of numerous "cigar shaped" structures or "longhouses" made from wooden posts placed in the ground and tied together at the top in an arch-like fashion. Although these windowless structures were only six metres wide and the same in height, they extended anywhere from nine to 45 metres in length providing shelter for up to 50 people[4]. Quite often these villages, some of which were one to four hectares in size, were surrounded by multiple rows of palisades suggesting that defence was a community concern during this period.

The Merton site (AjGv-24) is the only Late Woodland village that has been found within the Etobicoke and Mimico Creek watersheds. Covering an area between one and 2.5 hectares in size, this important site was destroyed by townhouse construction in 1970 before systematic excavations could take place. The whereabouts of any existing collections are not known.

After centuries of small-scale warfare and the gradual depletion of soil nutrients, firewood, and other resources, the Late Woodland groups that inhabited the Etobicoke and Mimico Creeks and adjacent watersheds began moving their villages northward towards Georgian Bay. It was these groups that eventually evolved into the Petun and Huron nations witnessed and recorded by the early French missionaries and explorers during the seventeenth century.

Middle Road Bridge

4 This number is based on a longhouse with four hearths, one family on either side of the hearth, and six people in each family. Past researchers have employed similar models based on what is known from the early missionaries that lived among these Iroquoian groups in the seventeenth century.

2.2 HISTORIC SETTLEMENT

The period of historic settlement in the Etobicoke and Mimico Creek watersheds extends from approximately 1650, when Aboriginal populations first had contact with Euro-Canadians, to approximately the mid-twentieth century.

French explorers and fur traders undoubtedly knew about the Etobicoke and Mimico Creeks and probably explored and camped near the creeks. Although the creeks contributed to the development of the Toronto area, they were always overshadowed by the larger Humber River to the east and the Credit River to the west. The presence of an established trail along the Humber River reaching all the way to the Holland River and eventually to the upper Great Lakes meant that the Etobicoke and Mimico Creeks did not figure as prominently in the history of Ontario as did the Humber River.

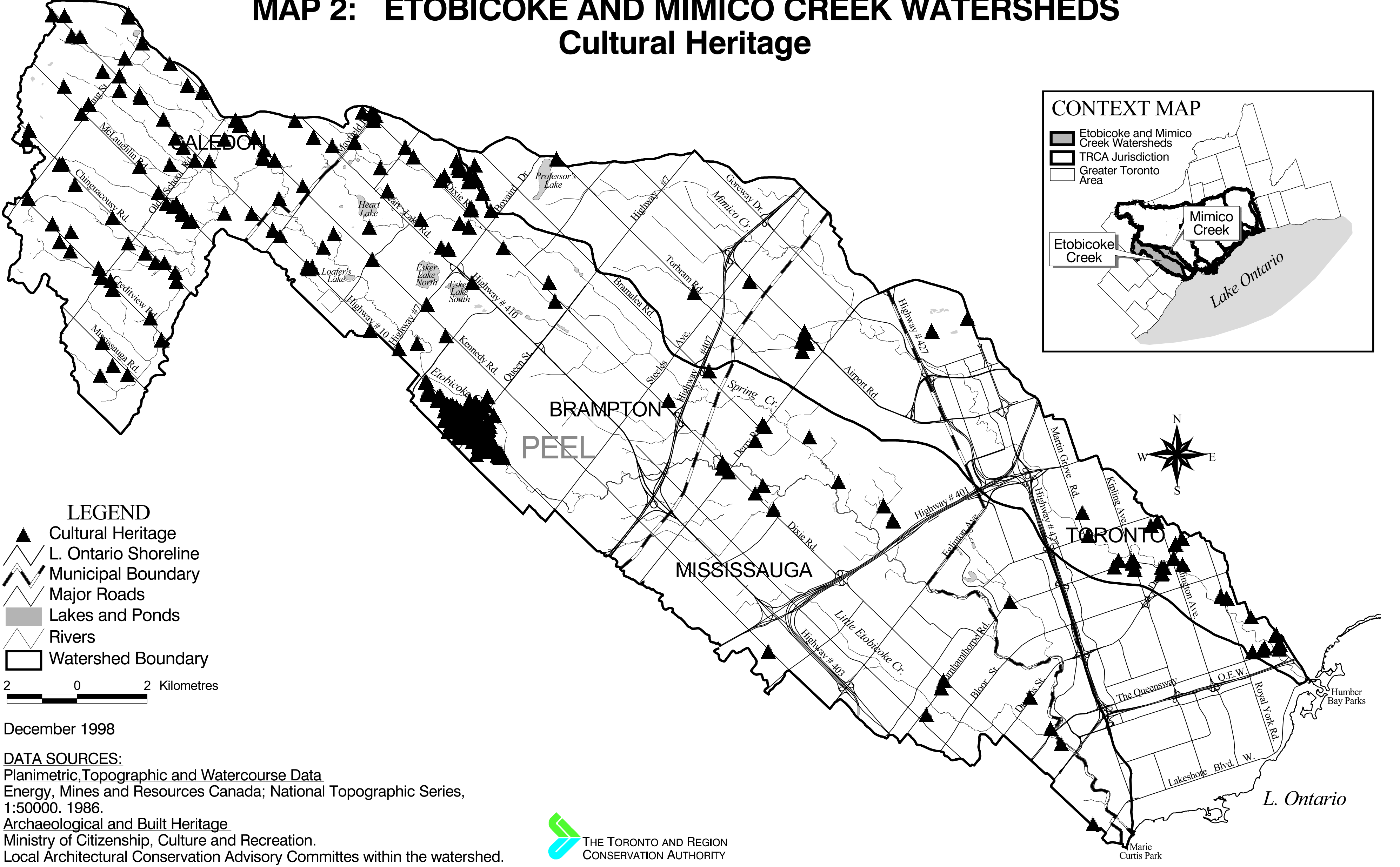
The following sections in this chapter provide an overview of the historic period including contact between Aboriginal and Euro-Canadian peoples, key characteristics of earlier and later periods of settlement, and heritage resources found in the watersheds. The prehistoric and historic heritage resources found to date, and briefly described in this chapter, are summarized in Table 2.2 (Map 2).

TABLE 2.2: Heritage Designation of Sites in the Etobicoke and Mimico Creek Watersheds*

Watershed	Etobicoke	Mimico	*Total*
Listed	279	35	*314*
Designated	26	4	*30*
Unlisted Burial Places	14	6	*20*
Archaeological	40	12	*52*
TOTAL	*359*	*57*	*416*

* Note: Sites considered listed or designated are determined by the municipalities within the Etobicoke and Mimico Creek watersheds through their Local Architectural Conservation Advisory Committee (LACAC), Heritage Division, or Historic Board. Archaeological sites listed on the table are registered with the Government of Ontario.

MAP 2: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Cultural Heritage



LEGEND

- Cultural Heritage
- L. Ontario Shoreline
- Municipal Boundary
- Major Roads
- Lakes and Ponds
- Rivers
- Watershed Boundary

2 0 2 Kilometres

December 1998

DATA SOURCES:

Planimetric,Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Archaeological and Built Heritage
Ministry of Citizenship, Culture and Recreation.
Local Architectural Conservation Advisory Committes within the watershed.

THE TORONTO AND REGION CONSERVATION AUTHORITY

2.2.1 Contact A.D. 1650-1800

Following the dispersal of the Petun and Huron by the Iroquois in 1650, southern Ontario was uninhabited for fifteen years. Then, during the middle to late 1600s, in an attempt to expand their fur hunting grounds to the north, the Iroquois established a number of villages along the north shore of Lake Ontario. Two of these, Ganatsekiagon and Teiaiagon, were built by the Seneca on the Rouge and Humber Rivers respectively. Current research indicates that no villages of this size and importance were likely ever built in the Etobicoke or Mimico Creek watersheds. However, local resources were without doubt used by native peoples in this late period as evidenced by numerous archaeological sites in the area. After the Seneca abandoned the north shore of Lake Ontario in the last half of the seventeenth century, the Algonkian speaking Mississauga moved into this area and they were flourishing when the French, and later the British, arrived.

The mouths of these creeks would have been particularly useful for hunting and fishing as a part of the seasonal round of the Mississauga living in the area. The Mississauga are also recorded as stating that they used the flats on these creeks to plant their crops (corn, beans, and squash). These resource-rich localities were attractive food gathering areas as they had been for thousands of years. In addition, parties of canoe-travellers would have stopped here for resting or camping on journeys between the head-of-the-lake and points along the Carrying Place Trail.

Unlike the other creeks and rivers under the auspices of The Toronto and Region Conservation Authority, the Etobicoke and Mimico Creek watersheds have retained their aboriginal names. Early Europeans in the area learned these names from the Mississauga. Both "etobicoke" and "mimico" are derivations of Algonkian words or phrases thought to mean, "place where the alders grow" and "resting place of wild pigeons" respectively. The wild pigeons in question are the extinct passenger pigeon which were once plentiful in this area. Faunal osteoarchaeological collections in Ontario show that the passenger pigeon was an important food source for aboriginal peoples. It is assumed then that the area around Mimico Creek might have been a noteworthy spot for harvesting this food resource.

2.2.2 Early Euro-Canadian

The name of Etobicoke Creek is linked with the seminal Toronto Purchase land transfer agreement between the Mississaugas and the Crown. Because of pressure from Loyalists entering Canada from the United States seeking land to settle under British sovereignty, a meeting was held in 1787 at Carrying Place, Bay of Quinte. Crown representatives and Mississaugas from the north shore of Lake Ontario met to hammer out a land purchase agreement. A document outlining what was called the “Toronto Purchase” was arranged and signed.

In 1788, surveyor Alexander Aitken was dispatched to begin to divide the thousands of acres covered by the Toronto Purchase into townships and lots in advance of settlement. However, as he was running his survey lines he was met with resistance by the local Mississauga while laying out the western boundary. The Mississauga believed that they had agreed to the Humber River as the western boundary of the Toronto Purchase while the British believed that they had purchased all the land up to Etobicoke Creek. The British prevailed and the surveying continued. The western edge of the Toronto Purchase agreement forms the border between the present day Cities of Toronto and Mississauga.

Hard feelings regarding the western boundary of the Toronto Purchase lingered until a second meeting was held in 1805 and the land deal was ratified. The steady flow of settlers seeking land soon filled available spaces in the Toronto Purchase. More land had to be acquired. In 1818, a second land purchase was concluded to transfer lands known as the “Mississauga Tract” to the Crown. This parcel of land included northern portions of the Counties of Peel and Halton and parts of Wellington and Dufferin. Through these two treaties, the whole of the Etobicoke and Mimico Creek watersheds had been transferred from the Mississauga to the British Crown and was available for settlement by 1818.

After his arrival in 1793, the earliest lands to be granted by Lieutenant-Governor John Graves Simcoe were in those concessions closest to the fledging Town of York, including the lands at the south end of the Etobicoke and Mimico Creek watersheds. The first land grants in the area were in 1793 to retired officers of the Queen’s Rangers, Simcoe’s regiment in the American Revolution.

For his services to the Crown, Captain (later Lt. Col.) Samuel Smith was granted over 1,500 acres along the lakeshore from the mouth of Etobicoke Creek eastward. This became the core of the much larger “Col. Smith Tract” which extended from Etobicoke Creek to Kipling Avenue south from Bloor Street to the lakeshore. Smith was supposed to have encouraged other half-pay (retired) officers to settle the lands adjacent to his, and establish a sort of *ad hoc* military colony. This would have provided Simcoe with a ready-made core militia close to the Town of York in case of military aggression from the United States.

However, the plan failed to come to fruition and Smith's house was the only one built in the area until shortly before his death in 1826. The house, built in 1799, stood near Forty-first Street and Lake Shore Boulevard until 1955, when it was demolished. This land grant, and the adjacent King's Mill Reserve (a tract of land set aside by Simcoe for timber harvesting), between Mimico Creek and the Humber River, had the effect of retarding settlement of the Township of Etobicoke, south of Dundas Street, until well into the 1820s. Gourlay's account of 1822 bitterly records the vast "wasteland" of the south reaches of the Etobicoke and Mimico Creek watersheds.

John and Joseph Silverthorne were also early settlers by Etobicoke Creek. The Silverthornes ran a milling establishment at Summerville. John Bagwell, a farmer from the west of England, is said to be the first settler in Chinguacousy Township. The Grahams were also a pioneering family and bequeathed their name to a village in the upper Mimico watershed.

The treaties of 1805 paved the way for the early settlement of what is now Mississauga. As soon as surveying was completed in 1808, seven families settled in the township. One of these in the Etobicoke Creek watershed was Absalom Wilcox. All of these lands were crossed by the ancient lake shore trail and the later Dundas Street, also thought to have been an aboriginal trail. Settlement sprang up first along Dundas Street and coalesced into communities such as Islington and Summerville. There were very few absentee landlords which plagued other nearby townships by slowing settlement. By 1821, almost all of the lots not reserved for clergy and Crown in the Etobicoke Creek watershed were occupied.

Montgomery's Inn, 4709 Dundas Street West

2.2.3 Later Euro-Canadian

The population grew steadily as settlers were attracted to the rich farmland close to the growing markets of the Town of York (later Toronto). Mixed farming was the mainstay of the economy with milling almost an insignificant addition. Later, market gardening thrived in lower Etobicoke and Brampton. Brampton boasted a large greenhouse industry featuring flower-growing in the early years of this century. The coming of the railway brought industry to the region, while the streetcar line along the lakeshore ushered in an era of holiday making and cottaging in Long Branch during the last quarter of the nineteenth century.

In the nineteenth and early twentieth century, there were many farming hamlets and villages within the watersheds. In the Mimico Creek watershed these included Mimico, Islington, Richview, Malton, Grahamsville, and Woodhill. Long Branch, Alderwood, Summerville, Eatonville, Burnhamthorpe, Elmbank, Fraser’s Corners, Hanlan, Mayfield, Mount Charles, Victoria, Nortonville, Brampton, and Edmonton (Snelgrove) were communities in the Etobicoke Creek watershed. New Toronto was a thriving industrial community, located in the triangle of land (the Lake Ontario Drainage Area) between the two larger watersheds. Rural and village life depended on the many resources found in the watersheds. Over time, the landscape was altered. The extent to which the once largely forest covered watersheds were affected by agriculture and other activities is demonstrated by the sparse forest cover remaining in the watersheds by 1954 (Map 3).

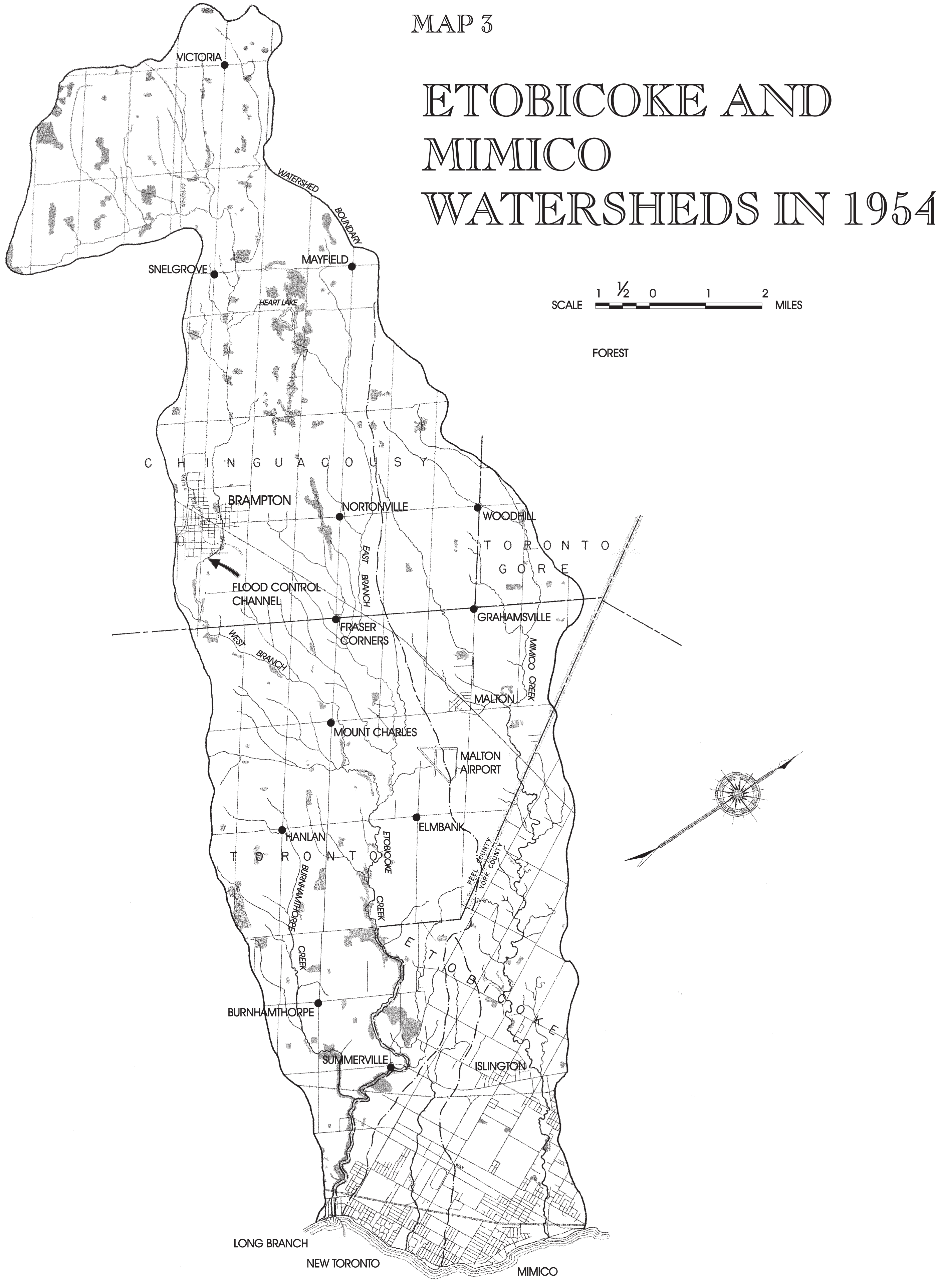
In terms of being a hydraulic power source, the Etobicoke and Mimico Creek watersheds were never as important as their larger neighbours, the Humber and Credit Rivers. Very few mills were recorded as having been built on these watersheds. The first was probably Abraham Markle’s sawmill in 1810. Sawmilling seems to have been more popular than grist milling. Data for this region is often hard to interpret as the returns for mills were included with those of the Humber and Credit Rivers on a county or township basis.

Throughout its history, the Etobicoke Creek provided water power for perhaps as few as a half dozen mills over the nineteenth century. Lack of a steady stream flow and periodic flooding made milling an unattractive business. Some early accounts seem to suggest that parts of the Etobicoke Creek amounted to little more than a seasonal stream; dwindling to mere isolated pools in the heat of the summer. The presence of steam mills on the Etobicoke Creek is testament to the need for an additional power source to keep the machinery humming.

As with much of the area surrounding Toronto, the rural depopulation of the Etobicoke and Mimico Creek watersheds at the middle of the nineteenth century was owed largely to the better job opportunities in the city. Intensive agricultural practices and improved machinery meant less acres were needed for cultivation, and less farm hands were required. However, particularly in the lower reaches of the watersheds, the trend began to reverse because of their proximity to Toronto.

MAP 3

ETOBICOKE AND MIMICO WATERSHEDS IN 1954



DEPARTMENT OF PLANNING AND DEVELOPMENT
- CONSERVATION BRANCH -
SEPTEMBER 3 1954 S.L. McCOLLUM

Population increased in areas along the lakeshore, such as Long Branch and the village of Mimico, towards the end of the last century and into the twentieth century. The advent of railway links along this corridor meant people could live in these areas and work in Toronto. The notion of bedroom communities had arrived. Much of the prosperity in Mimico occurred after the Canadian National Railway freight yards were built in the community in 1906.

By the early twentieth century, none of the more northern villages in the watersheds had been entirely abandoned, although some dwindled to only a few families. The automobile, and the post World War II baby and building booms, brought thousands of young families to the area seeking the dream of a new house in a new subdivision. This trend continues today as farmland in the headwaters of Etobicoke Creek is developed for residential purposes.

One of the lasting legacies of Etobicoke Creek is the devastation to human life and property wrought by Hurricane Hazel in 1954, on the lower reaches of the creek in Long Branch. The hurricane galvanized the province into taking action against allowing the construction of housing on flood-prone land.

In 1957, four Toronto area conservation authorities, including the Etobicoke-Mimico Conservation Authority, were amalgamated into The Metropolitan Toronto and Region Conservation Authority. The merger was a direct result of Hurricane Hazel. It is the legacy of the hurricane that continues to influence how flood plains and valley corridors are managed in the Etobicoke and Mimico Creek watersheds, and has thus influenced the form of urban development and human settlement through the latter part of the twentieth century.

SUMMARY

Archaeological resources provide evidence of Aboriginal settlement in the Etobicoke and Mimico Creek watersheds. The populations of each historic cultural period, Palaeo-Indian, Archaic, and Woodland, had distinguishing characteristics in terms of settlement patterns and technologies developed and used. Although some prehistoric archaeological sites have not been excavated, or have been destroyed by development, a number of sites have been found and documented within the Etobicoke and Mimico Creek watersheds.

The period of historic settlement extends from about 1650, when Aboriginal populations first had contact with Euro-Canadians, to post World War II. The lands were transferred from the Mississaugas to the British Crown, and were available for settlement by 1818. As the Euro-Canadian population grew in the watersheds, so did the activities taking place. Farming, market gardening, and industry led to the establishment of a number of communities. These settlements depended on the resources found within the watersheds for their livelihood and over time, changed the landscape. By 1954, the extent to which the landscape had been altered and fragmented is illustrated by the sparse forest cover in the area.

CHARACTERISTICS OF WATERSHED COMMUNITIES

CHAPTER 3

As discussed in Chapter 2, there have been humans in the Etobicoke and Mimico Creek watersheds for the last 12,000 years. Similar to past peoples who inhabited the watersheds, in the post-World War II period, diverse human populations have depended upon the watersheds for their livelihood and enjoyment. In turn, these peoples have affected the natural heritage system.

Euro-Canadian settlement began in a number of distinct communities such as Summerville, Elmbank, and Frasers Corners in the Etobicoke Creek watershed, and Malton, Woodhill, and Grahamsville in the Mimico Creek watershed. Today, some of these communities remain but all are more populous, diverse, and integrated into the larger municipalities of Toronto, Mississauga, Brampton, and in the Etobicoke Creek watershed, the Town of Caledon.

Changes in the size and composition of the human population within the watersheds places different demands on the natural heritage system; thus, an overview of relevant population characteristics is presented. These characteristics include population size, distribution, ethnicity, and language. The information in this section is based on an analysis of Statistics Canada 1996 census data unless otherwise noted.

3.1 POPULATION SIZE AND DISTRIBUTION

In 1996, the population of the Etobicoke Creek watershed was 276,346, while the population of the Mimico Creek watershed was 134,349[5].

As shown in Table 3.1, the majority of the population in the Etobicoke Creek watershed is located in the City of Brampton. In the Mimico Creek watershed, the City of Toronto makes up almost half of the population, as shown in Table 3.2.

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[5]Population data for the watersheds was obtained by aggregating census tract data collected by Statistics Canada, 1996.

Just as the distribution of the population in the municipalities is uneven, so is the growth rate. Between 1991 and 1996, the City of Mississauga grew most rapidly. The City of Brampton and the Town of Caledon also grew rapidly, while the City of Toronto grew more slowly. Tables 3.1 and 3.2 illustrate the rate of population growth among the municipalities. Based on these figures, it is likely that the largest population increases are occurring in the Cities of Mississauga and Brampton, and in the Etobicoke Creek watershed, the Town of Caledon.

TABLE 3.1: Municipal Population Ratios for the Etobicoke Creek Watershed

Municipality	% of Watershed Area	Growth Rate (1991-1996)%*	% of the Population of Etobicoke Creek
Toronto (Etobicoke)	7	6	15
Mississauga	33	17.5	27
Brampton	34	14.4	57
Caledon	26	14.1	1

TABLE 3.2: Municipal Population Ratios for the Mimico Creek Watershed

Municipality	% of Watershed Area	Growth Rate (1991-1996)%*	% of the Population of Mimico Creek
Toronto (Etobicoke)	38	6	46
Mississauga	24	17.5	22
Brampton	38	14.4	32

Source for Table 3.1 and 3.2: Statistics Canada, 1996.
*The growth rates are for the entire area of the municipality, including the area outside of the watersheds. It is assumed, therefore, that the rate of population growth is even throughout the municipality.
Note: Figures are rounded.

Migration is a significant source of population growth as illustrated by figures on mobility. In 1996, about 20 percent of the population within the Etobicoke Creek watershed had moved to their current municipality of residence within the five years prior to 1996. Around 31 percent of these migrants moved to the watershed from outside of Canada, and seven percent came from outside of Ontario.

In the Mimico Creek watershed, 38 percent of the population that had moved to their current municipality of residence within the five years prior to 1996 came from outside of Canada, and six percent came from outside of Ontario. As many residents within the watersheds are new to their community, watershed education initiatives could be particularly valuable for introducing these people to local environmental agencies and groups, as well as raising awareness of local environmental issues.

3.2 DIVERSITY

The populations of the Etobicoke and Mimico Creek watersheds are more culturally and ethnically diverse than they have been at any other time. Knowledge of this diversity is important for watershed management for a number of reasons. For example, some ethnic communities may be unaware or reluctant to participate in watershed regeneration activities because of cultural or language barriers. However, many groups make valuable contributions to heritage and outdoor recreation through planting edible and healing landscapes, participating in community gardening initiatives, and other activities.

The cultural diversity of the Etobicoke and Mimico Creek watersheds is characteristic of the Greater Toronto Area in general. The 1996 Census of Population asked a question about what ethnic or cultural group a person's ancestors belonged. As defined by this census, the six largest ethnic groups in the Etobicoke Creek watershed are English (22 percent), Canadian (19 percent), Scottish (13 percent), Irish (12 percent), East Indian (8.4 percent), and Italian (8.4 percent). In the Mimico Creek watershed, the largest groups are English (20 percent), Canadian (16 percent), East Indian (12.6 percent), Scottish (12 percent), Irish (11 percent), and Italian (10.5 percent).

The participation of diverse communities in the environmental activities of agencies has been poorly developed, despite the fact that these communities make up a large and growing portion of the Greater Toronto Area population. Visible minorities make up 28 percent of the population in the Etobicoke Creek watershed. In the Mimico Creek watershed, 35 percent of the population is made up of visible minorities. These communities are impacted by the environmental quality of the watersheds, but often do not become actively involved in watershed management and ecological restoration activities. The TRCA, in partnership with multicultural environmental and multi-service groups, are attempting to address the lack of formal mechanisms for engaging new Canadians and visible minority groups in environmental restoration activities through a new multicultural environmental stewardship program, funded by the Trillium Foundation.

3.3 LANGUAGE

Language can be a significant barrier to participation in watershed management and ecological restoration activities. For the majority of residents in the Etobicoke (65 percent) and the Mimico (59 percent) Creek watersheds, English is their mother tongue. However, many others may not speak English in the home or as a second language. As English is the language used by the TRCA, information about watershed events and other activities may not effectively reach these portions of the population unless they are specifically targeted. The four most common languages spoken in the Etobicoke Creek watershed other than English are Punjabi, Portuguese, Polish, and Italian. In the Mimico Creek watershed, the top four languages other than English are Punjabi, Italian, Polish, and Spanish.

SUMMARY

In broad terms, the populations of the Etobicoke and Mimico Creek watersheds have the following characteristics:

- In relation to their geographical size, the watersheds have large populations with over half of the Etobicoke Creek watershed population residing in the City of Brampton and almost half of the Mimico Creek watershed population residing in the City of Toronto. While both watersheds have experienced growth in recent years, the Etobicoke Creek watershed has grown more rapidly.

- The cultural diversity within the watersheds means there will likely be a variety of interests and preferences needing to be met in future watershed management activities. For example, people with different cultural backgrounds may create different recreational demands or have different landscaping traditions and, therefore, may help to define the community through types of open space and landscaping.

- While the majority of the residents in the watersheds speak English, information on watershed events and other activities may not reach residents that do not speak English unless they are specifically targeted.

RECREATION, MAJOR GREENSPACE, TRAILS, AND DESTINATIONS

CHAPTER 4

In the Etobicoke and Mimico Creek watersheds, major opportunities for outdoor recreation and public use are usually found within or near valley and stream corridors. These corridors often contain greenspaces and natural areas that are the base on which a linked, publicly accessible, and diverse greenspace and trail system may be developed. This chapter explores the existing opportunities and constraints these watersheds have for this type of system.

Significant leisure trends affecting the type of outdoor recreational activity people are participating in, and the infrastructure needed to accommodate these activities, include the following:

- a rapidly expanding and multicultural population in the Greater Toronto Area;
- free time being spent closer to home;
- a heightened interest in the environment and out-of-doors, physical and emotional health, and spontaneous recreation activities;
- an aging population which may lead to a rise in the demand for golf, bicycling, walking, and similar outdoor activities; and
- strong public support for linked parks and trails, and for preservation of natural areas (RCFTW, 1992).

Combined, these trends explain the rising demand for publicly accessible and linked greenspace and trail systems to provide outdoor recreational and public use opportunities and linkages to destination attractions.

4.1 GREENSPACE SYSTEM: OPPORTUNITIES AND LINKAGES

Traditionally, publicly owned lands have provided the majority of opportunities for outdoor recreation and other public uses for the public. Presently, local and regional municipalities, private businesses, and the TRCA provide many of the available outdoor recreational facilities and services--primarily in valley and stream corridors and adjacent lands. In the Etobicoke and Mimico Creek watersheds, municipal parklands, TRCA lands, and other open space areas provide the basis for publicly accessible greenspace and trail systems. Potential constraints to a linked greenspace and trail system include lands such as Lester B. Pearson International Airport, golf courses, and highways (Map 4).

4.1.1 Lands Owned by The Toronto and Region Conservation Authority

Since its inception the TRCA, in cooperation with the Province; its member municipalities; and other partners, has pursued an objective of providing outdoor recreation and destination attractions on lands that it has acquired for watershed management purposes. In total, the TRCA owns 374 hectares of land in the Etobicoke Creek watershed and 40 hectares of land in the Mimico Creek watershed (MTRCA, 1997). Lands owned by the TRCA in the Etobicoke Creek watershed are largely contained within the valley and stream corridors and includes Heart Lake Conservation Area and the Snelgrove Resource Management Tract. In the Mimico Creek watershed, lands owned by the TRCA are largely restricted to the valley and stream corridors and the mouth of the creek.

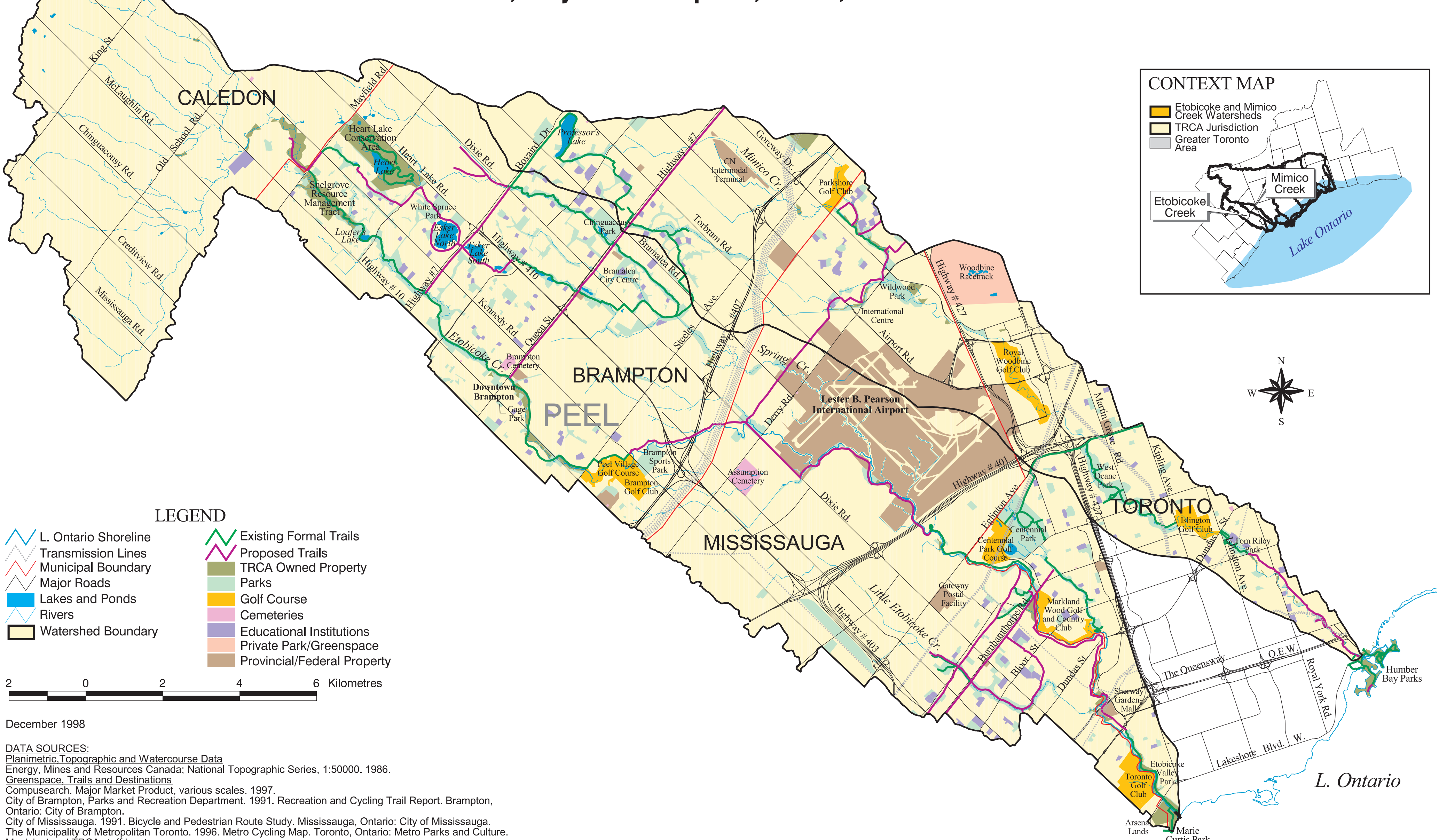
Heart Lake Conservation Area

Heart Lake Conservation Area, located in the City of Brampton, is owned and managed by The Toronto and Region Conservation Authority. The TRCA defines conservation areas as:

> designated resource management areas where the natural characteristics of land, together with the conservation land management activities of the Authority, will provide a broad range of outdoor recreation opportunities, supported by a variety of facilities and services, enabling all residents of the region to enjoy the out-of-doors (MTRCA, 1980).

Opened to the public in 1957, the conservation area is named after the lake which is the focus of much of the recreational activity. Prior to that date, these lands and waters had been used as a commercial waterfowl breeding site and a private estate. The 169 hectare conservation area provides many opportunities for outdoor recreation. In the warmer months, Heart Lake is used for swimming, fishing, boating, nature trail walking, and picnicking. Major festivals include the spring fishing derby, summer concerts, and the Fall Colour and Arts and Crafts Festivals. Group camping is also available. The area is closed during the winter months.

MAP 4: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Recreation, Major Greenspace, Trails, and Destinations



December 1998

DATA SOURCES:
Planimetric,Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.
Greenspace, Trails and Destinations
Compusearch. Major Market Product, various scales. 1997.
City of Brampton, Parks and Recreation Department. 1991. Recreation and Cycling Trail Report. Brampton, Ontario: City of Brampton.
City of Mississauga. 1991. Bicycle and Pedestrian Route Study. Mississauga, Ontario: City of Mississauga.
The Municipality of Metropolitan Toronto. 1996. Metro Cycling Map. Toronto, Ontario: Metro Parks and Culture.
Municipal and TRCA staff input.

In terms of use in 1997, 56,426 people visited Heart Lake Conservation Area. A visitors survey from 1994 revealed that almost half of the visitors to Heart Lake live in the City of Brampton. From a regional perspective, 72 percent of visitors came from within The Regional Municipality of Peel, and 23 percent came from the six municipalities which now form the City of Toronto (MTRCA, 1995).

Enjoying Heart Lake Conservation Area

Snelgrove Resource Management Tract

As defined by the TRCA, Resource Management Tracts are:

> designated resource management areas where the natural characteristics of land, together with the conservation land management activities of the Authority, will provide outdoor opportunities to study and observe, generally supported only by the provision of venues for public access (MTRCA, 1980).

In 1959, the TRCA acquired the Snelgrove lands to construct a dam and reservoir to serve as an auxiliary water supply for Brampton, which drew much of its supply from wells, and secondly, for recreational purposes (MTRCA, 1959). To date, the dam has not been built. Currently, portions of the lands are under agreement with the City of Brampton to meet local open space needs, such as trail development and use, while the TRCA maintains the remaining areas. Within this resource management tract, naturalization has occurred in recent years.

Leases and Management Agreements

A variety of lease and management agreements exist for other TRCA lands.

Within the City of Toronto, some of the lands managed by the City of Toronto Department of Economic Development, Culture and Tourism--Parks and Recreation Services, are owned by the TRCA. These lands are leased through a management agreement to the City of Toronto and include valley and stream corridors and associated tablelands. Humber Bay Parks located at the mouth of Mimico Creek, and Marie Curtis Park located at the mouth of Etobicoke Creek, are major destinations that have been developed through this partnership.

Within the Region of Peel, the Authority has entered into agreements with local municipalities for open space development on TRCA lands, primarily for local recreation purposes.

4.1.2 Municipal Parks

The overall open space system is guided by municipal official plans, parks and open space plans, trail plans, and policies related to urban development. Map 4: Recreation, Major Greenspace, Trails, and Destinations shows the location of the outdoor recreational opportunities in the watersheds.

Regional Parks

The City of Toronto operates regional scale parks through Parks and Recreation Services on lands owned by the TRCA. Since its inception in 1955, the regional parks system has evolved to accommodate a wide array of active and passive regional scale leisure facilities on a year-round basis. Regional outdoor recreational opportunities and destinations exist at the waterfront parks at the mouths of the Etobicoke and Mimico Creeks.

Kayaking on Mimico Creek under the new pedestrian bridge

Opened in 1984, Humber Bay Parks were created by The Toronto and Region Conservation Authority at the mouth of Mimico Creek at Lake Ontario. Humber Bay Park West is 26 hectares of parkland and Humber Bay Park East is 19 hectares of parkland. Some special features of the park include three yacht clubs and marinas, boat launching, model boating, picnic facilities, and natural areas. In 1998, a pedestrian bridge was constructed over Mimico Creek to link Humber Bay Park East and West.

A new project, Humber Bay Shores, is a regional open space link between Humber Bay Parks and the Humber River Pedestrian Bridge. It is a part of the Lake Ontario Waterfront Trail System. The park will contain the following special features: A Central Place, providing a public gathering place for programmed events and activities; The Wetlands, reflecting the wilder, natural landscapes found in Humber Bay Park East; The Beaches, offering naturalized areas, a separated system of walking and cycling trails, lookout areas, and closer contact with the water's edge along cobble beaches; a twinned trail system; and Waterfront Drive, which provides a scenic route through the area. It is anticipated that Phase 1 of the project will be completed in 1999.

Marie Curtis Park is situated on both banks of the mouth of Etobicoke Creek. The park was created in 1954 after high flood waters caused by Hurricane Hazel destroyed flood vulnerable areas at this site. The 25 hectares of parkland were subsequently acquired by the conservation authority. Special features of the park include the waterfront trail, a children's playground area, wading pool, supervised beach (July and August), public boat launch ramps, and moorings.

There are plans to regenerate Marie Curtis Park and the Lake Ontario waterfront. In 1991, The Metropolitan Toronto and Region Conservation Authority, The Regional Municipality of Peel, The Municipality of Metropolitan Toronto, the City of Mississauga, and the Province of Ontario purchased a 16 hectare site located immediately to the west of Marie Curtis Park called the Arsenal Lands. The site was originally developed by the Department of National Defence and used as a small arms and munitions manufacturing facility during World War II. In the post-war years the site was used for a variety of manufacturing activities. The site's final use was a Canada Post sorting facility, from 1981 until 1992.

The TRCA retained a consulting consortium to develop *The Arsenal Lands Park and Site Remediation Master Plan* (HWNDL et al., 1998). The plan includes site remediation and heritage, ecological restoration, and recreational enhancements. These lands provide a significant opportunity for a former industrial area to be rehabilitated and developed into a major regional park and destination attraction that links the waterfront from Mississauga to Toronto. The Master Plan was received by the Authority in 1998. It is anticipated that final approval for the plan will occur in 1999.

Local Parks

Local municipalities provide parks, recreation, cultural facilities, and programs through their Departments of Parks and Recreation or Culture. These departments produce parks and recreation master plan documents, and trail plans, to guide the provision of facilities and program development for parks, open space, recreation, and culture. These master plans provide inventory information and coordinate recreation service delivery across the municipality. The master plans are usually based on a specific planning period and include both short- and long-term goals based on future needs. As a result, master plans require frequent review and updating as development occurs and needs or trends change.

Two municipal parks within the Etobicoke Creek watershed are destination attractions which provide extensive municipal wide opportunities for outdoor recreation. Centennial Park, within the City of Toronto, is approximately 213 hectares in size. The park contains a number of attractions including ski hill and chalet, toboggan hill, greenhouse, woodlot, recreational ponds, wading pool, picnic areas, cricket pitches, golf course, mini-indi track, indoor soccer, playgrounds, and paddle boats. In the City of Brampton, Chinguacousy Park is approximately 40 hectares in size and contains a number of facilities including mini-golf, petting zoo, ski hill, toboggan hill, formal gardens, greenhouse, and private curling club.

In the Etobicoke Creek watershed, Gage, White Spruce, and Loafer's Lake Parks in the City of Brampton provide unique outdoor recreational opportunities and attractions. Gage Park, in the oldest part of the city, is located across the street from the Peel Museum and Art Gallery. The park contains mature trees, picnic areas, and a bandshell for summer concerts. White Spruce Park has 22 hectares of woodland for nature walks in the warmer months or for cross-country skiing in the winter. Loafer's Lake Park is situated in the valleyland of Etobicoke Creek and features fishing and paddle boating on the lake. Loafer's Lake Recreation Centre provides mini-golf, an indoor swimming pool, and social facilities.

In the Mimico Creek watershed, two municipal parks provide unique opportunities for outdoor recreation and attractions. Tom Riley Park is a 12 hectare park located in the City of Toronto. Facilities include lawn bowling, paths for biking and walking, swimming, and opportunities to play a number of organized sports. It also has a heritage building, Montgomery's Inn, on site. In the north end of the Mimico Creek watershed, Professor's Lake Park, located in the City of Brampton, has a recreation centre and an artificial beach making it a summer haven for swimming, boating, and picnicking.

4.1.3 Other Lands that Provide Opportunities for Outdoor Recreational Activities

In addition to lands traditionally considered as public greenspace, public golf courses; cemeteries; and utility corridors are, or potentially can be, used by the public for passive recreational activities.

Golf Courses
As shown on the Recreation, Major Greenspace, Trails and Destinations map, there are eight golf courses located in the valley and stream corridors of the Etobicoke and Mimico Creek watersheds. There are three private (Brampton, Markland, and Toronto Golf Clubs) and two publicly owned "pay as you play" golf courses in the Etobicoke Creek watershed (Centennial and Peel Village Golf Courses). There is one private (Islington Golf Course) and two semi-private courses in the Mimico Creek watershed (Parkshore and Royal Woodbine Golf Clubs). Opportunities for other recreational uses within golf course lands are restricted.

Cemeteries
Cemeteries constitute open space as they sometimes connect parks and other greenspaces, particularly when located near valley and stream corridors. There are two cemeteries near the valley and stream corridors of the Etobicoke Creek watershed: Assumption Cemetery in the City of Mississauga and Brampton Cemetery in the City of Brampton. Within the Mimico Creek watershed, one cemetery is located near Professor's Lake in the City of Brampton. Richview Memorial Cemetery is located at the intersection of Highways 427 and 401.

Utility Corridors
Public utilities such as hydro corridors represent opportunities for public use as sports fields, open spaces, and as trail linkages. There is a large hydro corridor running alongside Highway 407 as well as a number of smaller hydro corridors in the Etobicoke and Mimico Creek watersheds (Map 4).

Educational Institutions
There are a number of elementary and secondary schools within the watersheds which contribute to public uses through their outdoor sports facilities and fields, playgrounds, open spaces, and linkages to other greenspace areas. Often schools are clustered with other public facilities and are located adjacent to valley and stream corridors.

In the Etobicoke and Mimico Creek watersheds, there is a lack of outdoor educational facilities and there are no TRCA or school board education field centres.

Woodbine Racetrack
Opened in 1956, the racetrack is situated on 304 hectares of land in the Mimico Creek watershed. Woodbine is a significant recreation and tourism destination attraction in the Greater Toronto Area.

4.1.4 Trails

Trails are often multi-use routes intended to service both pedestrian and bicycle use. In total, there are approximately 54 kilometres of trails in the Etobicoke Creek and 23 kilometres of trails in the Mimico Creek watershed. The existing formal and proposed trails in the watersheds are indicated on Map 4. The 55 kilometres of proposed trails shown in the Etobicoke Creek watershed, and the 15 kilometres of trails proposed in the Mimico Creek watershed, are based upon municipal trail plans, namely those produced by the Cities of Mississauga and Brampton. Only off-road trails, or proposed linkages between off-road trails, have been included. Generally, trail development in the Etobicoke and Mimico Creek watersheds is directed toward meeting local recreational needs.

Local and Community Trail Systems
Municipalities are responding to trends which demonstrate the need for local trail systems and for trails that connect with other municipalities and watersheds. All of the local municipalities within the Etobicoke and Mimico Creek watersheds have shown a commitment to creating and supporting trail development.

The City of Toronto has three major recreational trail routes in the Etobicoke and Mimico Creek watersheds. These include the Etobicoke and Renforth Creek Route which runs from Centennial Park (Rathburn Road) to Dundas Street, the Centennial Park Route which connects the Eglinton Bicycle Route at the north of the park to Rathburn Road, and the fragmented route along Mimico Creek.

The Cities of Mississauga and Brampton have developed master plans for trails. Mississauga City Council approved a *Bicycle and Pedestrian Route Study* in 1991. The proposed routes are intended to connect natural corridors, parks, schools, and scenic neighbourhood areas over a 20 year period (City of Mississauga, 1991). These include the Malton Greenway and Etobicoke Creek Trails. The City of Brampton Parks and Recreation Department developed a *Master Plan for Pedestrian and Cycling Trail System (1991).* It identified a series of trail routes that are intended for use by pedestrians, cyclists, and the disabled. These include the Etobicoke Creek and Esker Lakes Trails. The Etobicoke Creek trail is proposed to extend into the Town of Caledon. The City of Brampton is currently revising the 1991 trail plan to reflect current needs.

Trails are also being enhanced by community groups in the watersheds. The Alderwood Environmentalists' Interpretive Trail is 2.4 kilometres and connects Marie Curtis Park at the mouth of Etobicoke Creek with Etobicoke Valley Park just south of the Queen Elizabeth Way. The group received a grant to pay for and build interpretive signs that line the trail and explain its features (WRT, 1995).

Inter-regional Trails

There have been many studies on the feasibility and potential of inter-regional trails in the Greater Toronto Area. These studies include *The Greenspace Strategy for the Greater Toronto Area* (MTRCA, 1989), *Space for All-Options for a Greater Toronto Greenlands Strategy* (Kanter, 1989), *MTRCA Inter-regional Trail Study* (1993), and *The Lake Ontario Greenway Strategy* (WRT, 1995) as well as municipal plans. The existing trails within the watersheds, though fragmented and incomplete, support the vision of an inter-regional recreational trail system that connects the Greater Toronto Bioregion. The system runs east-west along the north shore of Lake Ontario and has north-south trails within the valley corridors to link Lake Ontario to the Oak Ridges Moraine and Niagara Escarpment trails.

The City of Toronto is continuing the work of its former municipalities in supporting and publicizing the development of multi-use trails through Parks and Recreation Services. The City is responsible for the Eglinton Bicycle Route. This is a signed bicycle/pedestrian trail which extends from Scarlett Road to Renforth Drive (a distance of approximately six kilometres) connecting the Etobicoke and Mimico Creek watersheds with each other, and with the Humber River watershed.

Major inter-regional trails within or near the Etobicoke and Mimico Creek watersheds are the Waterfront Trail at the extreme southern end of the watersheds and the Caledon Trailway/TransCanada Trail to the north. The Waterfront Trail extends along the north shore of Lake Ontario and connects the mouths of Etobicoke and Mimico Creeks with each other and with many parks along the Lake Ontario waterfront. The Town of Caledon owns and operates the 35 kilometre Caledon Trailway/TransCanada Trail. This former rail corridor links with the Bruce and Oak Ridges Moraine trail systems. Currently, there is no trail link connecting either watershed with the Caledon Trailway.

4.2 CONSTRAINTS TO A GREENSPACE AND TRAIL SYSTEM

Despite the benefits greenspace corridors provide, a number of constraints and barriers have prevented the development of a connected public greenspace and trail system. This type of system could be used for outdoor recreation, developing destination attractions for public use, and enhancing the environment in the Etobicoke and Mimico Creek watersheds.

The watercourses and open spaces within valley and stream corridors of the watersheds represent an undervalued resource for integrating watershed communities. In many areas, these valuable amenities have not been identified or signed as accessible to the public, or they are not in public ownership. Where valley and stream corridors are publicly owned, specific access points to these lands below the top of bank may be undeveloped, restricted, unidentified, or acknowledged only where the corridors cross public streets.

Additional physical barriers which may prevent connected greenspace and trail corridors in the Etobicoke and Mimico Creek watersheds include Highways 401, 410, 407, 427, 409; the Queen Elizabeth Way; and Lester B. Pearson International Airport. Golf courses, major industries, and other lands in private ownership are barriers in some cases. Private ownership of valley and stream lands is another constraint to the linked greenspace and trail system. In some cases, however, private landowner stewardship agreements, conservation easements, and donations of land are strategies that may be used to obtain lands for public use.

SUMMARY

In the Etobicoke and Mimico Creek watersheds, publicly owned valley and stream corridors, conservation areas, parks, and other open spaces provide many recreational opportunities. Linking these areas to create a greenspace corridor and trail system enhances their contribution to watershed regeneration through additional environmental, economic, and recreational benefits. Currently, in many areas, the trail system in the watersheds is fragmented. There are a number of barriers to creating a connected system including highways, the airport, and lands in private ownership.

URBAN DEVELOPMENT

CHAPTER 5

The Etobicoke and Mimico Creek watersheds are primarily urban. The majority of the Etobicoke Creek watershed is located in the Region of Peel and the majority of the Mimico Creek watershed is located in the City of Toronto. Urbanization is still occurring, and is particularly rapid, in the mid-upper part of the Etobicoke Creek watershed, in the City of Brampton. This urbanization is important for economic development and necessary to accommodate the population growth described in Chapter 3. The following sections describe the patterns of land use within the watersheds, the infrastructure that has expanded alongside urbanization, and the general effects of urban development on the natural heritage system[6].

5.1 LAND USE

The pattern of development within the Etobicoke and Mimico Creek watersheds has been one of low density development, with large areas of land devoted to single uses including residential areas, business parks, industrial areas, or institutions such as Lester B. Pearson International Airport. This dispersed pattern of growth has resulted in urban development on many rural and agricultural lands in the headwater areas of the watersheds.

Urban expansion into rural areas, Etobicoke Creek watershed

In the past 20 years, the urban portion of the Etobicoke Creek watershed has increased rapidly from 21 percent of the watershed being considered urban in 1978 (James F. MacLaren, 1978), to approximately 53 percent of the watershed being covered by urban development in 1998.

6 The impact of urban development on the natural heritage system is discussed in more detail in Part III: Natural Heritage.

Urbanization is continuing to occur in the Etobicoke Creek watershed, with almost four percent of the watershed committed for development in the future. Most of this future development will be residential subdivisions located in the northern portion of the City of Brampton and in the Town of Caledon. The remainder of the watershed consists of open space and agricultural lands (Map 5).

Twenty years ago, 54 percent of the Mimico Creek watershed was considered urban (James F. MacLaren, 1978). Today, 77 percent of the watershed is covered by urban development. The remainder of the watershed is open space. As the majority of the watershed is located within the City of Toronto, it generally has a more urban character than the Etobicoke Creek watershed--meaning it is older and development is more intensive. Future development in the watershed will likely be accommodated through redevelopment or infill development.

In this report, seven categories are used to broadly define land use patterns in the Etobicoke and Mimico Creek watersheds[7]. These categories are represented on Map 5:

- *Industrial:* Lands used for manufacturing and industrial purposes, including both light and heavy industrial;
- *Office/Commercial Areas*: Lands used for retail, commercial, and office purposes;
- *Institutional:* This includes lands upon which government and religious institutions are located. For example, schools, hospitals, churches, fire and police stations, Lester B. Pearson International Airport, the Gateway Postal Facility, and the CN Intermodal Terminal;
- *Residential:* Although there are some small pockets of high density development, the vast majority of residential development in the watersheds is low to medium density; thus, density is not differentiated in any mapping or analysis;
- *Open Space*: Includes TRCA lands, major parklands, cemeteries, golf courses, private parks (e.g., Woodbine Racetrack), undeveloped lands adjacent to highway corridors such as the Parkway Belt West[8], and valley and stream corridors. Map 4 (in Chapter 4) differentiates between some of these types of open space;
- *Agricultural Areas:* Substantial tracts of land on which there is evidence of agricultural activity; and
- *Future Residential:* Substantial tracts of land on which development will take place in the near future. In the Etobicoke Creek watershed, most of this development is designated residential.

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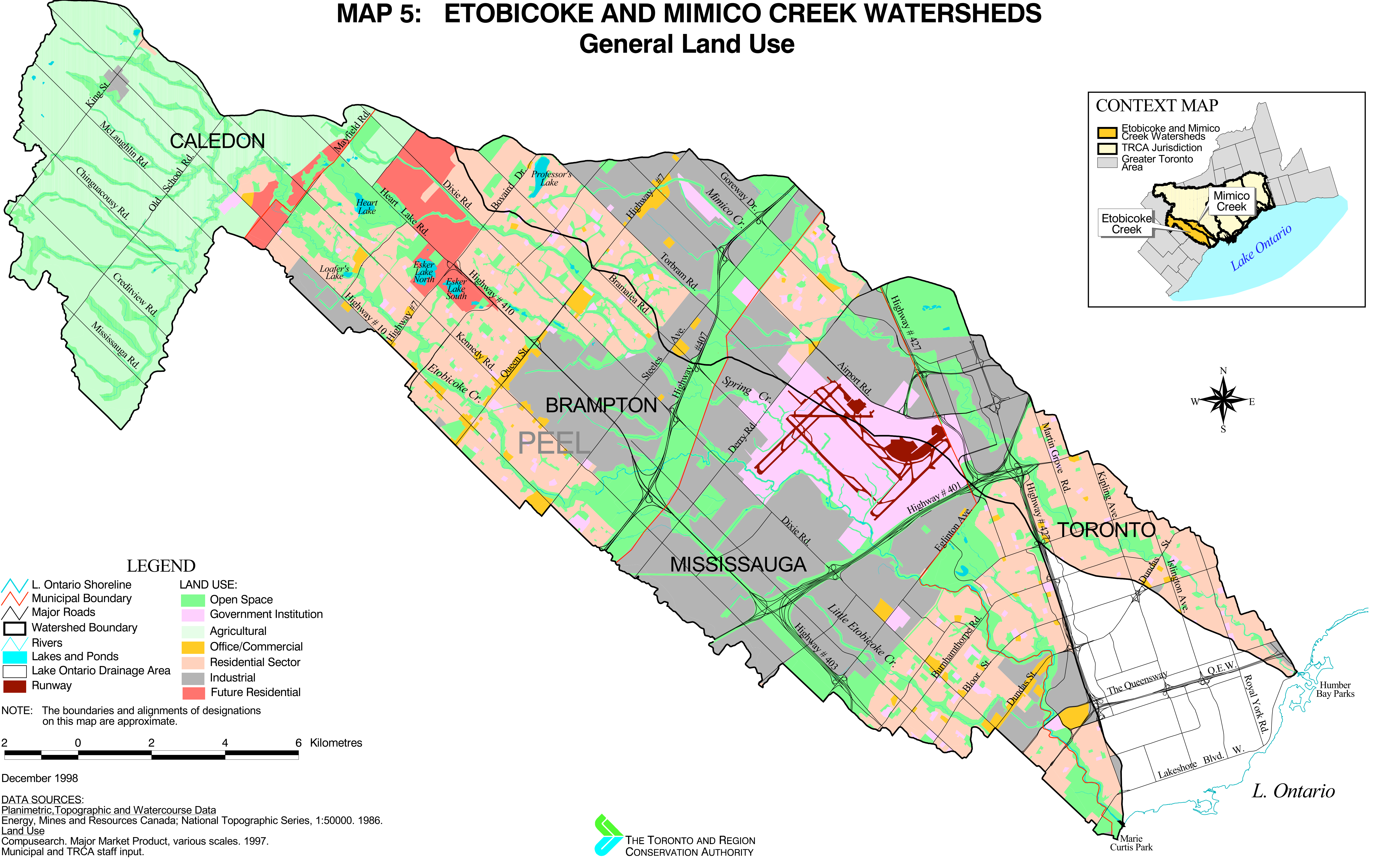
7 Information on land use plans and policies can be found in the Official Plans of the Cities of Toronto, Mississauga, and Brampton; the Town of Caledon; and the Region of Peel.

8 In a 1978 provincial plan, the Parkway Belt West system was envisioned as a multiple purpose corridor that would accommodate utility and infrastructure needs as well as provide a greenway linkage across the Greater Toronto Area.

MAP 5: ETOBICOKE AND MIMICO CREEK WATERSHEDS
General Land Use



The categories used to broadly define land use, as well as the proportion of the watersheds which they occupy, are presented in Table 5.1. Map 5 illustrates the spatial distribution of these land uses.

TABLE 5.1: Land Use in the Etobicoke and Mimico Creek Watersheds

Land Use	Etobicoke Creek	Mimico Creek
Industrial	22%	33%
Institutional	7%	9%
Retail/Commercial	2%	2%
Residential	22%	33%
Open Space	22%	23%
Agricultural	21%	0%
Future Development	4%	0%

Source: TRCA Information Management Group, 1998.

The above figures demonstrate that, in a number of ways, the land use patterns of the Etobicoke and Mimico Creek watersheds are similar. Both watersheds are predominantly urban with a high degree of industrial and residential land uses. The Lester B. Pearson International Airport (LBPIA) is a major use of land, particularly in the Etobicoke Creek watershed. The airport encompasses approximately 1,640 hectares of which 435 hectares drain to Mimico Creek and 1,205 hectares drain to Etobicoke Creek. Further discussion on the Lester B. Pearson International Airport is provided in section 5.2.2.

The high degree of industrial land use indicates that the economies of both watersheds are fairly dependant upon the manufacturing sector. Lower costs and close proximity to Lester B. Pearson International Airport has made the Etobicoke and Mimico Creek watersheds attractive locations for this economic sector. In addition, municipal zoning in accordance with provincial and federal policies encourages industrial activity around LBPIA as a compatible land use which does not interfere with airport operations.

Within the Etobicoke Creek watershed, residential development dominates the City of Toronto area and the southern portion of the City of Mississauga. In addition, the majority of the City of Brampton area is residential. Within the Mimico Creek watershed, residential land use is concentrated in the lower portion of the watershed, south of Highway 401, with pockets found in the Cities of Mississauga and Brampton.

In terms of land use, the Etobicoke and Mimico Creek watersheds are differentiated by two major factors: use of land for agriculture and lands committed for development. The upper portion of the Etobicoke Creek watershed, within the Town of Caledon, is predominantly rural with a high degree of agricultural land use. In the Town of Caledon and the northern portion of the City of Brampton are lands committed for development in the near future.

It is anticipated that even more development will occur in the Town of Caledon in the future. The Town is undertaking the Mayfield West Community Development Plan. The site is roughly bounded by Mayfield Road to the south, Old School Road to the north, and Chinguacousy and Dixie Roads to the west and east. This plan will establish a framework for anticipated future growth within the Mayfield West area. As of November 1998, a preferred Community Concept was developed that will provide the basis of a detailed community plan. The Concept envisages the development of a community of approximately 13,000 people in the next twenty years within the Etobicoke Creek watershed in Caledon (Salter, 1998). In contrast, there are no major tracts of lands remaining in active agricultural use in the Mimico Creek watershed and no large tracts of land are available for future development.

The land use patterns within the watersheds have implications for watershed planning and management. For example, agricultural runoff may impair water quality in the Etobicoke Creek watershed. While in the past, clearing lands for agricultural settlement reduced the amount of forest habitat for birds and other species, the high level of urbanization currently found within both watersheds means there has been a further loss of terrestrial habitat and there are large amounts of impervious surfaces, which affects both water quality and quantity.

Through their official plans, municipalities have an opportunity to guide land use patterns in a way that minimizes the impact of development or improves the natural heritage system. To varying degrees, municipalities have achieved this. Other methods may be employed by municipalities. For example, recognizing the issues around stormwater quality and land use, the City of Mississauga completed a strategy for controlling stormwater quality in 1996. This strategy sets out a plan for incorporating stormwater management facilities within new developments and retrofitting stormwater management infrastructure in existing urban areas.

The Authority, as a commenting agency under the *Planning Act*, provides input and reviews the official plans of its member and local municipalities in accordance with the Valley and Stream Corridor Management Program (MTRCA, 1994). The Program identifies valley and stream corridor boundaries in order that they can be identified in municipal planning documents and zoned in appropriate open space categories. The Program also provides policy direction on what types of land uses may be permitted within valley and stream corridors.

5.2 URBAN INFRASTRUCTURE

Infrastructure is needed to support urban and economic development. Water, sewage, and transportation infrastructure, as well as utility corridors, are important to consider in watershed management[9]. Ensuring that residents and businesses have a treated and safe supply of drinking water, wastewater is treated before being discharged, and people and goods are transported safely and efficiently, is important for economic development. These processes also affect the natural environment. Utility corridors are discussed in terms of their potential to provide opportunities for public use. As the Town of Caledon is largely rural, it has some different issues with respect to infrastructure.

5.2.1 Water and Sewage

All of the Mimico Creek watershed is supplied with treated drinking water from Lake Ontario. The portion of the watershed within the City of Toronto is serviced by the City via the Clark Filtration Plant. The portion of the watershed within Peel Region is serviced through the South Peel Water Supply System.

Most of the Etobicoke Creek watershed is supplied with water from Lake Ontario by Peel Region via the South Peel Water Supply System. Within this system, the Etobicoke Creek watershed is serviced by the Lakeview Water Treatment Plant (WTP).

The headwater area of the Etobicoke Creek watershed is serviced by groundwater sources. Most of the Town of Caledon and some remaining rural areas in the City of Brampton depend on groundwater from municipal and private wells for domestic, commercial, and industrial use (Region of Peel, 1996). The Region of Peel operates a number of wells within Caledon, however, most wells in the Etobicoke Creek watershed portion of Caledon are private (Region of Peel, 1996).

Many land uses and activities surrounding the Etobicoke and Mimico Creeks may use water taken directly from the creeks. Farms and golf courses often use river water in everyday operations. Although currently there are no active water taking permits for golf courses, there are a number of expired permits that were issued to these operations to extract water from both creeks. Although the current status needs to be confirmed, river water taking may be occurring in the agricultural areas of the Etobicoke Creek watershed as well as in the urban areas of both watersheds where numerous golf courses are located. As these activities are usually conducted on a private basis, the required infrastructure is constructed and maintained privately. Permits to take water, issued by the Ontario Ministry of the Environment, are only required when greater than 50,000 l/day are used.

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[9] Stormwater management infrastructure is discussed in section 9.2.1.4.

Wastewater in the northern portion of the Etobicoke Creek watershed is accommodated through private septic systems. For the remainder of the Etobicoke and Mimico Creek watersheds, wastewater is treated by two water pollution control plants (WPCPs): the Humber WPCP, operated by the City of Toronto, and the Lakeview WPCP, operated by Peel Region.

Water pollution control plants are designed to remove human waste sewage, and limited industrial and other sewage. These plants were not designed to treat other pollutants such as heavy metals and toxic organic compounds (e.g., pesticides). Despite these limitations, the WPCP's receive a number of chemicals through the dumping of paints, solvents, cleaners, and other substances commonly used by households and industry. Although some of these pollutants are removed through the sewage treatment process, many remain in the effluent discharged into Lake Ontario (Metro Toronto, 1995).

During 1998, the Region of Peel initiated the development of a Water and Wastewater Master Servicing Plan. The purpose of this exercise is to provide a planning framework for the development of the water and wastewater services necessary to accommodate strategies outlined in the regional and municipal official plans.

In addressing the Region of Peel's Wastewater System Master Servicing Plan, four servicing concepts and their options have been developed to handle the conveyance and treatment of increasing sewage flows, consistent with the Region of Peel's long-term planning growth projections. When the existing trunk sewer was originally constructed along Etobicoke Creek, it was envisioned to be twinned in the future. One of the wastewater servicing alternatives includes twinning of the existing sanitary trunk sewer facilities in the Etobicoke Creek flood plain from Dundas Street to Steeles Avenue. This servicing scheme would impact the Etobicoke Creek valley lands. However, should this alternative be selected, opportunities to protect and enhance the natural environment and develop recreational opportunities would also be created (Crockett, 1998).

The processes associated with water and wastewater infrastructure can affect the environment in a number of ways. During the water filtration process, plant filters accumulate solids, necessitating regular backwashing to clean the filters. The Clark filtration plant discharges backwash water, and thus pollutants that may be present, directly into Lake Ontario (Metro Toronto, 1995). The Lakeview Wastewater Plant has a facility to treat filtered backwash water. In terms of wastewater, while meeting the effluent discharge limits set by the Ministry of the Environment, water pollution control plants still represent a loading to Lake Ontario. Finally, infrastructure such as sewage systems, are often located within valley and stream corridors and, in the past, the alteration, movement, or channelization of watercourses to protect infrastructure has been necessary. Over time, movement of these watercourses can expose infrastructure, causing the need for maintenance, repairs, and the associated capital costs for these works.

5.2.2 Transportation

The transportation systems within the Etobicoke and Mimico Creek watersheds consist of roads and highways, Lester B. Pearson International Airport, rail, and public transit. These systems have a significant role in moving the Greater Toronto Area economy.

Roads and Highways
The Etobicoke and Mimico Creek watersheds are well serviced in terms of arterial roads and highways. Highways 401, 403, 407, 410, 427, and the Queen Elizabeth Way traverse the Etobicoke Creek watershed. Highways 401, 407, 409, 427, and the Queen Elizabeth Way traverse the Mimico Creek watershed. Within both watersheds, Highway 401 is the most travelled which results in severe congestion along its route through the Greater Toronto Area. In 1994, the design, development, and construction of Highway 407 began in an effort to relieve congestion on Highway 401 and improve traffic safety.

Roads and highways generally have a negative effect on the environment. The growing use of roads and highways is associated with increased automobile use which in turn, affects local air quality and contributes to global climate change. In addition, many roads and highways cut across natural areas which can reduce wildlife habitat or block important movement corridors used by wildlife. Further, roads and highways can affect water quality in local watercourses through stormwater runoff or spills. Table 5.2 provides a summary of these pollutants and their sources.

Transportation corridors in the Mimico Creek watershed

TABLE 5.2: Highway Pollutants and Sources

POLLUTANT GROUPS	EXAMPLES	SOURCES
Particulates	Dust, dirt, stones, sand, gravel, grain, glass, plastics, metal, fine residues	Tire, brake and pavement wear, car exhaust, and mud and dirt accumulated on vehicles
Heavy Metals	Lead, zinc, iron, copper, nickel, cadmium, mercury	Use of leaded fuels, tire and brake wear, motor oil additives, and rust
Organic Matter	Vegetation, dust, dirt, humus, oils, and fuels	Vegetation, litter, animal droppings, motor fuels, and oils
Pesticides	Weed killers	Right-of-way maintenance
Chlorides	De-icing chlorides	Road salt used for de-icing
Nutrients	Nitrogen, Phosphorous	Fertilizer use
Batrogenic Bacteria (Indicators)	--	Soil, litter, bird and animal droppings

Source: Adapted From Giffels Associates Limited, 1995.

Airports

Lester B. Pearson International Airport (LBPIA) covers approximately 1640 hectares of land (Winter and Associates, 1991). Most of the airport is within the City of Mississauga, however, a small portion is within the City of Toronto. Surrounding the airport is primarily industrial and commercial development.

Most of the airport drains to Etobicoke Creek including runways, cargo areas, Terminal Three, Terminal One aprons, and infield areas. Further, the entire portion of Etobicoke Creek between Highway 401 and Derry Road runs through the western end of the LBPIA property. The eastern branch of Etobicoke Creek (Spring Creek) also runs through the Airport until it joins the main branch near the middle of the western end of the property.

The Greater Toronto Airports Authority (GTAA) is expanding the capacity of LBPIA to meet the region's air travel demands. The expansion includes constructing new roads, an infield cargo facility, new runways, new and expanded terminal facilities, and new and retrofitted stormwater management facilities.

Airport operations can impact water quality through contamination of stormwater runoff by the following:

- aircraft de-icing/anti-icing fluids (ADF);
- runway de-icing compounds;
- accidental spills;
- sediment build-up (e.g., sand);
- runway rubber build-up; and
- fire-fighting training exercises.

Although runoff contamination from these sources is a concern, significant progress has recently been made to mitigate LBPIA's impact on water quality. Under the De-Icing Plan of Operations implemented in 1993, suction vacuum sweepers and pumping stations at de-icing sites have been used to recover spent glycol. In addition, modifications have been made to glycol spraying equipment to reduce the amount of glycol that is required for de-icing operations. In the fall of 1998, a central de-icing facility was constructed to collect excess ADF.

Similar efforts have been undertaken to mitigate the impacts of other contaminants. Efficient methods of rubber removal have been implemented, therefore, the amount of wash water from this source is limited. Fire-fighting exercises are conducted in a special self-contained area that is surrounded by a berm and located on clay soils, (which acts as an impervious barrier to infiltration). Urea (from runway de-icing), fuel (from accidental spills), and sediment, are more difficult to contain. Mitigation depends on capture and treatment using water quality control facilities. Some of these facilities exist within the airport (see Map 14, Chapter 9). A tank, which drains into Mimico Creek, is designed for quality control. There are a number of ponds which control water quality within the Etobicoke Creek watershed portion of LBPIA. With the airport's expansion, some ponds within the airport will be upsized or new facilities will be built to accommodate the increased stormwater runoff.

In addition to water quality, LBPIA affects air quality, the hydrologic cycle, and wildlife habitat. Aircraft emissions include carbon monoxide, carbon dioxide, volatile organic compounds, nitrogen oxides, and particulates. These pollutants can affect odour, visibility, and climate. Because of the impervious surfaces and altered watercourses (piping, straightening) within the airport, LBPIA also affects the hydrologic cycle. However, a number of stormwater management facilities exist which help to control LBPIA's hydraulic impact, including those built to accommodate development associated with runway expansion. Finally, wildlife such as birds and deer are discouraged outside of the valley system as they can be a safety hazard to the planes.

Rail

The Etobicoke and Mimico Creek watersheds are traversed by the Canadian National (CN) and Canadian Pacific (CP) Rail Lines. These rail lines are used mainly to service industry, but are also used by GO Transit for their commuter train services. Conventional rail transport uses less fuel, consumes less land, and releases less pollutants than automobile transport on roads and highways.

Public Transit

Both the Etobicoke and Mimico Creek watersheds are serviced by public transit, with the exception of the Town of Caledon portion of the Etobicoke Creek watershed. The transit system includes a combination of bus, streetcar, subway (along Bloor Street from downtown Toronto to Kipling Avenue), and GO Train. In addition to alleviating traffic congestion on roads, efficient public transit systems consume less fuel and land, and emit less pollutants than automobiles.

5.3 UTILITIES

There are a number of public utility corridors in the Etobicoke and Mimico Creek watersheds. In addition to their importance in distributing energy to the area, hydro corridors and gas pipelines represent opportunities for public use. Hydro corridors are shown on Map 4: Recreation, Greenspace, Trails, and Destinations (Chapter 4). The largest corridor is located in part of the Parkway Belt West, by Highway 407. It is shown as open space on Map 5. Often, there are opportunities to regenerate or link open space areas through utility corridors.

SUMMARY

The Etobicoke and Mimico Creek watersheds are highly urbanized with large amounts of residential, industrial, and institutional development. In the Etobicoke Creek watershed, approximately 21 percent remains in agricultural use, primarily in the Town of Caledon. Since the Mimico Creek watershed is nearly all developed, most future development will be accommodated through redevelopment or changing existing land uses (i.e. infill development). In contrast, the northern part of the Etobicoke Creek watershed remains undeveloped and much of the future development will likely occur in these areas, for example, in the Mayfield West community.

Urban infrastructure, such as water and sewage treatment, transportation networks, and utilities, has expanded alongside urbanization. These services are vital to support urban and economic development. However, urban development and the extension of water supply, wastewater treatment, and transportation networks have affected wildlife habitat, increased impermeable surfaces, and over time, changed the landscape. Utility corridors, however, can provide opportunities for public use.

RESOURCE USE

CHAPTER 6

Resource-based industries have historically been the most important sector of the Canadian economy. Today, they remain important for a diverse and prosperous economy. Resource-based land uses can affect the quality of life within a community. They can be aesthetically displeasing or cause odour, noise, or health concerns (e.g., dust from aggregate extraction, exposure to fertilizers, pesticides, and herbicides from intensive agriculture). There have been changes, however, to some agricultural, extraction, and forestry practices, which if they are implemented, may reduce the effect of these activities on communities and the environment.

6.1 AGRICULTURE

Only 20 years ago, agriculture was a significant economic activity within the Etobicoke and Mimico Creek watersheds. The pressures of urbanization and subsequent development, however, have diminished this activity in the Etobicoke Creek watershed, and have eliminated it as a land use within the Mimico Creek watershed.

In 1977, 79 percent of the Etobicoke Creek watershed was designated as agricultural/open space (James L. MacLaren, 1978). Today, only 21 percent of the Etobicoke Creek watershed is currently used for agricultural purposes. Almost 100 percent of this agricultural activity is located in the Town of Caledon. Plans for urban development within some areas of the Town of Caledon means there will likely be less agriculture in the Etobicoke Creek watershed in the future.

Similar to many industries, increased technology in the agricultural sector has led to a reduced number of employees. The number of farms is declining but those still operating are larger and more efficient, which reflects a more competitive market. There is also an increased dependence on off-farm incomes. Even with increased government support, net farm incomes are decreasing (Ministry of Treasury and Economics, 1991).

In terms of sustainability, agriculture is unique in its use of resources. The viability of the agricultural industry depends on productive soils. The difference between using soil resources and other non-renewable resources is that the economic goal of a farmer is usually to sustain, not deplete, the resource. The cost to Ontario agriculture of soil degradation from erosion, compaction, and loss of organic matter is as high as $545 million annually (Ministry of Agriculture and Food, 1989). Significant progress has been made in reducing soil erosion through practices such as conservation tillage, crop rotations, and tree plantings (to reduce wind velocities). Similar efforts have improved soil structure (Ontario Federation of Agriculture, 1995).

Initiatives such as the Land Stewardship Program, funded by the Ontario Ministry of Agriculture, Food and Rural Affairs, and the National Soil Conservation program, funded by Agriculture Canada, encourage sustainable farming practices. In addition, the Environmental Farm Coalition has developed the Environmental Farm Plan Program to help operators evaluate environmental conditions on their properties. As of 1995, over 5,000 farmers in Ontario have taken part in the Environmental Farm Plan process. Other initiatives such as the Rural Clean Water Program, which is administered by the TRCA, are available to assist farmers in mitigating the effects of their activities. Since 1995, three Rural Clean Water Program projects have been carried out in the Etobicoke Creek watershed. These included a septic system repair, a manure management project, and a field and streambank erosion project. These projects were undertaken in the Town of Caledon.

Although progress has been made in sustaining soil resources, agricultural processes can still affect the natural environment. Excessive applications of pesticides, fertilizers, and manure can contaminate ground and surface waters with nitrates, phosphates, and bacteria. In addition, underground tile drainage and irrigation can alter the normal seasonal pattern of water flow in streams and rivers.

6.2 AGGREGATE EXTRACTION

In the past, extraction was an important industry, as demonstrated by Loafer's and Professor's Lakes, which are rehabilitated sand and gravel pits. Today, although aggregate extraction continues within the Etobicoke Creek watershed, the economic importance of this activity has diminished.

The Brampton Esker is an important feature in the Etobicoke Creek watershed (see Map 6, Chapter 8). It has been used for years as a source of aggregates for the Brampton area. Many of the waterbodies on this landform were formed by mining. Mining of the sand and gravel resources is expected to continue in parts of the esker for another 15 to 20 years (Knox Martin Kretch Ltd., 1992).

In recent years, urban development has proceeded on the esker and the lands adjacent to it. At least 37 percent of the esker is currently covered by urban development. This development will continue around Esker Lakes North and South, both of which were formed by mining. Currently, there is only one active pit on the Brampton Esker, located west of Highway 410 and south of Bovaird Drive (Esker Lake South).

Extraction operations may negatively impact quality of life. They are aesthetically displeasing and can create significant amounts of dust, odour, and noise. However, after extraction operations cease, operators are required under the Ontario *Aggregate Resources Act*, to rehabilitate the pits. Rehabilitation can provide an opportunity to enhance the community. For example, the rehabilitation of Loafer's Lake has created opportunities for outdoor recreation. Old pits may also be rehabilitated to provide habitat for fish and wildlife.

The extraction occurring within the Etobicoke Creek watershed may affect groundwater. Sands and gravels perform extremely important functions within the hydrologic cycle. First, sand and gravel hold water and act as reservoirs for groundwater. Second, sand and gravel act as natural filters which purify water as it percolates through the ground. Once these aggregate resources are depleted, they cannot be restored and these critical hydrologic functions cannot be performed. This in turn can impact rivers and streams that are fed by groundwater. These concerns are relevant within the Etobicoke Creek watershed because the Brampton Esker has been recognized as an important groundwater resource and an excellent aquifer for well water supplies, including some municipal wells (Knox Martin Kretch Ltd., 1992). Further, the esker is located within the headwater area of Spring Creek, and extraction activities may have affected baseflow. However, more study and monitoring water levels in and around the active extraction operations would need to be undertaken to determine the impact of these operations on groundwater and potential baseflow.

Professor's Lake: a rehabilitated pit in the City of Brampton

6.3 FORESTRY

Although vast tracts of forests once covered the Etobicoke and Mimico Creek watersheds, clearing the land for agriculture and urban development has resulted in a dramatic reduction in forest cover. Today, only 4.3 percent of the Etobicoke Creek watershed and 1.7 percent of the Mimico Creek watershed is covered by forest (Map 22, Chapter 10). The majority of forests within the Etobicoke Creek watershed are located in the Town of Caledon and northern Brampton, with the largest area located around Heart Lake Conservation Area. Remaining forested lands within the Mimico Creek watershed are usually located in the valley and stream corridors.

As an economic activity, the contribution of forestry to the prosperity of the watersheds is limited by the lack of forested areas. However, forestry occurs at the Heart Lake Conservation Area. Forested lands owned by the TRCA are actively managed using a sustainable approach. Trees harvested under forest management programs are commercially sold for firewood, lumber, veneer, and other things. The most recent forest management at Heart Lake occurred in 1990-91 and included the management of 8.6 hectares. Revenues from the sale of wood products were used to offset costs associated with management operations.

Reforestation efforts are important on conservation authority property. The TRCA has a tree planting program designed to enhance the forest cover on both public and private lands. From 1958 to 1980, TRCA staff planted 107, 925 seedlings in the Heart Lake area, equalling the reforestation of approximately 43 hectares of land. Reforestation has continued in this area with support from the community. For example, the Terry Fox Public School, has been planting 1,000 seedlings per year since 1994, reforesting approximately 0.4 hectares. Reforestation efforts by the Brampton Scouts at the Snelgrove Resource Management Tract have resulted in the planting of approximately 20,100 seedlings, reforesting approximately eight hectares (D. Rogalsky pers.comm., 1997).

SUMMARY

Resource-based land uses, such as agriculture, aggregate extraction, and forestry can affect the quality of life within a community. They are often aesthetically displeasing, or can cause odour, noise, or health concerns. While these industries have historically contributed to the prosperity of the Etobicoke and Mimico Creek watersheds, their economic importance has declined, largely because of resource depletion or competition between uses of the resource. The depletion of these forest, aggregate, and soil resources has contributed to the poor environmental condition of the watersheds. However, increased use of sustainable farming practices, rehabilitation of pits for wildlife habitat or recreational purposes, and sustainable forestry programs, can help reduce the impact of these activities on the watersheds.

Natural Heritage includes the physical, chemical, and biological elements of the environment--what is often termed “Nature” or the “Environment.” A **Natural Heritage System** refers to the interactions and dependencies between and among the physical, chemical, and biological elements of natural heritage. It is these interactions that control the hydrologic cycle and the quality of habitat for plants, animals, birds, and fish.

The concept of natural heritage has frequently been used with initiatives to conserve natural areas, species, and ecosystems at risk (Riley and Mohr, 1994). However, this approach to natural heritage is narrow since it focuses on *landscape features*, such as woodlots and wetlands, and neglects the many interactions that occur within the entire *landscape system*. A broader approach is to recognize that the features and functions of the natural heritage system are present, throughout the Etobicoke and Mimico Creek watersheds, in a continuum of condition from the nature dominated (e.g., woodlots and wetlands) to the human dominated (e.g., urban and rural) landscapes. Urbanized ecosystems consist of natural features and built structures and function differently than more natural (and often rural) landscapes in the way they cycle water, air, and nutrients.

NATURAL HERITAGE

In this report, natural heritage[10] has been defined as the basic fabric of the landscape and thus is synonymous with environment. From this perspective, natural processes and nature are present everywhere. Specific locations differ only in the way they function within the overall system. Viewing the landscape in this way allows management activities to focus on the important interactions within and between landscape features.

The natural heritage system can be described in terms of four components:

- *Air* including climate and air quality;
- *Water* including surface and ground;
- *Land* including landforms, soils, and geology; and
- *Life* including all living things such as plants, animals, and insects.

Characterizing natural heritage in terms of these four components provides a framework for describing natural features. More importantly, it allows for description and analysis of the many interactions and interrelationships between components in the natural heritage system.

Climate, along with the form and composition of the land, are the driving forces that, in combination with society's influence, have determined the features and functions that are found within the watersheds today. Individual features include woodlands, wetlands, watercourses, valleys, and aquifers. It is the interaction between the many features in the watersheds that begins to define the functions that are performed.

The functions performed by the features in the watersheds vary from simple to complex interactions. For example, a woodlot can function as a habitat for many birds, mammals, and amphibians, but it also performs more complex functions by influencing the characteristics of surface runoff. In turn, the runoff characteristics affect the characteristics of local watercourses and thus fish habitat. The woodlot not only functions by directly providing habitat for specific species, but indirectly influences the characteristics of aquatic habitats.

There are far more interrelationships within the natural heritage system than can be described in this report. However, through knowledge of the interactions within the natural heritage system, an understanding of how the system functions can be gained and direction can be developed as to what might be achieved through regeneration activities. This part of the report provides a framework to begin developing knowledge and an understanding of the natural heritage system. In the four chapters that follow, the condition of the watersheds is described in terms of the four components of the natural heritage system.

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[10] This discussion of natural heritage and the natural heritage system is based largely on work of the Humber Watershed Task Force and documented in *Natural Heritage of the Humber River Watershed: Strategies for the Protection and Enhancement of the Natural Heritage System* (1996c).

AIR

CHAPTER 7

The composition of the earth's atmosphere provides the conditions necessary to support all plant and animal life, maintain surface temperatures, and protect the earth. In watershed planning and management, climate and air quality are important to consider as they are affected by and, in turn, affect land use and human activities. Changes in climate can affect the quantity of water in river systems and the viability of some economic operations such as agriculture. Changes in air quality can affect water quality, vegetation, and the health of humans and wildlife.

7.1 CLIMATE

Climate is a major force shaping the natural heritage system of the Etobicoke and Mimico Creek watersheds. Climate is the long-term average weather condition for a geographic area. Elements of climate include solar radiation, temperature, precipitation, humidity, and wind. These elements affect vegetation communities, wildlife, the hydrologic cycle, and some recreational and economic activities. There is increasing concern over the influence humans have on climate, both globally and locally.

The Etobicoke and Mimico Creek watersheds encompass two ecoclimatic regions--broad areas on the earth's surface characterized by distinctive ecological responses to climate. The northern parts of the watersheds fall within the Humid Mid-Cool Temperate Ecoclimatic Region and the southern portions are within the Humid High-Moderate Temperate Ecoclimatic Region (Environment Canada, 1989). By mapping these two regions, a transition zone with moderated characteristics of each region is apparent. Typically, the difference between these regions is a slightly longer growing season, more precipitation, and warmer summers in the southern areas.

The climate of the Etobicoke and Mimico Creek watersheds supports distinctive vegetation types and covers which support wildlife by creating habitat. Seasonal variations in temperature and precipitation impact the hydrologic cycle by changing water quantity and temperature in watercourses which affects aquatic habitat. In terms of human activities, variations in climate make a variety of outdoor recreation activities possible, for example, boating at Heart Lake Conservation Area and cycling along the Waterfront Trail in the warmer seasons. Ice skating and tobogganing are two activities that may be enjoyed in the winter months.

Agriculture is possible in the headwater areas of the Etobicoke Creek watershed because of the region's climate. Rainfall, relative humidity, and frost-free periods influence the amount of water that filters through the soil. The temperature of the region influences the speed of the chemical reactions within soils.

The climatic regions that the Etobicoke and Mimico Creek watersheds lie within are characterized by moderate winters, warm summers, and sufficient rainfall to allow the growth of farm crops (MAFRA, 1997). The Etobicoke Creek watershed supports field, fruit, and vegetable crops as well as livestock and poultry farming. However, changes in weather conditions from global climate change could alter temperature and precipitation patterns. This in turn could affect crop yields and the type of species able to grow in the Etobicoke Creek watershed.

Climate Change

The greenhouse effect is a natural process, without which global average temperatures would be too low to sustain life. Greenhouse gases (e.g., water vapour, carbon dioxide, nitrous oxide, and methane) "trap" heat in the atmosphere and warm the earth. The problem is that greenhouse gases are increasing in the atmosphere largely because of human activities. The increases are enhancing the greenhouse effect and trapping more heat (Scheraga, 1998).

Changes in global climate due to human activities is a controversial and intriguing issue. Current research indicates that atmospheric concentrations of carbon dioxide (CO_2) are expected to double by the year 2060. This doubling is relative to levels prior to the Industrial Revolution, before the beginning of major fossil fuel use (Scheraga, 1998).

Much of the controversy surrounding climate change is related to our ability to reduce or eliminate the impacts of increasing levels of carbon dioxide in the atmosphere. It is argued that even with the best efforts of Canada, the United States and other major emitters of greenhouse gases to reduce CO_2 loadings, the doubling of concentrations in the atmosphere will occur regardless. This is because an increasing share of emissions are originating in developing countries (Scheraga, 1998). Efforts to reduce loadings must ensure CO_2 is not increased beyond the anticipated levels (i.e. greater than a doubling of CO_2).

Given the premise that CO_2 concentrations will double, Environment Canada has been involved in modelling to predict anticipated climate changes at the global, national, and local levels. Several studies related to Ontario and the Great Lakes Basin have been completed. As well, Environment Canada has initiated and undertaken studies, workshops, and seminars regarding adaptation to the impacts of this scenario.

Doubling the amount of CO_2, and increases in other greenhouse gases, will result in the earth's atmosphere trapping a higher percentage of the sun's incoming solar radiation. This will increase the earth's overall mean temperature and allow for a greater amount of water vapour to remain in a gaseous state.

The ability of the atmosphere to contain higher amounts of water vapour will affect the functioning of the hydrologic cycle and directly affect the Great Lakes and the rivers within the TRCA's jurisdiction. The anticipated impacts include lower baseflows within rivers and streams, lower lake levels, longer more severe drought periods, milder winters, and a change in precipitation patterns resulting in more intense rainfalls. These anticipated changes would affect the management of water and other natural heritage resources.

Within the TRCA's jurisdiction, the potential implications of climate change could affect watershed management in a number of ways, including the following:

- Fisheries management may be affected due to temperature changes and lower baseflows within rivers and streams;
- More intense rainfalls may result in more frequent flooding events on rivers and an increase in street and basement flooding;
- Milder winters may result in more mid-winter snow melts which have the potential to create more frequent flooding and greater amounts of streambank erosion;
- A reduction in the water levels of the Great Lakes may impact erosion and flooding along shorelines and affect wetlands, fisheries, and human use of the shoreline; and
- Forest ecosystems are expected to shift northward. Species currently threatened with extinction would be at greatest risk, while opportunities for successful establishment of exotic species would be enhanced.

Climate change is a global issue and requires international cooperation and action. However, there are actions at the local level that can play a role in reducing greenhouse gas emissions. It is very likely that vehicle, industrial, and residential emissions from within the Etobicoke and Mimico Creek watersheds are contributing to the problem of climate change. Government leadership and public education on local climate change issues are two strategies important for motivating behavioural change leading to a reduction in emissions. Another potential local action is tree planting, as trees take carbon dioxide out of the air and convert it to plant tissue.

While we may not be able to reverse the trend and potential impacts of a doubling of CO_2 in the atmosphere, we can adapt to some of its impacts. The Authority and the future task force for the Etobicoke and Mimico Creek watersheds are in a unique position to incorporate techniques into the watershed management strategy process that allow for adaptive management. For example, planting species of trees and shrubs that will likely be able to adapt to climate change when carrying out regeneration projects. As well, most of the TRCA's current policies and regulations recognise the impacts of natural processes; thus, the Authority is in a position to at least partially adapt to the response of our rivers and streams to climate change.

Local Climate

Distinctive natural features in and around the Etobicoke and Mimico Creek watersheds can create micro-climates which may affect the natural heritage system. Lake Ontario, which is one of the largest natural features, has a moderating effect on climate.

Landforms can also affect micro-climates. For example, south facing valley slopes are drier, less shaded, and warmer than north facing slopes. Since the Etobicoke and Mimico Creek watersheds are located at the northern extent of the Carolinian Forest Region, south facing slopes and flat lands tend to support more Carolinian vegetation. Carolinian vegetation is not likely to be found on cooler, more moist, north facing slopes. In these ways, landscape features influence local climate which in turn influences other components of the natural heritage system.

Urban development in the watersheds may also affect climate at the local level. Urbanization alters the earth's surface and its ability to absorb and reflect sunlight as well as release heat. In addition, due to large amounts of impervious surfaces, urban development can influence local climate through, for example, reducing evaporation as rainfall is quickly drained away.

Extensive urban development may create an "urban heat island" which is thought to be caused by heat from buildings and vehicles combined with increased heat retention by paved, stone, and concrete surfaces. This results in warmer temperatures in summer and winter which can affect vegetation communities and the hydrologic cycle by causing more precipitation in winter to occur as rainfall.

In general, the climate in urban areas is harder on human health. For example, in the summer, heat stress is typically more pronounced due to higher than average temperatures combined with increased pollutant levels. This can severely affect the health of elderly people and those with respiratory problems, making outdoor activity difficult.

Figures 3 and 4 provide a summary of the temperature and precipitation patterns in the Etobicoke and Mimico Creek watersheds. Measurements were taken by Environment Canada near the southern end of the watersheds (Toronto) and in the middle of the watersheds at Pearson Airport. Precipitation is measured in the headwater area of Spring Creek at Heart Lake.

The figures illustrate that in the southern area, near the mouths of the creeks, the temperature is slightly warmer year-round and there is more precipitation in the colder months than there is in the northern portion of the watersheds. This difference is recognized by the distinction of Ecoclimatic Regions. The Humid High-Moderate Temperate Ecoclimatic Region, in the southern portions, is likely moderated due to the presence of Lake Ontario and the greater extent of urbanization in the lower portions of the watersheds.

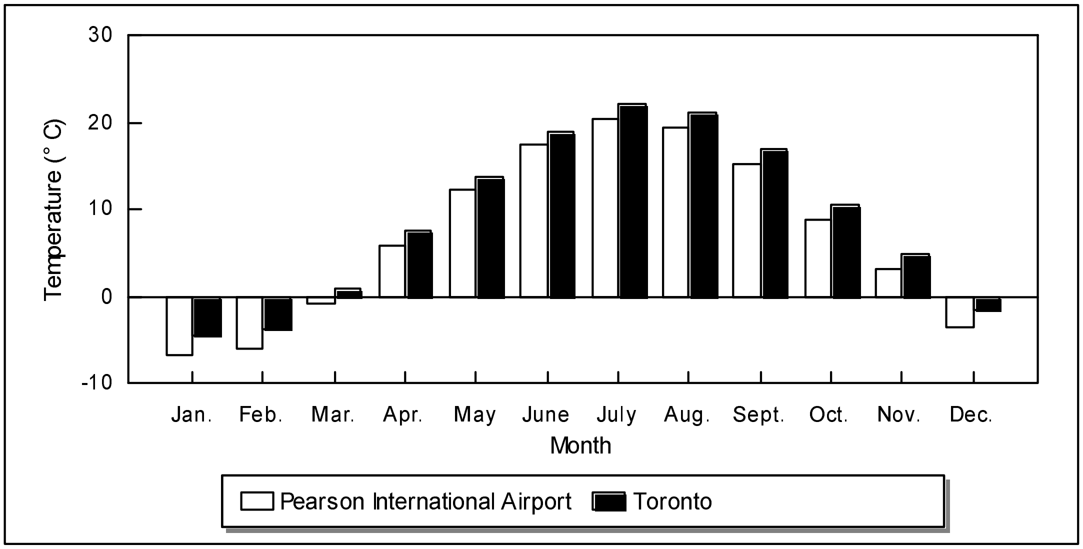

Figure 3: Etobicoke and Mimico Watersheds Monthly Mean Temperatures, 1961 - 1990

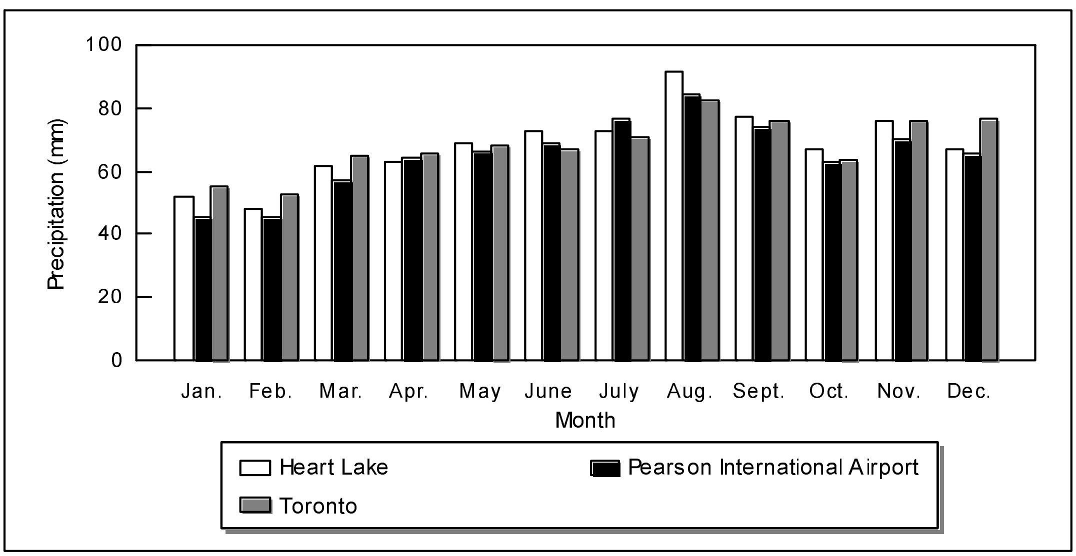

Figure 4: Etobicoke and Mimico Creek Watersheds Monthly Mean Precipitation, 1961 - 1990

Source: Environment Canada. 1993. *Canadian Climate Normals, 1961-1990. Ottawa: Minister of Supply and Services Canada.*

Note: Temperature information is not available for Heart Lake. Climate normals are calculated over a standard thirty year period.

7.2 AIR QUALITY

Air quality affects other components of the natural heritage system. Impaired air quality can result in the deposition of pollutants on land and can affect water quality, soils, vegetation, and the health of humans and wildlife. For example, it has been estimated that between 40 to 50 percent of the toxic pollutants in Lake Ontario are from the airborne deposition of toxic chemicals (Ashworth, 1986).

Sources of air pollution are numerous, particularly within urban centres. Potential sources include emissions from vehicles and industry. While local sources of pollutants are of concern, more than half of Ontario's ground-level ozone can be attributed to transboundary pollution from the United States (MOEE, 1997).

Jurisdictional responsibility for air quality is divided between the federal and provincial governments, with the Ontario Ministry of the Environment monitoring air quality to determine the concentration of selected pollutants (Box 1). Municipalities affect air quality through their land use and transportation policies and practices.

Overall, data from the Ontario Ministry of the Environment's Air Quality Index (AQI) indicates that for the majority of the time, air quality within and near the Etobicoke and Mimico Creek watersheds is Very Good or Good (Figure 5). In 1995, air quality monitoring stations within or near the watersheds reported the following:

- Very Good conditions about 70 percent of the time;
- Between 25-30 percent of the time, air quality was in the range of Good;
- Less than five percent of the time air quality was in the Moderate range; and
- Less than one percent of the time was air quality in the Poor range.

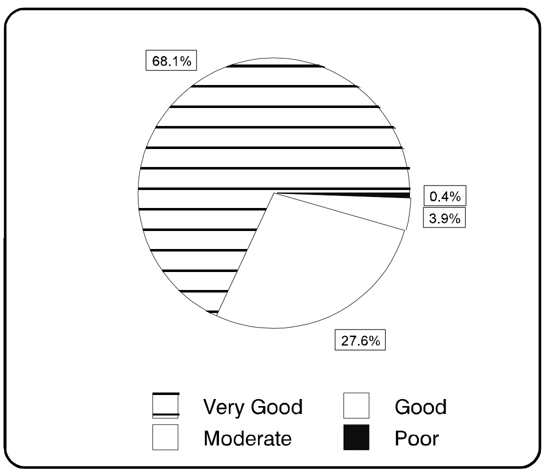

Figure 5: Etobicoke and Mimico Creek Watersheds, 1995 Air Quality Index

Source: MOEE, 1997.
Note: Percentage represents an average of Etobicoke West and South monitoring stations.

In the watersheds, ground-level ozone and suspended particulate levels have been the primary causes for Moderate (greater than 31) AQI readings. Ground-level ozone at the moderate level is injurious to many species of vegetation while moderate levels of suspended particles may cause reduced visibility. Table 7.1 provides further details on the sources and effects of these pollutants.

BOX 1: AMBIENT AIR MONITORING

The Ontario Ministry of the Environment's Air Quality Information System (AQUIS) is a large database containing air pollution measurements. The AQUIS data is used to monitor pollutant concentrations throughout Ontario. Data are divided into two major groupings: continuous (1-hour) and daily (24-hour) measurements.

The measurements gathered by AQUIS are used to calculate The Air Quality Index (AQI). Operating since 1988, the AQI measures six common air pollutants which affect human health and the environment: sulphur dioxide (SO_2), ozone (O_3), nitrogen dioxide (NO_2), total reduced sulphur compounds (TRS), carbon monoxide (CO), and suspended particles (SP). The Air Quality Index is measured at 29 sites in 24 of Ontario's urban centres. The AQI is categorized into five levels:

AQI Categories

0-15	16-31	32-49	50-99	100+
Very Good	Good	Moderate	Poor	Very Poor

Since 1993, Environment Canada and the Ontario Ministry of the Environment have been issuing air quality advisories to the public when elevated air pollution levels due to ground-level ozone were forecast. This program helps to increase public awareness of air quality and human health issues and encourages pollution prevention.

The Air Pollution Index (API), based on 24-hour running averages of sulphur dioxide (SO_2) and suspended particles (SP), is included as a AQI sub-index. Not all pollutants are measured at each AQI site. Research studies have linked respiratory illness to elevated concentrations of SO_2 and particulates. API advisories were introduced to southern Ontario in 1993. The API is used as the basis of an alert and control system to warn of deteriorating air quality. When air pollution levels reach a value of 32 and are expected to persist for at least six hours, an Air Pollution Advisory is issued. Regulation 346 under the *Ontario Environmental Protection Act* (1971) authorizes the Minister of the Environment for Ontario to order any point source of air pollution that is not essential to public health or safety to curtail or cease its operation. During an advisory, the public is encouraged to limit activities that contribute to air pollution, for example, unnecessary car trips and using gas-powered lawn mowers. People with respiratory problems are encouraged to limit outdoor activities.

Source: MOEE.1997: *Air Quality in Ontario: 25 Years of Environmental Achievement*. Toronto, Ontario: Queens

TABLE 7.1: Pollutants that Frequently Exceeded the Ontario Ambient Air Quality Criteria in 1995

POLLUTANT	SOURCES	EFFECTS
OZONE (O_3)	It is a colourless gas produced by photochemical reaction between nitrogen oxides, volatile organic compounds (typically emitted from internal combustion engines) and air in the presence of sunlight. Ozone is not directly emitted into the atmosphere in significant amounts. Ozone is formed downwind of these sources and is capable of travelling long distances. A large portion (over 50 percent or greater) of the ground-level ozone concentrations found in Ontario can be attributed to long range transport of ozone and its precursors from industrial states south of the Great Lakes. High levels generally occur from May to September between noon and early evening. In Ontario, the highest concentrations of ozone are recorded on hot and sunny summer days. Ground-level ozone pollution is a primary component of smog.	Human: Ozone is a pulmonary irritant that affects the respiratory mucus membranes, other lung tissues, and respiratory functions. Studies have demonstrated that ozone impairs the normal function of the lungs, causing alterations in respiration rates, the most characteristic being shallow, rapid breathing. People with respiratory and heart problems are at higher risk. Exposure may result in chest tightness, coughing, and wheezing. Vegetation: Injury to vegetation is an early signs of photochemical air pollution. Ozone will generally cause a plant to grow 10 to 40 percent more slowly, age prematurely, lose leaves during its growing season, and produce pollen with a shorter life span (Region of Peel, 1995). Sensitive plants are useful biological indicators of this type of air pollution. Visible signs of injury due to ozone are flecking and leaf discolouration.
TOTAL SUSPENDED PARTICULATES (TSP) **SUSPENDED PARTICULATES (SP)**	TSP is a generic term for airborne particles including aerosols, smoke, fumes, dust, fly ash, and pollen. The composition varies but normally includes soil particulate, organic matter, sulphur and nitrogen compounds and metals such as lead, carbon, or higher hydrocarbons formed by incomplete combustion of hydrocarbon fuels. Size range varies from 0.1 to 100 microns. SP is a relative measure of suspended particulate matter in the atmosphere most likely to reach the lungs (diameter generally less than 10 microns, PM_{10}). These have the greatest effect on health. Particulate matter is emitted from industrial processes including combustion, incineration, construction, mining, metal smelting and processing. In the urban airshed, motor vehicle exhaust, and road dust are major sources of particulate emissions. Natural sources of particulate matter include windblown soil, forest fires, ocean spray, and volcanic activities.	Human: The greatest impact on health is from particles less than 10 microns in diameter which can penetrate deep into the lungs and can aggravate bronchitis, asthma, and other respiratory diseases. More serious health effects may be associated with suspended particulate matter which contains a toxic particulate component or which has adsorbed a gaseous pollutant on the surface of the particles. Other effects: Corrosion, soiling of materials, damage to vegetation, and visibility reduction are additional effects.

Unless otherwise noted, Table 7.1 is adapted from MOEE, 1997.

These findings for the Etobicoke and Mimico Creek watersheds are consistent with findings throughout the province. Ground-level ozone is the pollutant which exceeded the provincial air quality criterion most often. More than 50 percent of Ontario's ozone levels are due to the long range transport of ozone and its precursors, particularly from the high emission areas of the United States to the south or west of Ontario (MOEE, 1997). The environmental effects of inhalable particulate matter is a growing concern as numerous recent studies have linked particulates with significant human health problems (MOEE, 1997). Table 7.2 summarizes the AQI for the sites within and around the watersheds.

TABLE 7.2: 1995 Air Quality Index Summary for Sites in and Near the Etobicoke and Mimico Creek Watersheds

Station Name	# of Hours Pollutant Responsible for AQI >31	
	Suspended Particulates	Ozone
Etobicoke West (Elmcrest Road) [a]	34	221
Etobicoke South (Evans Ave. and Arnold Ave.) [b]	66	416

a - located in the Etobicoke Creek Watershed
b - located between the Etobicoke and Mimico Creek Watersheds
Source: Table adapted from MOEE. 1997. *1995, Air Quality in Ontario: 25 Years of Environmental Achievement.*

The API measures 24 running averages of sulphur dioxide (SO_2) and suspended particulates and is used as the basis for issuing an Air Pollution Advisory. Table 7.3 illustrates the number of occasions in which API exceeded 31 at sites within or near the Etobicoke and Mimico Creek watersheds and an Air Pollution Advisory was issued. Research studies have linked respiratory illness to elevated concentrations of SO_2 and particulates.

TABLE 7.3: Number of Instances an Air Pollution Advisory was Issued, Etobicoke and Mimico Creek Watershed Sites (1988-1995)

STATION	1988	1989	1990	1991	1992	1993	1994	1995
Etobicoke West [a]	1	0	0	0	0	0	2	0
Etobicoke South [b]	0	2	0	0	0	0	1	1

a- located within the Etobicoke Creek watershed b- station located between the watersheds
Source: MOEE. 1997. *Air Quality in Ontario, 1995*. Toronto: Queen's Printer for Ontario.

Motor vehicles are significant contributors to air pollution within the Etobicoke and Mimico Creek watersheds. Automobile exhaust is composed of five major pollutants: hydrocarbons (HC) including volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxides (NO_x), carbon dioxide (CO_2), and suspended particles (SP). Figures from 1987 show that vehicles were the largest source of CO, the second largest source of NO_x, and a significant source of particulate pollution in the Region of Peel (Region of Peel, 1995). Figures for the City of Toronto from 1987 were similar. It was found that the transportation sector was the largest source of NO_x and CO pollution in the City of Toronto and a significant source for SO_2, VOCs, and particulate matter emissions (Metro Toronto, 1995).[10]

The highest emission levels occur along the major transportation routes: Highways 401, 403, 410, 427, and the Queen Elizabeth Way (QEW). The morning rush hour in Peel represents the largest release of vehicle emissions during the day. The highest vehicle emissions in the Region of Peel occur south of the Lester B. Pearson International Airport on Highway 401 and along the QEW in south-east Mississauga. In these areas, eastbound traffic becomes congested in the morning which increases vehicle emissions (Region of Peel, 1995). This indicates that air quality in the southern portions of the Etobicoke and Mimico Creek watersheds may be worse than that found in the north.

Lester B. Pearson International Airport also affects air quality within the watersheds. Aircraft emissions include carbon dioxide, carbon monoxide, volatile organic compounds, nitrogen oxides, and particulates. Thus, aircraft emissions may contribute to climate change and be sources of ground-level ozone.

The industrial, residential, and transportation sectors are largely responsible for particulate pollution within the Etobicoke and Mimico Creek watersheds. In terms of particulate pollution, concentrations of fluoride, lead, total suspended particulate, and total dustfall in the Region of Peel all exceeded the provincial 24 hour criteria at least once in 1991. At 34 percent, industry was found to be the largest producer of Total Suspended Particulates in the Region of Peel, while the residential sector contributed 27 percent (Region of Peel, 1995). In Toronto, the pattern differs, with residential sectors contributing the most particulate matter, and the transportation sector emitting the second largest amount (Municipality of Metropolitan Toronto, 1995).

In addition to these pollution sources, a lack of forest cover in the watersheds contributes to air quality impairment. Plants filter dust, absorb contaminants, and cool air temperatures by providing shade. This shading may reduce the production of ground-level ozone.

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10 For Toronto, figures for the transportation sector are from 1987 and include off-highway engines, railroad, aircraft, and marine sources. However, road vehicles (cars, buses, trucks, motorcycles) are the primary contributor to transportation-related pollutant emissions (Metro Toronto, 1995).

As air quality has only been measured within urban areas, data is lacking on air quality in the rural headwaters of the Etobicoke Creek watershed. Since the headwaters in the Town of Caledon are surrounded by agricultural land use and there are more vegetated areas and fewer roads, air quality could be better than in the lower, more urban reaches of the watersheds. However, this cannot be assumed. The precursors of ozone travel long distances and urban locations, because of the scavenging of ozone by nitric oxide and other pollutants, often record lower annual levels of ozone than rural locations (MOEE, 1997). Thus, it is difficult to determine the quality of air in rural locations within the Etobicoke Creek watershed. Air quality in the Mimico Creek watershed is likely more consistent because the watershed is urbanized throughout.

SUMMARY

The climate of the Etobicoke and Mimico Creek watersheds affects vegetation communities, wildlife, the hydrologic cycle, and other components of the natural heritage system. Within the watersheds, global climate change could have implications for a number of watershed management activities including fisheries and forest management and flood and erosion control. The Authority and the future task force for the watersheds are in a unique position to recognize and incorporate techniques into the watershed management strategy process that allow for adaptive management. For example, when carrying out regeneration projects, planting species of trees and shrubs that will likely be able to adapt to climate change.

In terms of micro-climate, the extensive urban development in the watersheds may be affecting the local climate through contributing to the “urban heat island” effect. In turn, these changes may influence air quality as well as the health of humans, vegetation communities, and wildlife.

Air quality within the Etobicoke and Mimico Creek watersheds is very good the majority of the time. However, particulate pollutants and ground-level ozone exceed provincial air quality standards on a number of occasions, particularly in the summer months. Impaired air quality is largely a consequence of vehicle, industrial, and residential emissions, with a large amount of ground-level ozone and its precursors originating from outside of the watersheds.

LAND

CHAPTER 8

Land provides the foundation for the landscape. Characteristics of the land such as soil permeability and topography, along with climate, influence the functioning of the hydrologic cycle and habitats for living things. Land, through the mineral content of rocks and soils, may also influence water chemistry.


The South Slope in the Town of Caledon

Physiographic regions are areas defined by similar topography, soils, and geology. The Wisconsin glacial period, which ended about 11,000 years ago, was influential in forming the physiographic regions and landform features currently found in the Etobicoke and Mimico Creek watersheds.

Within the watersheds, there are three distinct physiographic regions that provide the basis for the composition and form of the watersheds' landforms: the South Slope, the Peel Plain, and the Iroquois Plain. These plains lend character to the watersheds and play an important role in the natural heritage system. The discussion in this section focuses on major landform features found in the watersheds: plains, eskers, and valley and stream corridors (Map 6).

8.1 PLAINS

The plains in the Etobicoke and Mimico Creek watersheds are characterized by flat to gently sloping topography. Fine clay soils are found on the Peel Plain. Sands, gravels, and clays are found on the South Slope and Iroquois Plain.

8.1.1 South Slope

The South Slope is a till plain that was formed by retreating glaciers. As Map 6 shows, there are three distinct areas of the South Slope within the watersheds.

- The upper region is the southern slope of the Oak Ridges Moraine[12] and is bounded on the south by the Peel Plain. The surficial geology in this area is primarily young till, deposited 22,000 to 13,000 years ago. Within the Town of Caledon, the surface is mostly a ground moraine of limited relief (Chapman and Putnam, 1984). The headwaters of the main branches of the Etobicoke and Spring Creeks originate within this upper region. The headwaters of Mimico Creek's main branch are also located on the South Slope.

- The middle region is bounded on the north by the Peel Plain and on the south by the Iroquois Plain. The surficial geology in the middle region is also primarily young till.

- The lower region, or "Old" South Slope, is located between the Iroquois Plain and Lake Ontario. The surficial geology in this region is primarily older till that was deposited by retreating glaciers 50,000 to 22,000 years ago. Within the Cities of Toronto and Mississauga, it is characterized by ground moraine with irregular knobs and hollows (Chapman and Putman, 1984).

The South Slope has moderate permeability. Meltwaters and precipitation soak into the ground and the water is stored within aquifers. The shallow aquifers tend to discharge locally as coldwater springs or seepages which may contribute to the baseflow of watercourses. There are several aquifers present within the upper section of the South Slope of the Etobicoke Creek watershed (see Map 7 in Chapter 9). While these aquifers are not large enough to support a municipal well, there are private wells which provide water to rural residents. However, as communities grow, many new subdivisions are receiving their water supply via the South Peel Water Distribution System.

Historically, the South Slope was important economically for its soils which were excellent for agriculture. Today, only the uppermost portion of the South Slope, in the Town of Caledon, is used for this purpose. Aggregate extraction was also an important economic activity on the South Slope as evidenced by Professor's Lake and Loafer's Lake, both of which are former gravel pits in the City of Brampton. Currently, extraction activities are occurring on the Brampton Esker, located within the Etobicoke Creek watershed.

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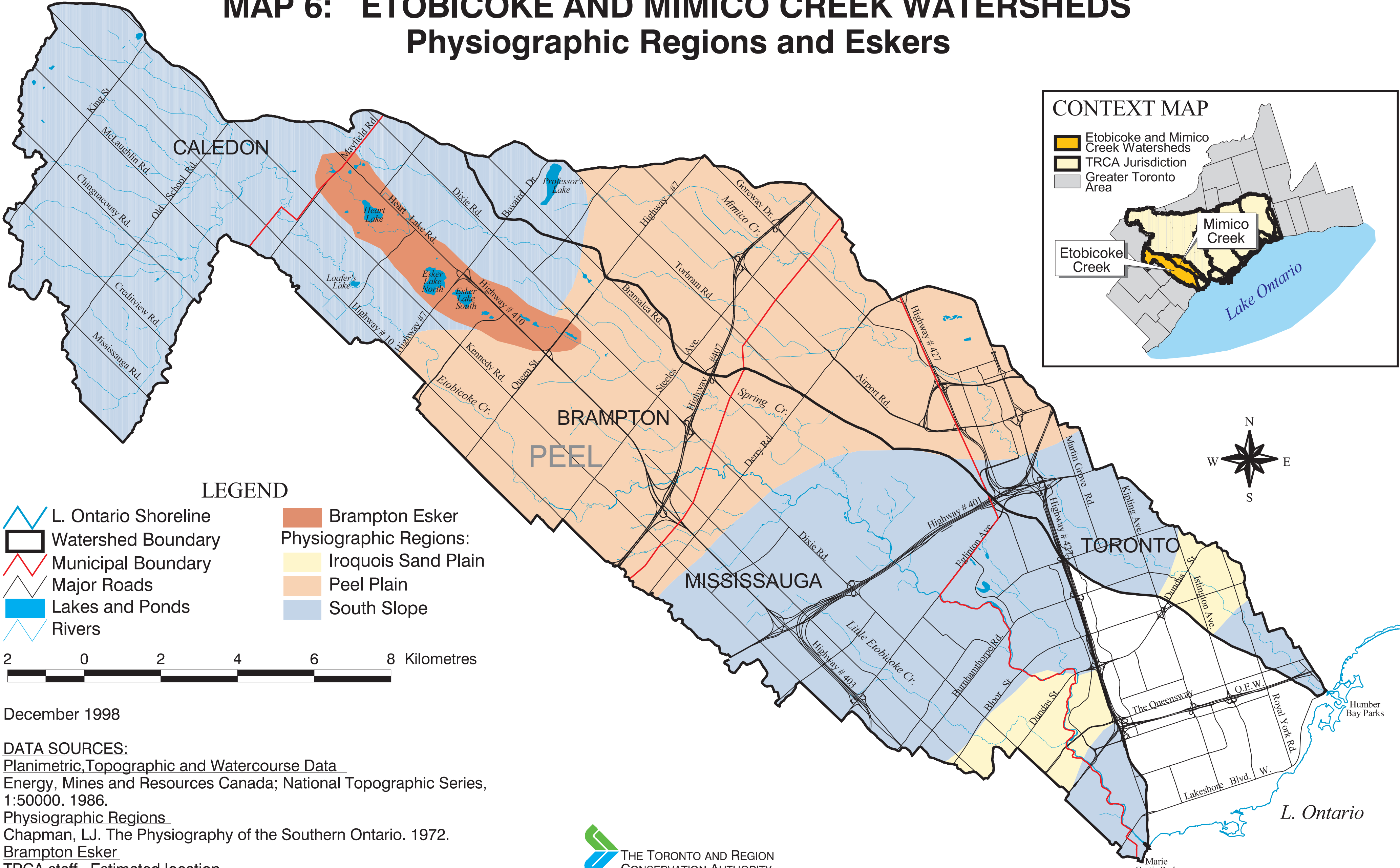
12 The Oak Ridges Moraine was formed between 22,000 and 13,000 years ago when two converging ice lobes receded, one toward what is now Lake Ontario and the other toward what is currently Lake Simcoe. As these sheets of ice melted, sand and gravel were deposited on the bedrock between them forming the interlobate Oak Ridges Moraine.

MAP 6: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Physiographic Regions and Eskers



December 1998

DATA SOURCES:

Planimetric,Topographic and Watercourse Data

Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Physiographic Regions

Chapman, LJ. The Physiography of the Southern Ontario. 1972.

Brampton Esker

TRCA staff. Estimated location.

THE TORONTO AND REGION CONSERVATION AUTHORITY

Within the watersheds, the middle and lower sections of the South Slope are completely urbanized and dominated by residential, commercial, and industrial land uses. These are the older areas of the Cities of Toronto and Mississauga.

8.1.2 Peel Plain

The Peel Plain is a level-to-undulating tract of clay soils. Although there are some well-drained soils within the Peel Plain, the dominant soil is the fine and less well drained Peel Clay (Chapman and Putnam, 1984). This means infiltration is low and groundwater supply is limited as more precipitation ponds on the surface, or is lost through evaporation or surface runoff. Major watercourses, including Etobicoke Creek, have cut well defined valleys in the Peel Plain and provide drainage for this runoff (Chapman and Putnam, 1984).

Historically, the Peel Plain included several large wetland areas within the Etobicoke and Mimico Creek watersheds (Snell, 1989). These wetlands would have been important in the attenuation of flows over the otherwise impermeable Peel Plain soils. These wetlands were found in areas with imperfect drainage and flat slopes, possibly associated with watercourses. Currently, there are no large, natural depressions with standing water on the Peel Plain, although drainage is imperfect in many of the inter-stream areas (Chapman and Putnam, 1984).

Over time, land use on the Peel Plain has changed considerably. The clay soils of the Peel Plain were fertile. In the nineteenth century the forests were cleared so the lands could be used by European settlers for agriculture. However, over the last 50 years or so, much of this agricultural land has been urbanized. Today, most of the Peel Plain is covered with industrial and residential development.

8.1.3 Iroquois Plain

The Iroquois Plain was formed during the stage of glacial retreat that followed the formation of the Peel Plain. About 12,000 years ago, melting glaciers raised water levels in the ancient Lake Iroquois--what is currently known as Lake Ontario. This lake extended to present day Dundas Street, where the ridge of the Lake Iroquois shoreline is found. Within the Etobicoke and Mimico Creek watersheds, this feature is most noticeable in the Kipling Avenue-Dundas Street area, but generally is not easily recognized in the watersheds.

South of the ancient shoreline, Lake Iroquois formed a slightly sloping plain. The soils of the plain are variable, ranging from clays to large deposits of sand and gravel associated with the ancient shoreline and beach bars. In some cases the deposits were mined. The deposits are highly permeable and may contribute baseflow to streams flowing through the area. However, impermeable surfaces, such as asphalt and concrete, have likely impeded infiltration and reduced baseflow discharge to watercourses.

Within the Etobicoke and Mimico Creek watersheds, the Iroquois Plain has been completely urbanized. The valley corridors remain the only significant open space areas. Much of the development occurred before the effects of urban drainage on watercourses or groundwater was considered; thus, small streams that once drained this area have been buried or channelized. The impervious surfaces caused by buildings and roads on the Iroquois Plain limits the amount of precipitation that enters the ground. The result is an increase in surface runoff to streams which may cause erosion, flooding, impaired water quality, or degraded aquatic habitats.

The South Slope, Peel Plain, and Iroquois Plain play an important role in the natural heritage system. For example, the South Slope and Iroquois Plain recharge groundwater and provide baseflow to streams while, historically, the Peel Plain provided wetland habitat. The plains have also provided the basis for prosperity in the watersheds as the Peel Plain's fertile soils were suitable for agriculture, and extraction activities occurred on the South Slope. In the Etobicoke and Mimico Creek watersheds, however, these functions have diminished as extensive urban development has occurred on the plains. The exception is the South Slope in the headwater area of Etobicoke Creek, which remains a rural area.

8.2 ESKERS

An esker is a long, winding ridge of sand and gravel that was deposited by glacial meltwaters which flowed through crevasses and channels within or beneath an ice sheet. The Etobicoke Creek watershed contains the only esker in The Toronto and Region Conservation Authority's jurisdiction.

The Brampton Esker, located in the City of Brampton, extends in a southeasterly direction from around Heart Lake in the north to just south of Queen Street (Map 6). The esker is elongated and linear in shape, approximately eight kilometres long, up to 1.8 kilometres wide, and has a surface relief of 10 to 20 metres. It was formed during the retreat of the Lake Ontario ice lobe from the Brampton area (Gartner Lee and Assoc., 1983). It is composed of coarse glaciofluvial sands and gravels and is capped by a layer of clay till (Morrison Beatty Limited et al., 1983).

The sands and gravels of the Brampton Esker hold and purify water as it percolates downward, making the esker an aquifer and a groundwater resource. The esker also provides a source of water for Spring Creek. In the past, the esker was an excellent aquifer for well water supplies, including municipal wells for the Town of Brampton. In 1972, the municipal well was replaced by the South Peel Water Distribution System which supplies water from Lake Ontario to area residents (MOE, 1976).

Recognizing the esker's important functions, in its Official Plan, the City of Brampton has designated the esker an "Environmentally Sensitive Area," defined as an area with natural features or ecological functions of such significance as to warrant their protection or preservation. These areas may provide ancillary benefit for scientific research, education, or recreation (City of Brampton, 1997). The buried esker has also been designated an earth science Area of Natural and Scientific Interest (ANSI) by the Ontario Ministry of Natural Resources.

In addition to groundwater, the esker is an important source of aggregate. The esker has been mined for many years, and it is expected that extraction will continue on parts of the esker for the next 15 to 20 years (Knox Martin Kretch Ltd., 1992). Currently, there is only one active pit on the Brampton Esker, located west of Highway 410 and south of Bovaird Drive.

The Brampton Esker is scattered with small lakes and ponds, remnants of former gravel pits which have filled in with groundwater. These waterbodies are usually surrounded by residential development or parkland and serve aesthetic or recreational purposes. Presently, planning is under way to develop the land around Esker Lake North and Esker Lake South, primarily for residential purposes.

Despite recognition of the esker's valuable natural functions by the City of Brampton and the Ministry of Natural Resources, these functions may be threatened by continuing urban development and mining activities. Currently, at least 37 percent of the esker is covered by urban development. As urban development continues, more of the esker will be covered by impermeable surfaces which will likely alter its hydrological functions. With regard to the impacts of mining, the Ministry of the Environment reported in 1976 that extensive excavation did not appear to have significantly altered the hydrological characteristics of the aquifer (MOE, 1976). The impact of groundwater extraction has also been studied, but no conclusions have been made on its potential to affect baseflow to streams. It is likely, however, that both development and aggregate extraction on the esker have had negative impacts on groundwater and potential baseflow of the Etobicoke Creek, although further study would be required to confirm the extent of the impacts.

8.3 VALLEY AND STREAM CORRIDORS

Valley and stream corridors are features associated with current and historic river systems. Valley corridors can be visually identified by a distinct physical landform which differs from the surrounding landscape. Stream corridors are generally distinguished by the presence of a watercourse and an associated flood plain, but cannot be visually identified from the surrounding landscape. Thus, valley corridors are distinguished from stream corridors by the presence of a distinct landform.

As natural water collection systems, valley and stream corridors are important components of the natural heritage system. Natural processes influence their form, features, and functions. They are dynamic systems that convey and provide storage of storm and melt waters, and can be important areas for groundwater recharge and discharge. Valley and stream corridors provide many important hydrologic and other ecological functions including the following:

- Conveyance and provision of storage for storm and melt waters;
- Recharge and discharge areas for groundwater;
- Nutrient and sediment transport;
- Provision of fish and wildlife habitat and migration routes;
- Air quality improvement;
- Noise level attenuation;
- Creation of microclimates; and
- Maintaining a genetic pool for native flora and fauna (MTRCA, 1994).

In addition to their environmental benefits, the maintenance and enhancement of valley and stream corridors can provide many recreational and economic benefits. These corridors often provide opportunities for outdoor recreation such as walking, cycling, and other trail related activities. The greenway potential of valley and stream corridors also offers important economic opportunities through, for example, attracting private investment in areas adjacent to these corridors.

Within the Etobicoke and Mimico Creek watersheds, many headwater tributaries and their associated valley and stream corridors have been lost through the filling of valley slopes and flood plains and the piping and channelizing of watercourses. In the past, these activities were frequently practised as these lands were viewed as obstacles to agriculture and urban development. Today, the TRCA regulates the alteration of watercourses, construction in the flood plain, and placing fill within valley and stream corridors, as shown by Map 12 in Chapter 9[13].

Despite historic practices, some valley corridors remain in the watersheds. In the south part of the Mimico Creek watershed, a well formed valley is present. However, upstream of Derry Road, the valley system is very shallow.

Due to the larger size of the Etobicoke Creek watershed and the greater streamflows, the valley systems are more pronounced than those found along Mimico Creek. In the headwater areas, there are several stretches with well defined valley walls and flood plains. The steepest valley walls along Etobicoke Creek are found in the lower part of the watershed, south of Highway 401. Here, the valley walls are nine to 12 metres high and the underlying shale bedrock is exposed.

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[13] See Box 2 for further discussion.

SUMMARY

The landforms discussed in this chapter: the plains, the Brampton Esker, and the valley and stream corridors, are important components of the natural heritage system. Of particular emphasis in this section has been their hydrologic functions and contribution to the movement of water across the landscape, into the ground, and up to the atmosphere. These landforms also provide direct benefits to humans. The plains provide topography and soils suitable for agriculture, the Brampton Esker provides aggregate for development, and valley and stream corridors provide opportunities for outdoor recreation, among other things. However, historic settlement, agriculture, and more recently, extensive urban development, have impacted the functioning of all these landforms. For example, despite the numerous benefits valley and stream corridors provide, filling, burying, piping, and other watercourse alterations have resulted in a loss of these corridors and the associated reduction in terrestrial, riparian, and aquatic habitat; species diversity; natural corridors for the movement of wildlife; and a disruption of the hydrologic cycle.

Shale Valley Wall, Etobicoke Creek Watershed

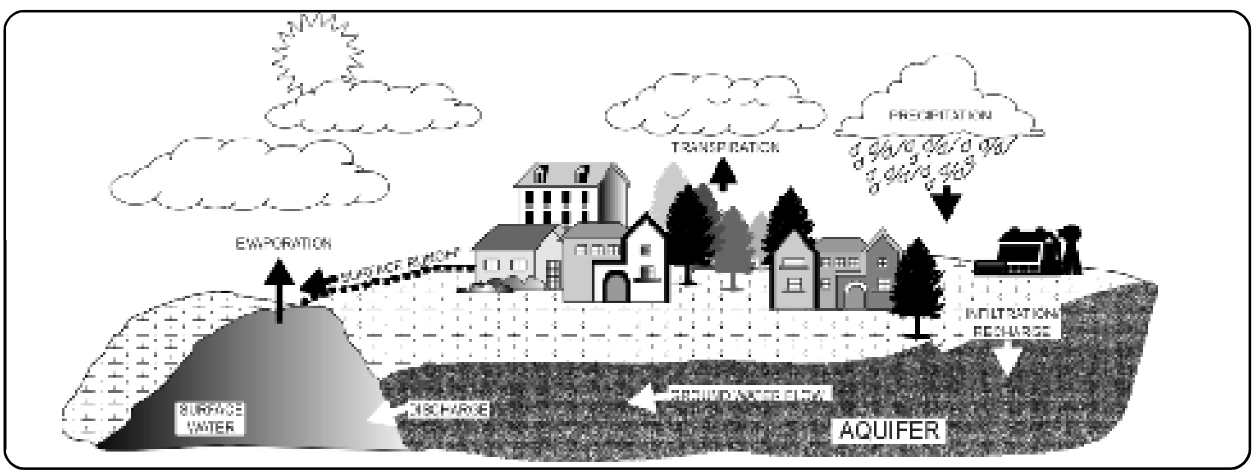
WATER

CHAPTER 9

Water is a vital and integrating component of the natural heritage system, and it is at the heart of watershed management activities. Water is essential for the movement of minerals in the air and through the soil. Water can cause erosion and contribute to other physical processes that shape landforms. It is the constituent of all living things and forms the basis for many habitats. This chapter describes the quantity and quality of surface and groundwater within the watersheds.

The hydrologic cycle describes the movement of water. Water vapour in the atmosphere is released by oceans, rivers, and lakes through evaporation, and by plants in the process of transpiration. Water vapour rises, cools, and condenses to form clouds and generate precipitation (rain and snow). Once on the ground, this precipitation either seeps into the ground (infiltration) or flows overland to surface watercourses and water bodies (runoff). This natural, self-sustaining circulation of water from oceans, lakes, and rivers to the atmosphere, to the earth, and back to surface waters, is illustrated in Figure 6.

Figure 6: The Hydrologic Cycle



The movement of water through the hydrologic cycle affects and, in turn, is affected by climate, land, vegetation, and human uses of the land. Elements of climate, such as precipitation and temperature, influence the amount and form of water in the cycle. Characteristics of land, such as soil and slope, influence the movement of water within the cycle. Vegetation can affect the hydrologic cycle as it absorbs and transpires water. Land use also affects the movement and quality of water: urban development increases surface runoff due to loss of permeable area.

In watershed management, a significant issue is whether melting snow and rainfall infiltrate to recharge groundwater, are stored on the surface to evaporate, or flow overland to runoff into lakes and watercourses. The route that precipitation takes depends on a number of factors including slope, soils, vegetation, and land use.

9.1 GROUNDWATER

Groundwater is an essential component of the hydrologic cycle. Groundwater originates as precipitation that falls to the ground, infiltrates, and moves down through the soil to meet the zone of saturation or water table. At the water table, water fills the pore spaces between the soil particles or crevices and cracks in bedrock. A deposit of coarse material or crack in bedrock that is saturated with water is called an aquifer. The amount of water in an aquifer depends on the size and compaction of the soil particles, and the size of the deposit.

As groundwater moves through one or more geologic layers, it can eventually discharge, or seep out, into valleys, streams, lakes, or wetlands. In this way, groundwater provides the baseflow for many streams and can regulate factors such as water quantity in the summer, quality, and temperature. This movement of water from precipitation, into the soil, to the water table, and back to the surface, forms the groundwater component of the hydrologic cycle.

Groundwater is the source of drinking water for headwater communities in the Etobicoke Creek watershed. Supplies of groundwater can be diminished through extraction to meet demands for drinking water, or through an impairment in quality. Nitrates, bacteria, pesticides, chlorides, and complex contaminants, are potential forms of groundwater contamination.

9.1.1 Groundwater Quantity

In the watersheds, there are bedrock and overburden[14] aquifers. Information on major known overburden aquifers is available for the Town of Caledon and the City of Brampton. Although other sources of data, such as Ministry of the Environment records for water wells, could supplement this information, examination of these records is beyond the scope of this study. Investigations of other major aquifers may need to be undertaken in the future.

The Queenston and Georgian Bay Formations are the main bedrock aquifers in the watersheds. In south central Caledon, the Queenston Formation consists of red shales which underlie much of the Peel Plain. Both the Queenston and Dundas Shales are relatively dense and do not transmit water well (Region of Peel, 1996). The wells located in these areas are low yield domestic wells which generally yield less than 10 litres per minute.

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[14] Overburden refers to unconsolidated soils deposited on top of bedrock by melting glaciers. The overburden can range in thickness and infiltration capacity.

The following major known overburden aquifers have been found within, or partially within, the boundaries of the Etobicoke and Mimico Creek watersheds: Mayfield, Lower Snelgrove and Terra Cotta-Cheltenham, Snelgrove, Sandhill, Wildfield and Gore Aquifers, and the Brampton Esker. These aquifers are described in Table 9.1 and shown on Map 7: Overburden Aquifers.

Groundwater does not follow watershed boundaries. Consequently, the aquifers may be located only partially within the Etobicoke and Mimico Creek watersheds. Further study would be required to identify areas of groundwater recharge and discharge and to determine what extent these aquifers provide baseflow to the creeks.

TABLE 9.1: Major Overburden Aquifers Within the Etobicoke and Mimico Creek Watersheds*

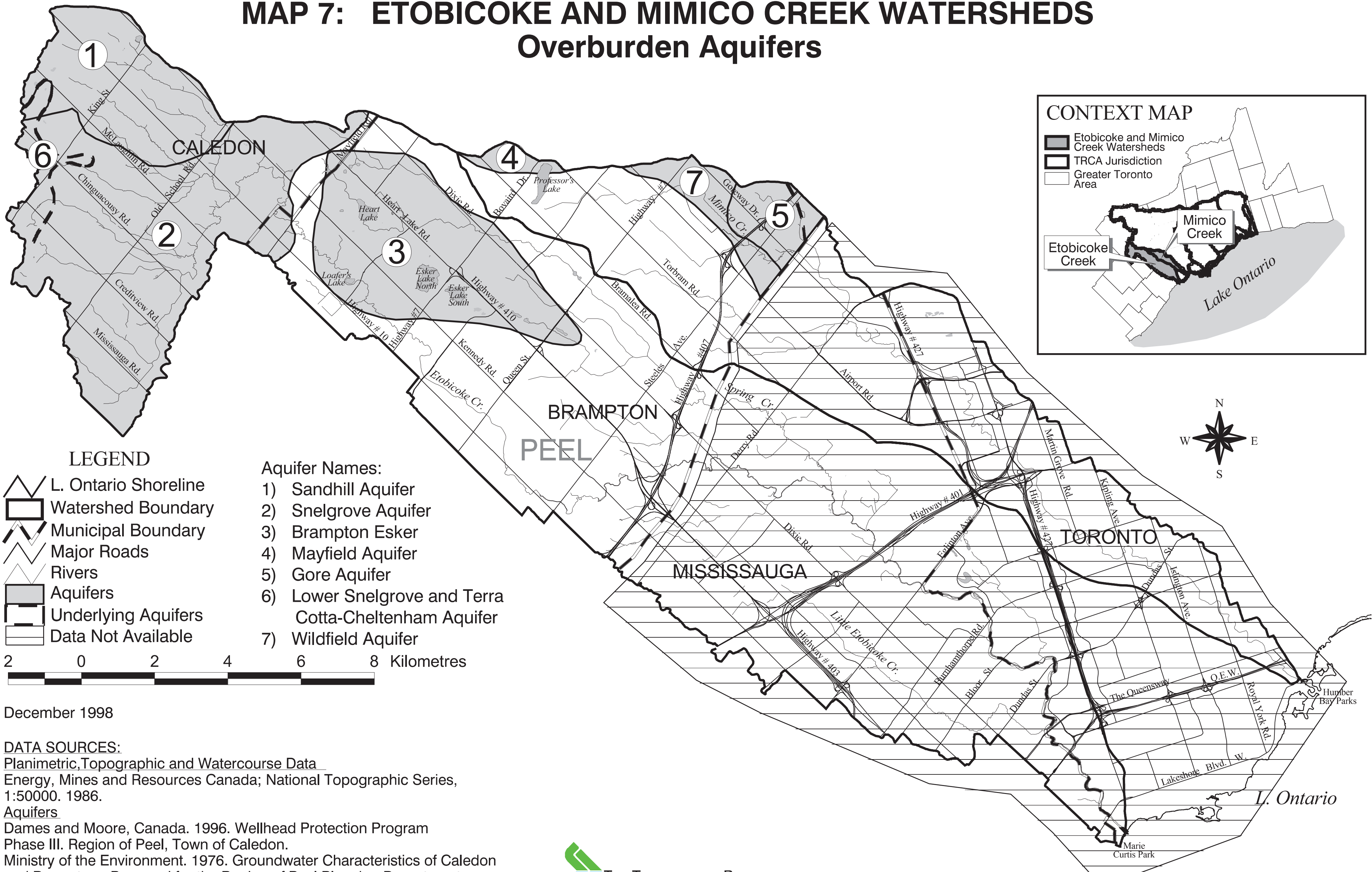
AQUIFER	WATERSHED	DESCRIPTION	DEPTH TO TOP OF AQUIFER (BELOW GROUND LEVEL)	TYPICAL WELL YIELDS (PER MINUTE)
SANDHILL AQUIFER	Etobicoke Creek	Shallow water bearing granular deposits. Much of this aquifer is under artesian conditions.	6-18 metres	10-45 litres
SNELGROVE AQUIFER	Etobicoke Creek	Granular lenses within the silty clay till.	9-18 metres	10-45 litres up to >225 in the west
LOWER SNELGROVE AND TERRA COTTA/ CHELTENHAM AQUIFER	Etobicoke Creek	Wells in this area generally completed in medium sand and gravelly sand below thick silt and clay units.	40-55 metres	45->225 litres
MAYFIELD AQUIFER	Etobicoke Creek	Sand and gravel deposited in a buried bedrock valley. A belt of silt and clay units surrounds sands. Several high capacity municipal wells were developed in this aquifer in Brampton.	>30 metres	>225 litres
BRAMPTON ESKER	Etobicoke Creek	Sand and gravel materials.	---	227-2728 litres
GORE AQUIFER**	Mimico Creek	Is partially overlain by another aquifer, the Wildfield.	25-40 metres	190 litres
WILDFIELD AQUIFER	Mimico Creek	Generally clay till, silty sand. Some well records indicate more granular deposits.	12-21 metres	10-45 litres

Source: Adapted from Region of Peel, Planning Department. 1996.

* Information is not available for the Cities of Mississauga and Toronto.

** Information on the Gore Aquifer was obtained from: Ministry of the Environment. 1976.

MAP 7: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Overburden Aquifers



December 1998

DATA SOURCES:

Planimetric,Topographic and Watercourse Data

Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Aquifers

Dames and Moore, Canada. 1996. Wellhead Protection Program Phase III. Region of Peel, Town of Caledon.

Ministry of the Environment. 1976. Groundwater Characteristics of Caledon and Brampton. Prepared for the Region of Peel Planning Department. Ontario: MOE Water Resources Branch.

9.1.1.1 Recharge

Groundwater recharge is important for the maintenance of aquifers. The major sources of aquifer recharge are the infiltration of surface waters and movement of water between aquifers. The amount or rate of recharge depends on a number of factors including the following:

- Soil permeability and thickness;
- Topography;
- Vegetation type and coverage;
- Land use;
- Soil type and moisture conditions within unsaturated zones;
- Depth to the water table;
- Intensity, duration, and seasonal distribution of precipitation; and
- Air temperature and other meteorological factors (MTRCA, 1996).

The maximum recharge rate is reached when soils become completely saturated during late spring (after snowmelt and spring rainfall) and again in late fall. In areas with more permeable or coarse surficial materials, for example, sands and gravels (Map 8), it is estimated that there is potential to infiltrate 40 to 50 percent of annual precipitation. In the less permeable soils composed of silt and clay, infiltration is typically between 5 and 20 percent (MTRCA, 1996).

Changes in land use affect the natural runoff/infiltration process. Deforestation, conversion of cropland to housing, paving roads, and other aspects of urban development increase surface runoff rates causing reduced infiltration and groundwater recharge. This is the case in the Etobicoke and Mimico Creek watersheds where urban development, with extensive impervious surfaces such as parking lots, buildings, paved roads and streets dominate the watersheds, with the exception of the Etobicoke Creek headwaters.

9.1.1.2 Discharge

When groundwater reappears above ground and discharges to a stream it is called baseflow. Baseflow can originate from shallow or deep aquifers where they intersect the surface along the length of the watercourse. The contribution of groundwater to streamflow depends on the availability of groundwater in the watershed, basin retention by lakes and wetlands, vegetation, and groundwater withdrawal for human use.

The amount of baseflow that contributes to local conditions along any section of a creek reflects local surficial geology and land use. In areas where the surficial soils are relatively impervious, such as clay, there is expected to be a lower groundwater contribution. Similarly, in areas that are highly developed, and thus made impervious through the amount of asphalt, roofs, and concrete in the area, the amount of baseflow in the river can also be affected.

Streamflow data measured at gauging stations can be used to show flow characteristics including baseflows and total flows in the watercourses. These measurements are useful for understanding the characteristics of the flows. In the Etobicoke and Mimico Creek watersheds, total flow and baseflow are currently only being measured at the downstream section of each watercourse. In the Etobicoke Creek watershed, the gauging station is located at the Queen Elizabeth Way (QEW). In the Mimico Creek watershed, the gauging station is located at Islington Avenue. As there are no other stream gauging stations currently active in either watershed, determining how baseflow is or has been affected by land use change at other locations is not possible.

In both watersheds, because the surficial geology is relatively impervious (Map 8), the amount of baseflow to the creeks has not been significantly impacted as the watersheds have developed (Figures 7 and 8). In Mimico Creek, baseflow did not change from 1973 to 1990. However, in Etobicoke Creek total baseflow appears to have increased by approximately 50 percent. This latter result is contrary to what would be expected and requires further analysis to determine possible reasons for the result.

Based on these results, changes in baseflow have likely not adversely impacted the aquatic community. However, there is probably one exception. On the Brampton Esker, in the Etobicoke Creek watershed, the soils are relatively pervious (sands and gravels), and the land is being developed. As land use change occurs, the surficial watershed features will become less pervious and this may result in changes to local baseflow. Although there are no gauging stations in these areas to monitor changes to baseflow or total flow, it can be expected that if mitigation measures are not undertaken as these areas develop, baseflow may decline and significant changes in stream flow may be noted in the future. These changes may have serious implications for aquatic life and affect recreational opportunities in the watershed.

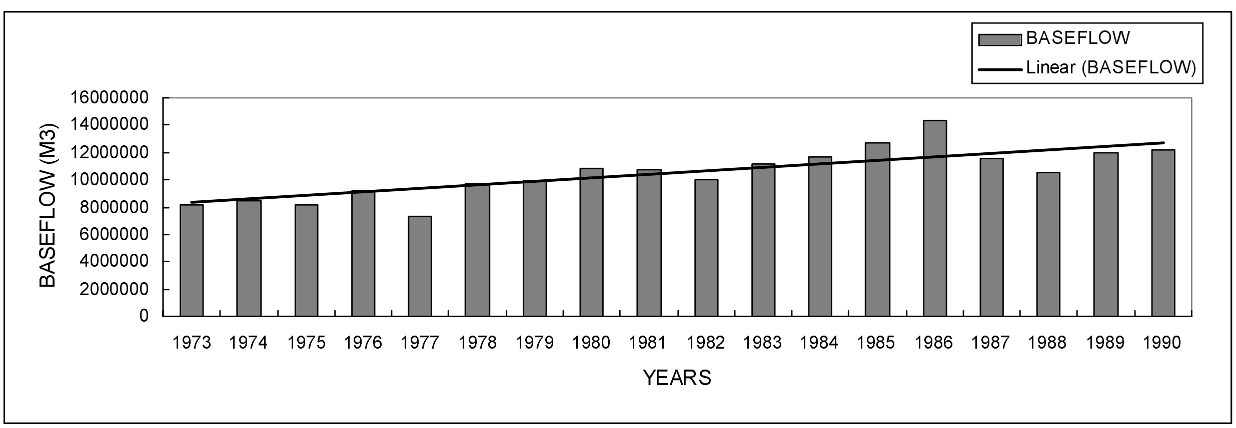
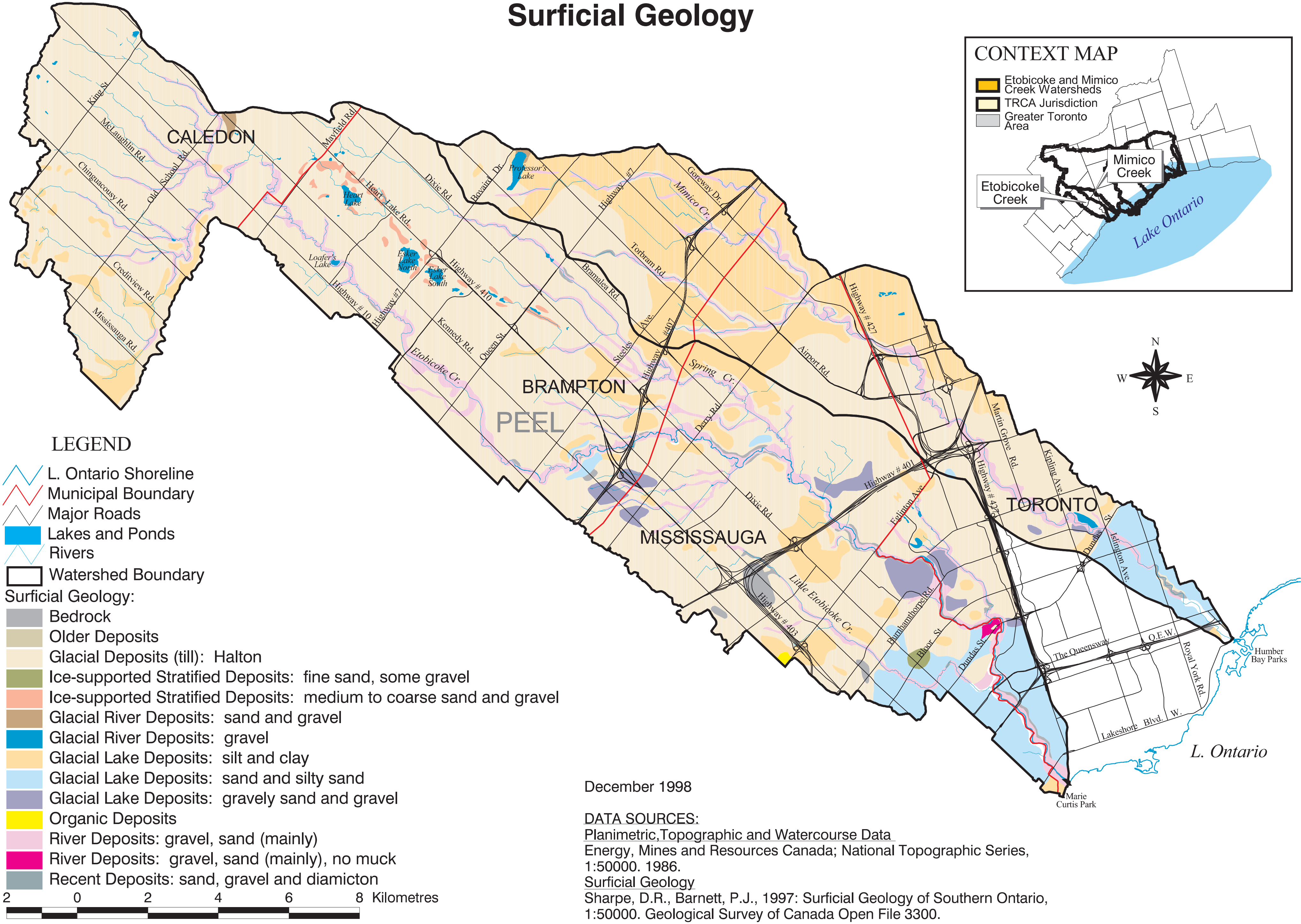


Figure 7: Etobicoke Creek, Total Mean Summer Baseflow

MAP 8: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Surficial Geology



December 1998

DATA SOURCES:

Planimetric,Topographic and Watercourse Data

Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Surficial Geology

Sharpe, D.R., Barnett, P.J., 1997: Surficial Geology of Southern Ontario, 1:50000. Geological Survey of Canada Open File 3300.

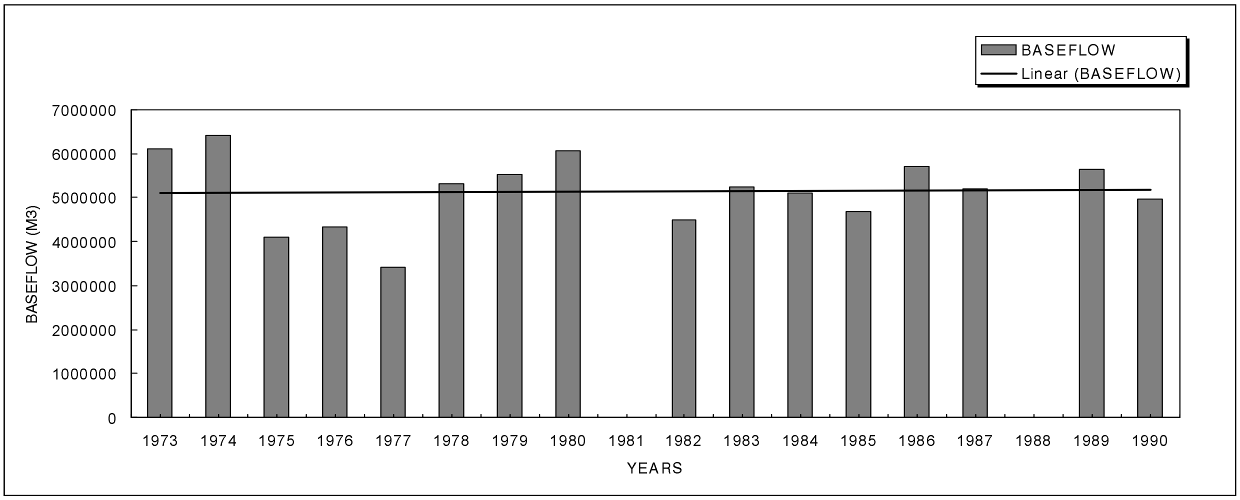


Figure 8: Mimico Creek, Total Mean Summer Baseflow
Note for Figures 7 and 8: Baseflow is expressed as a total volume of baseflow on an annual basis. Linear regression showing trend through time.

9.1.1.3 Groundwater Use

Groundwater is an important source of water for drinking and other for other uses. As a result, groundwater supplies may be diminished by new development and increased demand for water. If new developments or established communities extract groundwater beyond sustainable limits, the results may lead to the reduction or elimination of baseflow to streams, the drying of wetlands and wells, and adverse impacts on habitats and communities (MTRCA, 1996). Below is a description of the areas within the watersheds which have depended on groundwater for their water supply. More detailed information on groundwater use in the watersheds may be found in the Ministry of the Environment records for water taking permits which are required when greater than 50,000 l/day is used. However, analysis of these permits to determine the impact of groundwater use on the watersheds is beyond the scope of this study.

Within the watersheds, groundwater has been extracted for use in a number of communities:

- Until 1923, the former Township of Etobicoke relied entirely on groundwater for its water supply (Watt, 1968). From 1923 to 1954, several municipal wells and waterworks systems were built but in 1954, these were abandoned when water from Lake Ontario was supplied through the New Toronto waterworks system.

- Prior to 1972, there were several high-yield private and municipal wells developed on the Brampton Esker in Brampton (MOE, 1976). This area is no longer dependent on groundwater as it is currently serviced with water from Lake Ontario through the South Peel Water Distribution System.

- Currently, the Town of Caledon depends upon groundwater resources for water consumption. However, the aquifers located within the boundary of the Etobicoke Creek watershed are not suitable for multiple-use municipal wells. All existing wells within the watershed are privately operated (Region of Peel, 1996). Future development in areas dependent on groundwater will need to be sensitive to pressures on limited groundwater resources.

- Although within the Etobicoke and Mimico Creek watersheds there are no municipal wells located on the aquifers listed in Table 9.1, a number of these aquifers presently supply water to rural properties in the City of Brampton and the Town of Caledon for domestic and agricultural purposes. In general, wells located in the overburden of the other areas of the Cities of Brampton and Mississauga are expected to yield low water volumes which may be insufficient for domestic and agricultural uses without a water storage tank (Region of Peel, 1996).

- The agricultural community in the Town of Caledon is almost entirely dependent on the groundwater system to meet their needs. Through discussions with farmers in the area, the Town has heard that many farming operations are having increasing problems meeting their water needs from groundwater, and approximately 22 farming operations have had to import water (via truck) to meet their needs. It is not clear, however, if this problem is a result of increased use, decreased groundwater quantity, or a combination (Salter, 1998).

SUMMARY

Groundwater is a key component of the hydrologic cycle. However, uncontrolled land use can result in reduced recharge rates and increased water use can deplete groundwater resources. In turn, this can reduce or eliminate baseflow to streams and dry up shallow wells. Within the urbanized portions of the watersheds, impermeable surfaces have likely had a negative effect on recharge, and consequently the discharge of groundwater or baseflow to streams, because rainfall is lost as surface runoff and there is less potential for infiltration. Although many agricultural lands have been tiled or ditched to drain water quickly off of the land, it is likely that within the more rural headwaters of Etobicoke Creek, the effects of land use are not as severe since open farmland and pastures generally allow for more infiltration than urban land use. It should be noted, however, that due to their physiographic and geologic composition, these watersheds naturally had lower rates of recharge when compared to other areas such as the Oak Ridges Moraine.

9.1.2 Groundwater Quality

On a global scale, groundwater is the largest source of fresh potable water. It is also the source of drinking water for communities in the headwaters of Etobicoke Creek. Thus, protection against its impairment is critical.

Groundwater quality is affected by natural factors such as geology and by human activities, for example, farming. There are two categories of groundwater contaminants: point and non-point sources. Point source refers to pollution which originates from a specific, identifiable location such as landfills, spills, and septic systems. Non-point sources of pollution include discharges of road de-icing agents, oil, grease, fertilizers, and pesticides. Generally, their source is broadly based and they often originate from agricultural and urban runoff.

Although there have been not been any studies that deal specifically with the quality of groundwater resources within the Etobicoke and Mimico Creek watersheds, nitrates and bacteria, pesticides, chlorides, and complex contamination were selected for discussion. Due to the land uses present in the watersheds, these are potential forms of groundwater contamination. However, further study would be needed to determine the extent to which groundwater resources are contaminated within the watersheds.

9.1.2.1 Nitrates and Bacteria

In the headwaters of Etobicoke Creek, in the Town of Caledon, agricultural activity is a potential source of nitrates and bacterial contamination. The seasonal application of fertilizer and manure can leach into the soil and contribute nitrates and bacteria to groundwater.

Non-agricultural application of fertilizers, particularly on golf courses, public parklands, or for residential landscaping, are another potential source of groundwater contamination. Golf course maintenance and residential gardening practices could have a greater impact on groundwater quality than agriculture due to the relatively intensive use of fertilizer. Because there is a significant amount of residential development within both watersheds and a number of golf courses and manicured parklands along both creeks, these areas may be sources of nitrates.

Septic systems can also be a source of nitrate and bacteria contamination. These systems have a finite life span and require maintenance. When septic beds are installed in soils that are very pervious, close to the water table, on a steep slope, or when they are undersized, their failure can result in groundwater contamination. Septic systems can also cause localized impairment of groundwater quality when operating properly. Plumes with concentrated levels of contaminants may be found down-gradient of the system and extend below the tile field. Elevated levels of nitrates, chlorides, sodium, potassium, and bacteria may be found in the plume. In some instances, more hazardous materials may be found as a result of improper disposal of domestic cleaning products and pesticides.

9.1.2.2 Pesticides

Pesticides are often used on agricultural lands, golf courses, parks, and residential properties. Although many pesticides have the potential to be altered to less toxic or persistent forms (by volatilization, photo-degradation, or microorganisms) before entering groundwater, a Ministry of the Environment pesticides monitoring program has shown that herbicides such as atrazine, occurred in 50 percent of the wells sampled around Ontario (MOEE, 1989).

Potentially, some golf courses, manicured parks, and residential properties within both watersheds, and agriculture in the Etobicoke Creek watershed, might have a deleterious effect on water quality because of intensive and regular use of pesticides. However, management practices regarding the application of pesticides are changing. Golf courses in Ontario are increasingly practising improved environmental management through, for example, their participation in the Audubon Society's Co-operative Sanctuary Program. Part of the certification for this program requires that measures be taken to protect water quality.

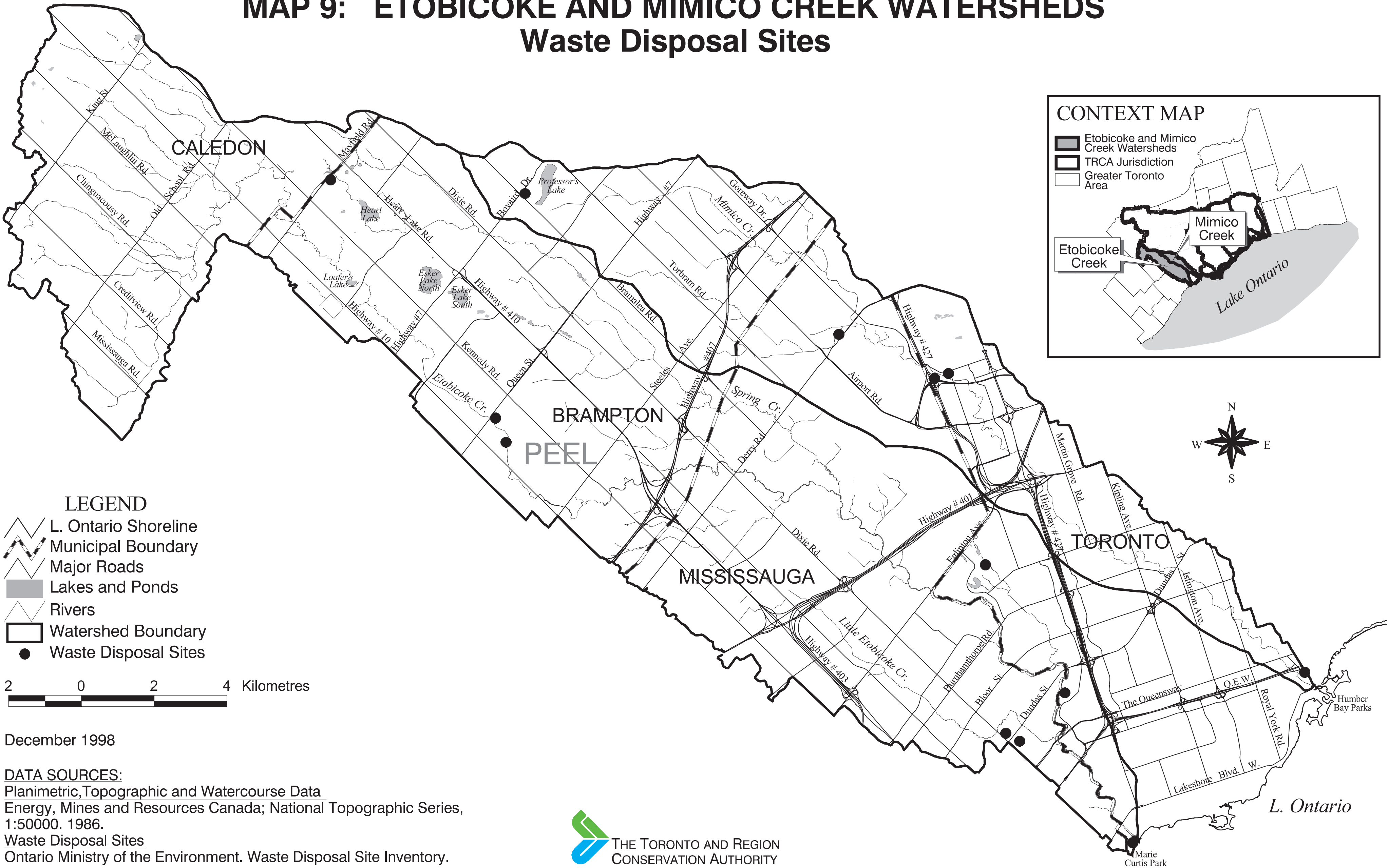
9.1.2.3 Chlorides

The network of roads that span the Etobicoke and Mimico Creek watersheds may have a negative effect on groundwater quality, particularly in areas with permeable soils. Road salt, spills, and residue from road surfaces (exhaust, gas, oil, and metals) can enter the groundwater system. A recent study in the Highland Creek watershed indicated that of the approximately 10,000 tonnes of salt applied for road de-icing on an annual basis, only 45 percent is flushed out of the watershed via surface runoff: the rest infiltrates into the ground and contaminates the groundwater (Howard and Haynes, 1997). Since the Highland Creek watershed is also highly urbanized, similar conditions may exist in the Etobicoke and Mimico Creek watersheds.

9.1.2.4 Complex Contamination

Landfills, both active and closed, can potentially contribute to groundwater contamination extending outward and down-gradient from the site. The chemicals found most consistently in association with landfill leachate include chlorides, calcium, magnesium, sodium, potassium, iron, ammonia, nitrate, and trace metals such as zinc, copper, lead, and chromium. Leachate may also contain concentrations of more hazardous materials such as petroleum, phenols, solvents, and pesticides. Because of leachate concentration and complexity, depth of penetration, and long-term life span, landfills can have a significant impact on groundwater. Although there are approximately eight closed landfill sites in the Etobicoke Creek watershed and five closed sites in the Mimico Creek watershed, it is not known whether they are contributing leachate to groundwater (Map 9). However, when a problem is detected through monitoring leachate, remedial actions are taken.

MAP 9: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Waste Disposal Sites



December 1998

DATA SOURCES:

Planimetric,Topographic and Watercourse Data

Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Waste Disposal Sites

Ontario Ministry of the Environment. Waste Disposal Site Inventory.

THE TORONTO AND REGION CONSERVATION AUTHORITY

The Region of Peel monitors methane gas and leachate at waste disposal sites on municipal and conservation authority lands. Ground and surface water monitoring is undertaken at selected sites to determine if there is any migration of leachate offsite or other impacts which may be associated with the landfill. Two sites within the Peel portion of the Etobicoke and Mimico Creek watersheds are actively monitored by the Region.

The City of Toronto monitors methane gas and leachate at selected sites. The program focuses primarily on gas and, to a lesser extent, on surface water monitoring. The program is currently under review because of the recent City amalgamation. The City's priority outfall program may also detect leachate by monitoring outfalls which service landfill sites.

In conclusion, groundwater pollution has wide ranging impacts--it carries contaminants from the land into lakes and rivers where it affects the health of these ecosystems. In streams, contaminants affect aquatic habitat and accumulate in the body tissues of organisms, which may then be passed on to another organism through the food chain, or affect the health of the individual organism. While there are many human activities that can adversely affect groundwater quality, those which are described above are most likely the greatest contributors in these watersheds.

Groundwater contamination can also affect human health. For example, it can affect the skin and, consequently, affect quality of life. Once groundwater has become contaminated and rendered unusable for human consumption, it takes many years and is very costly to clean up. This is because the residence time of groundwater may be hundreds or even thousands of years. Further, since groundwater is not as accessible as surface water and the flow of groundwater is less predictable, efforts to remediate contaminated groundwater are often very expensive (Region of Peel, 1996).

SUMMARY

There have not been any studies conducted to specifically assess the quality of groundwater resources within the Etobicoke and Mimico Creek watersheds. However, due to the land uses present in the watersheds, nitrates and bacteria, pesticides, chlorides, and complex contamination are all potential sources of groundwater contamination. The contamination of groundwater resources has many environmental, social, and economic consequences as it may affect aquatic life and human health, and once it is impaired, it can be very expensive to remediate.

9.2 SURFACE WATER

As water moves on the earth's surface, it stores and transports sediments, gases, minerals, heat, and living things. The quantity and quality of surface water is determined by groundwater infiltration and discharge and stormwater runoff. These, in turn, are affected by land use, human activities, vegetative cover, topography, and soils.

9.2.1 Surface Water Quantity

Baseflow, surface runoff, and changes in the relative proportion of total streamflow made up of these components indicate water quantity conditions within a watershed. The quantity of water that is delivered to a watercourse from rainfall or snowmelt is a direct result of the characteristics of its drainage area. These characteristics affect erosion, flooding, development on flood plain lands, the management of stormwater, and the nature of species and habitats that are present in a watershed.

9.2.1.1 Impacts of Drainage Area Characteristics on Streamflow

The natural flow of water in the watersheds would have been greatly affected when the forest covered landscape was cleared to accommodate settlement and agriculture. In more recent decades, the flow regime has been affected by agricultural improvements such as ditching and tile drains, and urbanization.

Urbanization can alter the quantity of water entering watercourses. Within a watershed, extensive areas of impervious surfaces (e.g., asphalt, concrete, and roofs) result in an increase in the quantity and rate of surface runoff. Grading the land removes shallow depressions which hold water, allow infiltration, promote storage as soil moisture, and promote evaporation.

In the past, creeks were altered to accommodate development. Since some urban areas within the watersheds were developed over 30 years ago, many watercourses were altered, as indicated on Table 9.2 (Map 10). This resulted in the loss of meanders and pool/riffle sequences which naturally dissipate energy and reduce flow velocities; thus, the flow of water is sped up. Within streams, the increased frequency of higher and faster flows contributes to increased natural stream bank erosion and sedimentation processes.

TABLE 9.2: Percentage of Natural, Concrete, Altered, and Piped Watercourses

Watershed	Natural	Concrete	Altered*	Piped
Etobicoke Creek	67%	4%	28%	1%
Mimico Creek	41%	19%	40%	0%

* Watercourses which have been straightened or otherwise modified, but not lined with concrete or piped.
Data is based on air photo interpretation with some field verification. Based on a comparison of current watercourses with those in 1954 (Map 3), it is likely that more piped watercourses exist than are indicated.

Historically, when the Etobicoke Creek watershed was in a more natural state, there were moderately high rates of runoff in the watershed and moderate to steep stream gradients. As urban development has increased over the past 25 years, the total yearly volume of flows in the creek has increased by 19 percent. In 1995, Etobicoke Creek's total yearly streamflow volume, measured at the Queen Elizabeth Way, was almost 80 million cubic metres.

The Mimico Creek watershed is characterized by steep stream gradients, impermeable soils, and is urbanized throughout. As it is a small and narrow watershed, surface runoff is conveyed quickly to the creek. The creek is characterized as having a "flashy" nature and responds rapidly to precipitation events. Over the past 25 years, total volume of flow has increased by 22 percent. The 1995 total yearly volume, measured at Islington Avenue, was 30 million cubic metres.

As annual precipitation has remained about the same over the past 25 years, these increases in the total volume of flows may be attributed to urban development and the associated increase in imperviousness of the watersheds. However, due to the natural characteristics of the watersheds, these increases in total volume are probably less than would be found in other watercourses with more deposits of coarse soil and thus higher infiltration capacity, such as the Don River watershed.

Information on streamflow for the creeks is collected by Environment Canada. The long-term average monthly discharges are illustrated in Figure 9. There is currently one active gauging station located in the southern end of each watershed. Etobicoke 1 is located in Brampton and is no longer active. The streamflow data for the Brampton station is based on the period 1957-1989. The second station in the Etobicoke Creek watershed (Etobicoke 2) is active and located below the Queen Elizabeth Way (QEW). The data for this station is based on monthly streamflow data from 1966-1996.

The station in the Mimico Creek watershed is located at Islington Avenue just south of Highway 5 (Mimico 1). The streamflow data for this station are based on streamflow data records from 1965-1996.

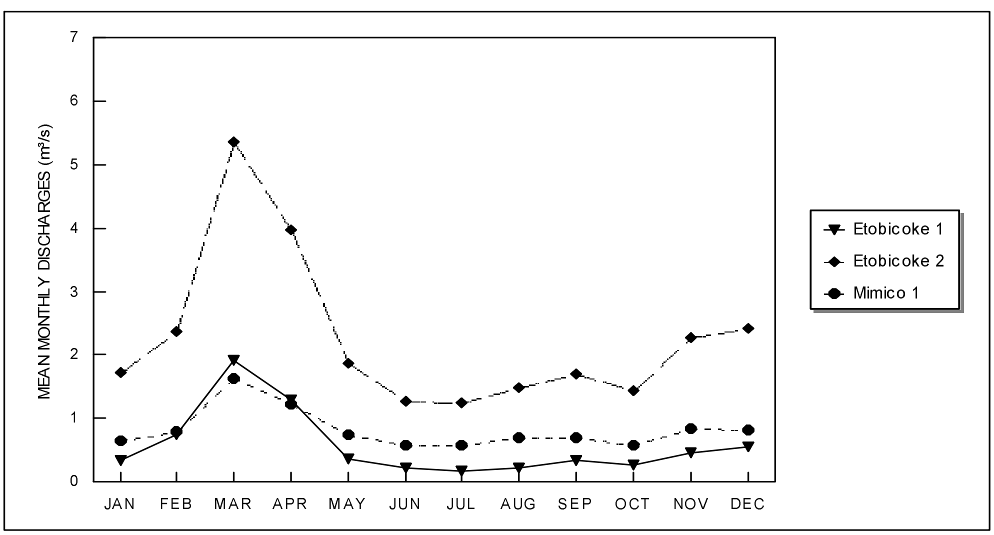
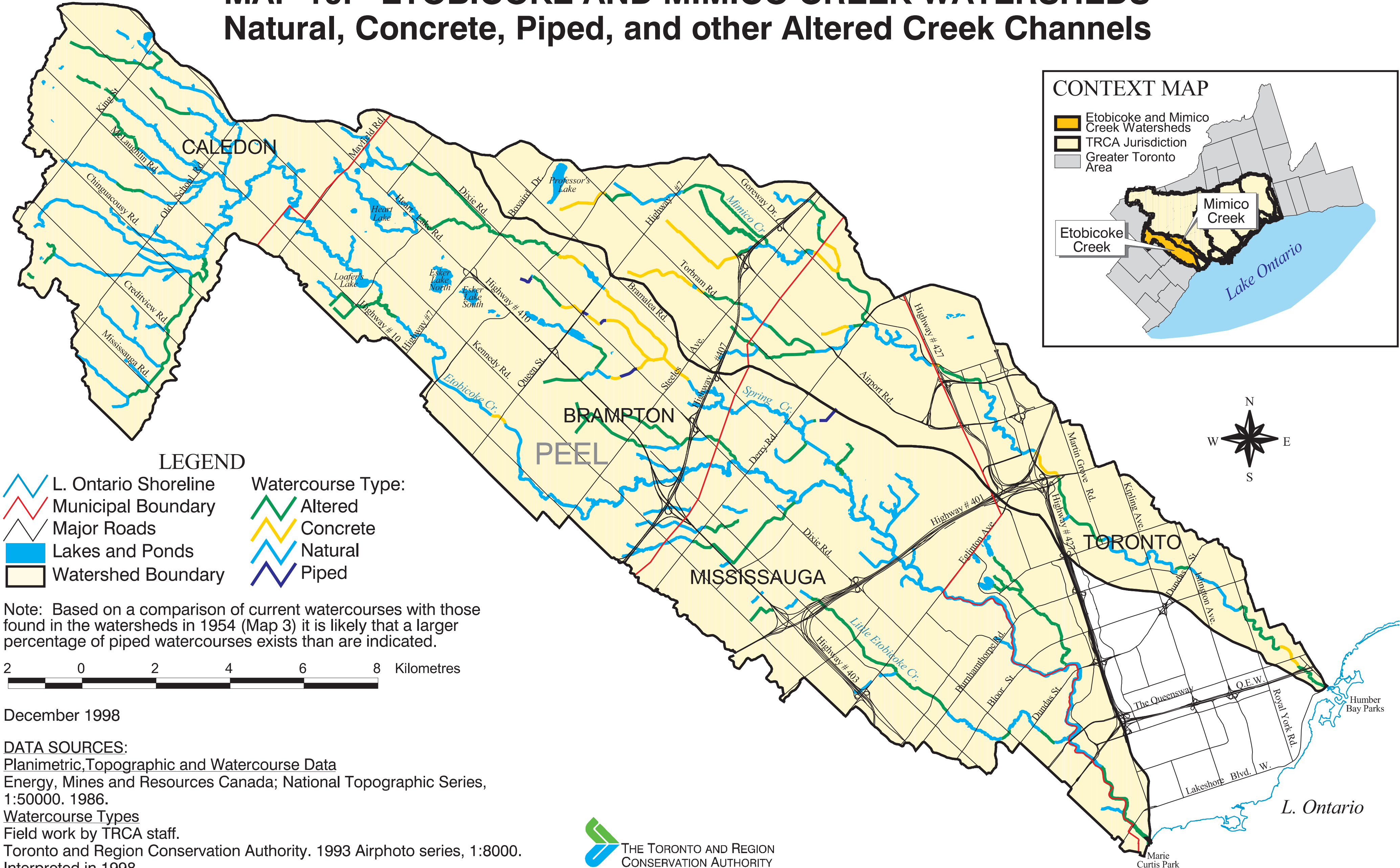


Figure 9: Surface Flow, Mean Monthly Discharges

MAP 10: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Natural, Concrete, Piped, and other Altered Creek Channels



Note: Based on a comparison of current watercourses with those found in the watersheds in 1954 (Map 3) it is likely that a larger percentage of piped watercourses exists than are indicated.

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DATA SOURCES:

Planimetric,Topographic and Watercourse Data

Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Watercourse Types

Field work by TRCA staff.

Toronto and Region Conservation Authority. 1993 Airphoto series, 1:8000. Interpreted in 1998.

In Etobicoke Creek, mean flows in March and April are higher than for the rest of the year and the low flow period is during June to August. The spring runoff is almost double the mean annual runoff and represents about 46 percent of the annual discharge.

In Mimico Creek, flows are highest during February to April, accounting for about 40 percent of annual discharge. Low flows typically occur between June and October.

In general, the mean monthly flow in both watersheds is greatest from February until April. This corresponds to the spring snow melt combined with frequent precipitation events. The lowest monthly flows occur during the summer months when precipitation events are less frequent but more intense.

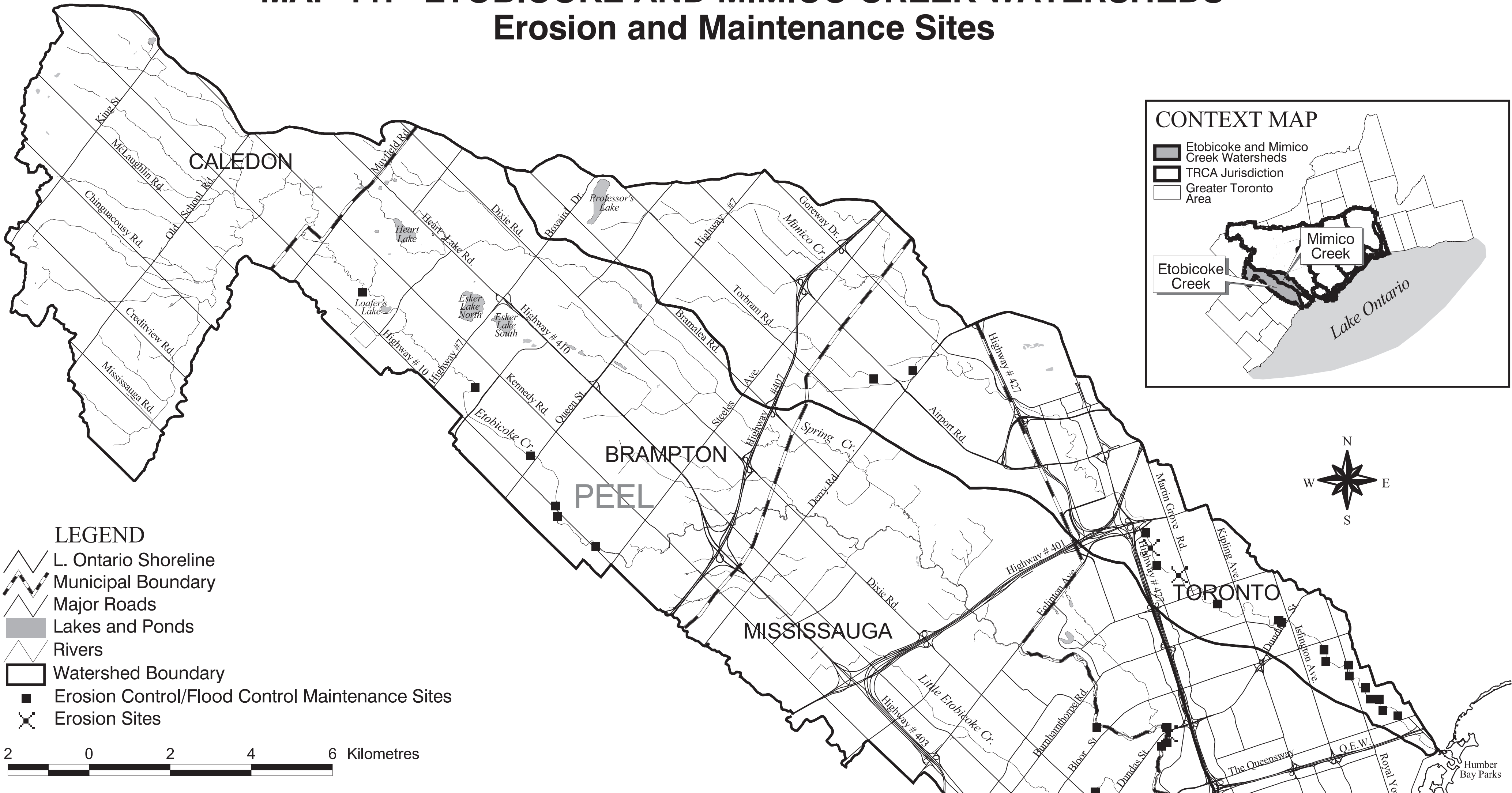
Changes in the flow regime, causing very high and very low flows, can affect aquatic communities. In terms of low flows, not enough water in streams means aquatic life will not survive. Too much water may subject stream banks and bed to greater erosional forces. This may result in increased sedimentation, particularly if woody riparian vegetation is not present. The high levels of suspended solids often seen during high flows may also cause damage to fish gills and result in sedimentation of important spawning areas. As well, any instream structures that fish use to escape from high flows, such as fallen trees, may be washed downstream. Fish and other aquatic organisms could be carried downstream as well. High flows may also be a safety hazard through, for example, increasing erosion or flooding which can threaten human life and property.

9.2.1.2 Erosion

Generally, erosion is concentrated in the lower portions of the creeks and along the main branch of Etobicoke Creek. Map 11 identifies areas where significant erosion has occurred or where erosion control works have been carried out.

A number of factors have contributed to the erosion problems within the lower portions of the watersheds including urbanization, lack of stormwater management and development controls, and location within the watersheds. Although erosion is a natural and relatively slow process, urban development in a watershed can accelerate the process and increase its severity. More specifically, urban development results in the regrading of natural contours, the removal of native vegetation, alterations to natural drainage patterns, and the creation of impervious surfaces. These changes ultimately lead to higher volumes and velocities of flows within natural watercourses and create the conditions whereby increased energy causes increased erosion activity.

MAP 11: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Erosion and Maintenance Sites



December 1998

DATA SOURCES:
Planimetric,Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.
Erosion and Maintenance Sites
Field work by TRCA staff.

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Etobicoke Creek: erosion, erosion control works, and 10 years after work was completed.

At the time the lower portions of the watersheds were developed, stormwater controls were reactive and focused on the fast, efficient conveyance of runoff to watercourses. As a result, watercourses were altered to accommodate the change in volume and velocity of flow. Modifications included piping, concrete lining or gabion lining of natural channels. The portions of the rivers left in their natural state were subject to increased volumes and velocities of flow and were heavily eroded as a result. Today, stormwater management has evolved to include quantity, quality, and erosion control measures. However, this shift did not occur until after the lower portions of the watersheds were developed; thus, stormwater management facilities in the lower watersheds are largely absent.

Lenient development regulations were also in place when the lower portions of the watersheds were being developed. Structures and buildings were often allowed to be built adjacent to the top of a valley slope without any consideration of setbacks. This practice resulted in the loading of slopes and ultimately to slope instability and erosion problems. Today's development controls identify the need to regulate development which is adjacent to valley and stream corridors. These controls may be enforced through municipal rear/side lot setbacks or through policies such as TRCA's *Valley and Stream Corridor Management Program (1994)*. These modifications allow for greater protection of unstable river banks and valley walls and, and help to prevent bank instability and erosion.

Location within a watershed plays an important role in the characteristics and flow conditions of a watercourse. Headwater streams typically have smaller cross-sections (i.e. are less defined), slower velocities, gentler gradients, lower kinetic energy, finer suspended loads, and smaller volumes of flow. However, at the lower end of the system, the reaches have more defined channels with higher banks, increased flow volumes and velocities, and steeper gradients. In addition, at the lower end of a watershed, larger particles are picked up by the flows in larger volumes because of higher velocities. Each of these characteristics contributes to greater erosion problems within a mature river system. The conditions within the lower portions of the Mimico and Etobicoke Creek watersheds confirm this relationship.

The third area of concern lies along the main branch of the Etobicoke Creek. As Map 11 indicates, the erosion sites along this branch have been protected by some type of erosion control structure. These erosion problems likely resulted from both natural processes and from the effects of increased urbanization as the City of Brampton expanded. Although erosion does exist along this branch, it is substantially less than in the lower portions of the Etobicoke Creek watershed because refined development regulations and stormwater controls were in place when development began in this area, and because of the natural mechanics of the watercourse and soil characteristics of the surrounding area, among other factors.

By the time Brampton was undergoing rapid urbanization, municipalities and TRCA had adopted a protection and prevention approach. This approach ensured erosion-prone areas were protected and further erosion was prevented or minimized through increased development regulations and stormwater management controls. Increased controls consist of those previously mentioned including municipal rear/side lot setbacks, development policies, and stricter stormwater management controls for development applications.

Typically, erosion is minimal in the headwaters, slight in the mid-reaches, and heavy in the lower sections of a watershed. This natural trend is demonstrated in the Etobicoke Creek watershed. Compared to the headwater streams, mid-reaches have increased cross-sectional area, increased velocity and volumes of flow, and relatively steeper gradients. This combination will produce the first signs of significant erosion within the watercourse, as is seen along the main branch, but will be moderate enough not to cause the frequency and severity of the erosion found in the lower portions of the watershed.

The main branch of Etobicoke Creek is located within the Peel Plain which is composed of the Peel Clay and the Chinguacousy Clay Loam soils. Clay particles are unique in that they are flat and extremely fine. The smallest of the four soil categories, clay particles are less than 0.005 millimetres in diameter. These natural soils also explain the fewer number of erosion sites along the main branch.

9.2.1.3 Flooding

Flooding is a common, natural occurrence. Historically, flooding has occurred regularly in the Etobicoke and Mimico Creek watersheds.

Detailed historic accounts of flooding along Mimico Creek are scattered. The most severe flooding occurred during Hurricane Hazel. Damage was reported to buildings in the vicinity of Kipling Avenue, Dundas Street, Van Deusen Boulevard, and Bonnyview Drive.

Numerous accounts of flooding within the Etobicoke Creek watershed have been recorded. Historically, flooding was severe at Long Branch, a small village located near the mouth of Etobicoke Creek. Annual flooding also occurred in what is today the central area of Brampton. This was, in part, caused by development of the main business area in close proximity to a large meander of Etobicoke Creek, south of Queen Street East. Water levels would rise, overtop the banks of the watercourse, and the area encircled by the meander would quickly become flooded. This was the case in 1857, when the area was heavily flooded resulting in severe damage.

The issue of flooding in Brampton was addressed in the Etobicoke Valley Report of 1947. The report recommended the construction of a flood diversion channel to alter the course of the creek and prevent recurrent flooding in the business section of the town. The construction of this diversion channel was undertaken by the Etobicoke Creek Conservation Authority (and from its formation in 1949, the Etobicoke-Mimico Conservation Authority) and completed in 1952 (see Map 3, Chapter 2).

The risks associated with flood plain development were clearly demonstrated on October 15 and 16, 1954, when Hurricane Hazel dropped in excess of 28 centimetres of rainwater in a 36 hour period. The diversion channel in Brampton prevented serious flooding damage even though flood waters filled the new channel to approximately 30 centimetres above the concrete lining. However, in the lower section of Etobicoke Creek, there was serious damage. Channel improvements previously completed at Long Branch were not sufficient to protect the area from flooding as the flood waters were at least four times the capacity of the channel. The cottage settlement by the mouth of Etobicoke Creek was destroyed and seven people drowned. Overall, within the TRCA's jurisdiction, 81 lives were lost and 1,868 families were left homeless as a result of the Hurricane. On the main branch of Etobicoke Creek, significant flooding also took place during Hurricane Hazel at Dundas Street and on Spring Creek upstream of Steeles Avenue (MTRCA, 1959; James F. MacLaren, 1978).

After the devastating loss of life and property associated with Hurricane Hazel, public attention focused on the need to manage hazards associated with flood plains. As a result, four smaller conservation authorities were amalgamated to form The Metropolitan Toronto and Region Conservation Authority. The intent was to provide better watershed management, particularly in flood control, throughout the region. The MTRCA program of flood risk reduction, *Plan for Flood Control and Water Conservation (1959),* was developed based on the protection, prevention, and acquisition of hazard lands. The plan proposed that the Snelgrove Dam and Reservoir be constructed within the Etobicoke Creek watershed to serve as a recreational lake and as an auxiliary source of water for the City of Brampton which, at that time, obtained most of its water from wells. The Snelgrove Resource Management Tract was acquired by the Conservation Authority. To date, the dam and reservoir have not been built. The 1959 plan also proposed the acquisition of 485 hectares of flood plain land.

More recently, channel works have been completed on Little Etobicoke Creek, around the Dixie Road and Dundas Street area, to protect properties located in flood vulnerable areas along the tributary. The Little Etobicoke Creek subwatershed is dominated by impermeable soils and is covered with residential and industrial development. As a result, precipitation tends to runoff directly into the creek. Little Etobicoke Creek is also characterized by low baseflow and flashy discharges during the spring freshet and precipitation events.

To reduce the risk of flooding and erosion, the TRCA regulates development within valley and stream corridors as shown on Map 12. These valley and stream corridors include the regulatory flood plain (Box 2). Today, a threat to life and property from flooding still exists in the Etobicoke and Mimico Creek watersheds. There are also many areas where structures and facilities exist within the flood plain which are vulnerable to flooding, including a number of transportation routes (Map 13).

BOX 2: DEVELOPMENT IN THE FLOOD PLAIN

Flood plains represent the natural storage areas of rivers into which high flows from rainfall and snow melt spill over the banks. When development occurs within flood plains, storage capacity is lost and there can be a threat to life or property from flooding.

To ensure that new areas at risk from flooding are not developed, the TRCA was granted an Ontario Regulation under the Conservation Authorities Act. Ontario Regulation 158 requires proponents to apply to the TRCA for permission if they plan to build in an area susceptible to flooding, place fill in an area shown on registered schedules, or alter a watercourse. The requirements under the regulation have traditionally related to the protection of life and property from flood and erosion hazards on the valley floor and along the valley slopes. Since the TRCA's 1980 *Watershed Plan*, and the adoption of the 1988 *Provincial Flood Plain Planning Policy* and 1996 *Provincial Policy Statement* (3.1 Natural Hazards), where lands are subject to flood risk, no new development is permitted within the flood plain, with the exception of essential services such as gas or water, or through the designation of a Special Policy Area (SPA) or a Two Zone Area. In areas where historic communities exist, Special Policy Areas (SPAs) have been designated by the Province. Within such areas, development or redevelopment may be permitted in order to maintain the community's social and economic viability. There is one Two Zone Area located in the Malton area of Mimico Creek. There are four Special Policy Areas within the Etobicoke Creek watershed:

- Downtown Brampton
- Steeles Avenue and Dixie Road (Brampton)
- Etobicoke Creek at Dundas Street (Mississauga)
- Dixie Road and Dundas Street (Mississauga)

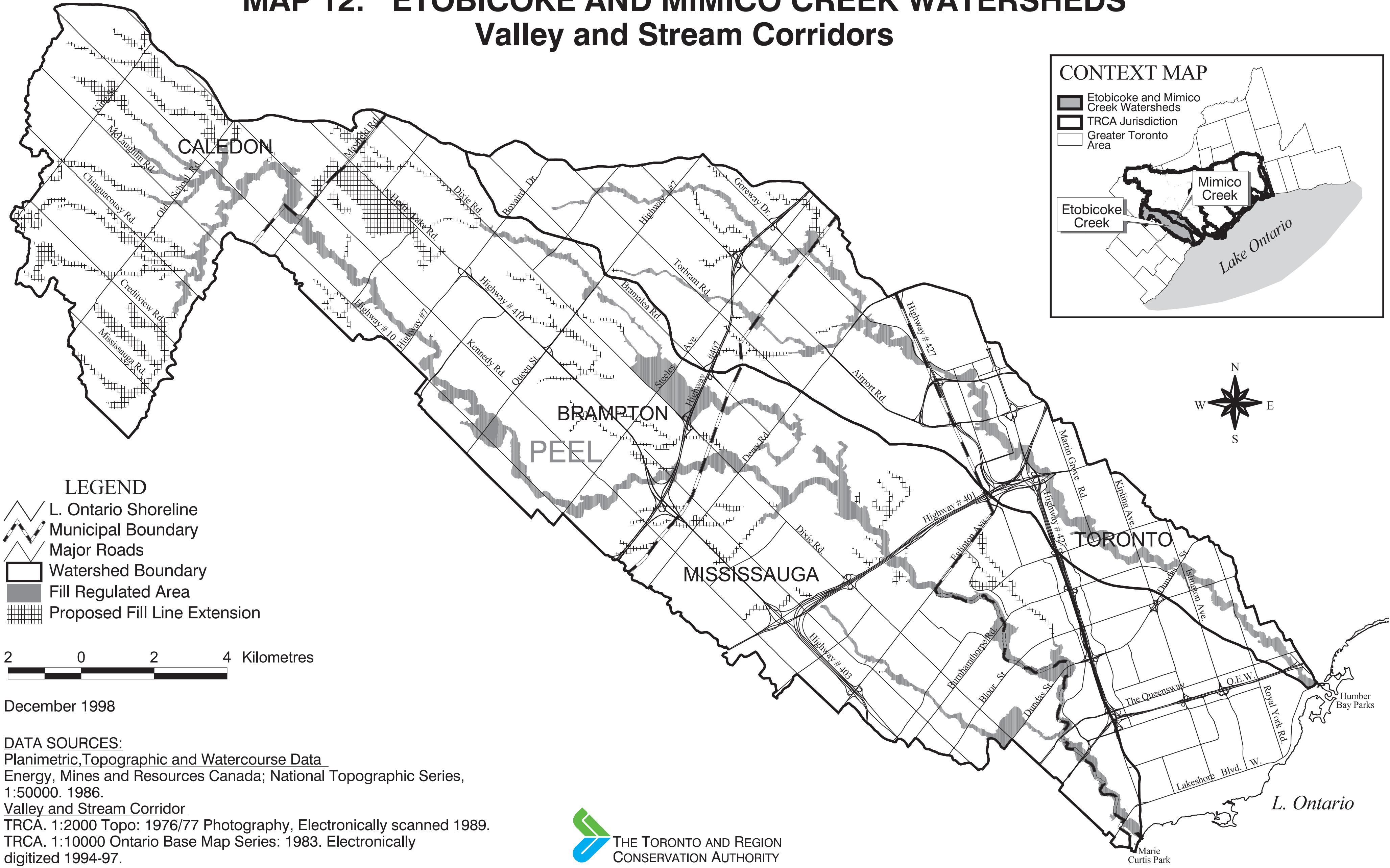
Considering that there are a total of 16 SPAs within the TRCA's jurisdiction, this is a relatively high number of SPAs for a single watershed. No SPAs have been designated within the Mimico Creek watershed.

The 1994 *Valley and Stream Corridor Management Program* is the current TRCA policy through which the valley and stream corridor areas, including flood plains, are managed. The TRCA implements both the provincial and TRCA policy documents through its role as a commenting agency under the *Planning Act* and the *Environmental Assessment Act*, and through implementation of Ontario Regulation 158 under the *Conservation Authorities Act.*

To assist in the administration of the policies and Ontario Regulation 158, the TRCA has developed flood plain mapping for areas where watercourses drain in excess of 1300 hectares. This mapping is available for the Etobicoke and Mimico Creek watersheds. The TRCA presently does not regulate flood plains draining less than 125 hectares. In areas where no flood plain mapping exists, the flood plain limits are determined by the proponents of development adjacent to these watercourses.

Development in the flood plain can have significant social and economic costs in terms of loss of life and property. Further, development within flood plains can have significant ecological impacts. The valley and stream corridors (in which a flood plain is located) perform several ecological functions which could be threatened by development including nutrient and sediment transport, provision of fish and wildlife habitat and migration routes, air quality improvement, noise level attenuation, moderation of micro-climates, and the maintenance of a genetic pool for native flora and fauna (MTRCA, 1994).

MAP 12: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Valley and Stream Corridors



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DATA SOURCES:

Planimetric,Topographic and Watercourse Data

Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Valley and Stream Corridor

TRCA. 1:2000 Topo: 1976/77 Photography, Electronically scanned 1989.
TRCA. 1:10000 Ontario Base Map Series: 1983. Electronically digitized 1994-97.

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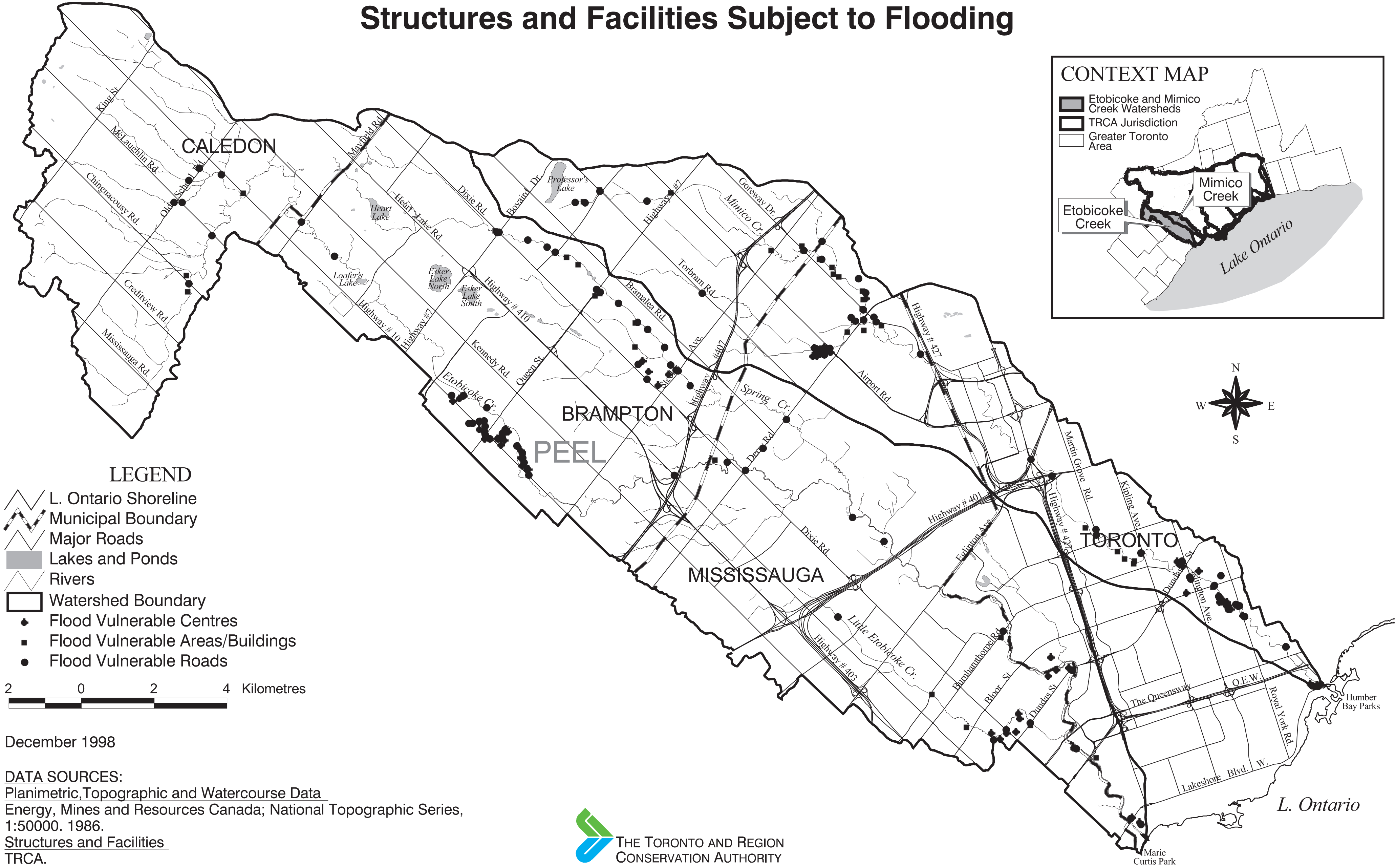
MAP 13: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Structures and Facilities Subject to Flooding



December 1998

DATA SOURCES:
Planimetric,Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.
Structures and Facilities
TRCA.

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9.2.1.4 Stormwater Management

While erosion and flooding of valley and stream corridors are natural processes, in the Etobicoke and Mimico Creek watersheds they are accelerated or made more severe by the predominance of impermeable surfaces. Proactive management of stormwater is necessary to reduce the risks of flooding and erosion.

Up to the mid-to-late 1980s, the driving influence behind the management of urban runoff was to move water quickly away from urban areas to prevent increased flooding. Many watercourses were engineered to accommodate increased flows due to storm events and a network of storm sewers was constructed to discharge stormwater into concrete lined rivers and streams. These practices created many environmental problems such as reduced fish habitat, fluctuating flows, erosion, and deteriorated water quality.

While preventing increased flooding remains an important component of stormwater management, since the mid-to-late 1980s, the focus has expanded to address both water quality and erosion impacts. Today, stormwater is being recognized as a resource which should be managed as an important element of the hydrologic cycle. Box 3 provides an overview of newer approaches to managing stormwater. An integrated "treatment train" approach addresses a complex range of watershed management objectives. This approach involves a combination of stormwater management practices at the lot-level (at source), along the conveyance system, and at the end-of-pipe. Together these practices help maintain or restore a more natural cycling of water by encouraging infiltration, reducing runoff volumes and velocities, and filtering out pollutants carried in stormwater.

Consistent with this approach to stormwater management, The TRCA has established criteria that new developments must meet to mitigate potential flooding, erosion, and water quality impacts. Stormwater ponds are one method of mitigating the impacts of increased stormwater runoff to watercourses that occurs with development. Currently, there are 41 stormwater management ponds in the Etobicoke Creek watershed. Of these, 15 are designed for water quantity control, 11 are for quality control, and 15 control both quantity and quality. In the Mimico Creek watershed, there are nine stormwater management ponds. Of these, four are quantity ponds, two control for quality, and three control water quantity and quality. The total area of land with quantity and quality control is shown in Table 9.3.

Stormwater Management Pond (Quality), Etobicoke Creek Watershed

The location of these ponds and their drainage areas are shown on Map 14. Further discussion on stormwater discharges in the watersheds, as they relate to water quality in the creeks, is discussed in section 9.2.2.4.

TABLE 9.3: Areas Controlled by Stormwater Management Ponds

Watershed	Area Controlled for Quantity (hectares)	Area Controlled for Quantity and Quality (hectares)	Total Urban Area (existing and future)	Total Watershed Area (hectares)
Etobicoke Creek	1,158	1,949	12,040	21,164
Mimico Creek	1,743	273	5,936	7,709

Within developed areas, 'retrofitting' existing quantity ponds can provide water quality and erosion control benefits (Box 5). Monitoring results indicate that stormwater management ponds are effective in reducing post development peak flows to predevelopment levels and removing pollutants. Monitoring and evaluation of the cumulative effects of stormwater management facilities are ongoing.

SUMMARY

The natural flow of water in the Etobicoke and Mimico Creek watersheds would have been affected when the forested landscape was cleared to accommodate settlement and agriculture. More recently, the flow regime has been affected by extensive urban development in the watersheds. Grading the land, altering watercourses, and an increase in impermeable surfaces have caused an increase in the total volume and rate of streamflow. However, in recent years, a variety of methods have been used to mitigate the effects of stormwater runoff.

Concrete lined section of Etobicoke Creek

BOX 3: WATER QUANTITY AND QUALITY MANAGEMENT: NEW SOLUTIONS

Attitudes toward urbanization and the environment have been changing over the past two decades. An important element of this change is the development of a more natural approach to stormwater management--one that attempts to mimic the natural functioning of the hydrologic cycle in terms of flow controls, as well as removing pollutants and providing aquatic and terrestrial habitat. Stormwater management is achieved using a combination of four approaches:

1. Pollution Prevention

- Elimination or reduction of the use of pesticides, fertilizers, or other pollutants.
- Municipal maintenance activities such as street cleaning.

2. Stormwater Lot Level (Source) Controls

These measures are implemented on-site:

- *Reduced Lot Grading* to encourage ponding, natural infiltration, and evaporation of runoff.
- *Roof Leaders* to discharge to ponding areas, soakaway pits, or rain barrels
- *Sump Pumping of Foundation Drains* to either the surface or soakaway pits.

3. Stormwater Conveyance Controls

Conveyance systems are used to transport stormwater runoff from lots to receiving waters:

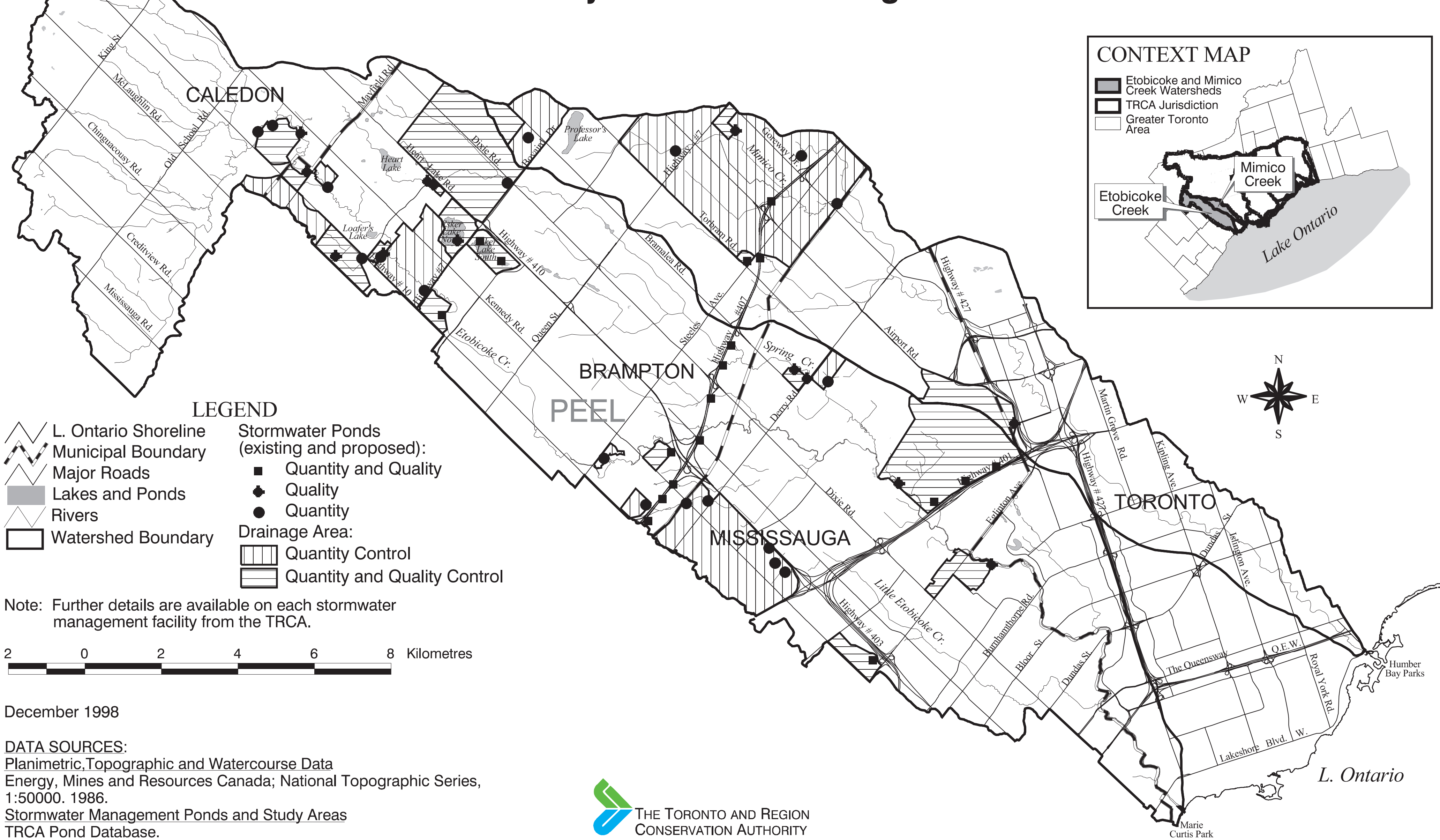
- *Pervious Pipe Systems* allow exfiltration of water through the pipe wall into a deep gravel bed and then to the surrounding soil as it is conveyed downstream. The City of Toronto (Etobicoke District) is one of the few municipalities which has attempted to implement this method.
- *Pervious Catch-Basins* are oversized catch-basins connected to exfiltration trenches. They are intended to infiltrate road drainage which has high levels of suspended sediment.
- *Grassed Swales or Roadside Ditches* encourage infiltration and reduce flow velocities.

4. End-of-Pipe Stormwater Management Facilities

These are used to service numerous lots or whole subdivisions. These facilities receive stormwater from a conveyance system and then discharge it to receiving waters:

- *Wet and Dry Ponds* temporarily store stormwater to allow settling of sediments. Wet ponds retain a permanent pool of water which allows sediment and other pollutants to settle to the bottom. Dry ponds have no permanent pool of water and are generally only used for quantity control. In other watersheds, dry ponds have recently been successfully retrofitted to provide quality control as well. A discussion of retrofitting ponds to treat the quality of stormwater is provided in Box 5 (Section 9.2.2.4).
- *Constructed/Artificial Wetlands* improve water quality as well as provide ancillary benefits in terms of habitat, although concerns have been raised because of the introduction of flora and fauna to pollutants.
- *Infiltration Systems* include infiltration trenches and basins.
- *Filter Strips* spread stormwater across a strip of vegetated land to promote filtering of pollutants and infiltration of stormwater.
- *Oil/Grit Separators* combine storage chambers for sediment trapping and oil separation with a drainage inlet, or inflow sewer, for intercepting stormwater runoff.
- *Buffer Strips* are natural areas (e.g., vegetated set backs) located between development and receiving waters.

MAP 14: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Areas Controlled by Stormwater Management Ponds



Note: Further details are available on each stormwater management facility from the TRCA.

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DATA SOURCES:
Planimetric, Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.
Stormwater Management Ponds and Study Areas
TRCA Pond Database.

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9.2.2 Surface Water Quality

Water quality in the Etobicoke and Mimico Creeks can be described through addressing the following questions:

- What is the current water quality in the Etobicoke and Mimico Creeks? Does it vary within streams? How does it compare with other streams?
- Is water quality getting better or worse? Is there a trend?
- Is the water safe enough for use? Does it meet objectives?
- Where does the pollution come from?

Water quality data from Ontario's Provincial Water Quality Monitoring Network (PWQMN) provide a basis for this assessment. Data has been obtained for the four stations on Etobicoke Creek and the two stations on Mimico Creek for approximately the last 30 years. Data from the period of 1985 to 1995 were considered to reflect "current" conditions. This assessment was augmented with data for the same period from the City of Toronto's fourteen Lake and Stream sampling stations in these watersheds. Data from this source were only collected during the summer months. Map 15 shows the location of the monitoring stations.

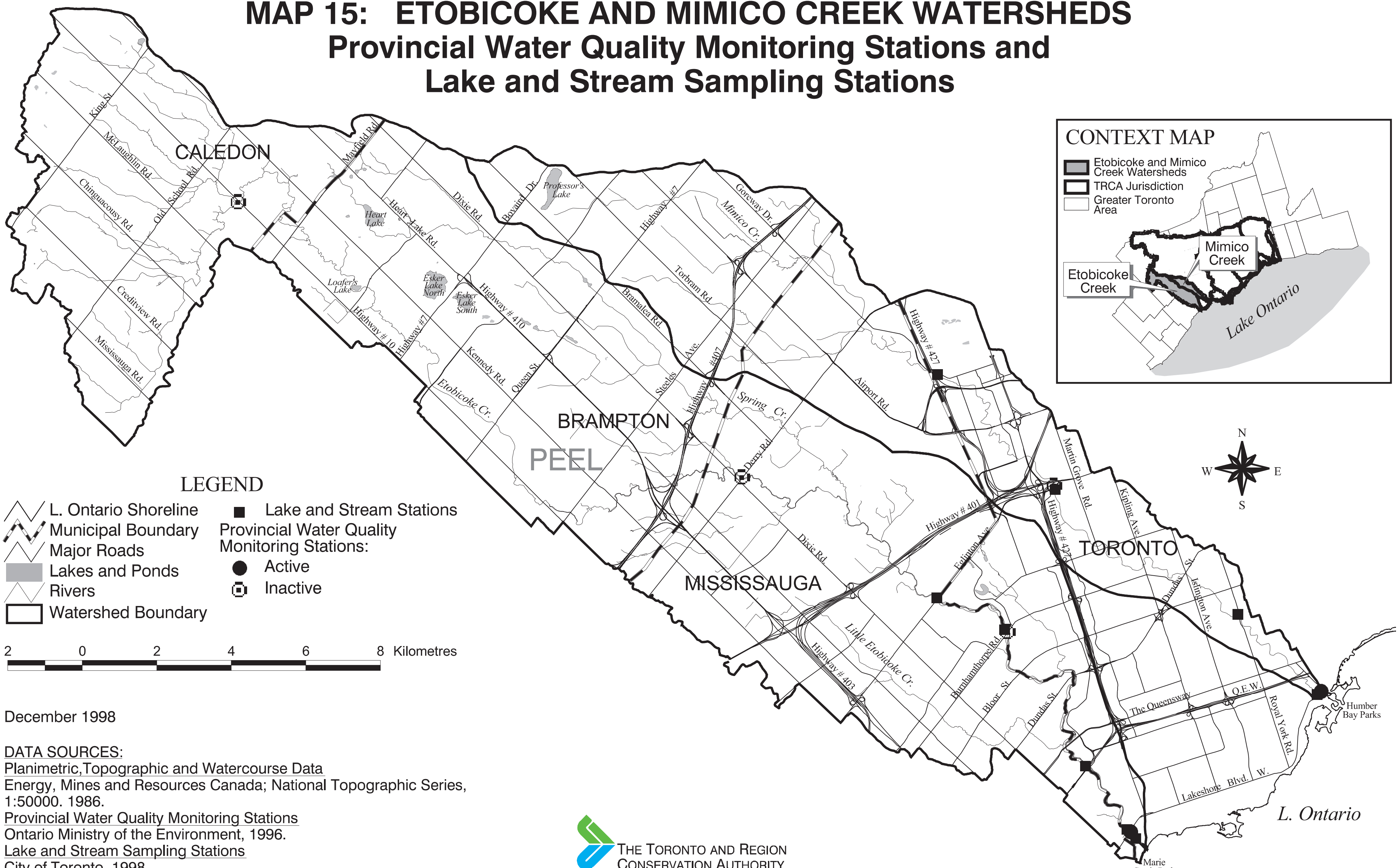
The assessment focused on four selected water quality parameters: phosphorus, suspended solids, chlorides, and faecal coliform bacteria. These parameters were selected for analysis due to their relevance to common water use concerns (Table 9.4). While heavy metals and persistent organic pollutants (e.g., pesticides) are also of interest, an accurate assessment of these parameters is not possible with data provided by the above-noted monitoring programs due to limitations associated with sampling and analytical techniques. Results of a specialized study of organic contaminants is included in Box 4.

Sections 9.2.2.1 to 9.2.2.4 summarize the results of this water quality assessment, which is described in more detail in *Etobicoke Creek and Mimico Creek Surface Water Quality Background Technical Report, Draft* (TRCA, 1998b).

9.2.2.1 Current Conditions

Water quality is degraded with high levels of phosphorus, suspended sediment, chlorides, and bacteria. Concentrations of these parameters progressively increase towards the mouth of each creek, with the exception of phosphorus which is high throughout the watercourses. Maps 16 to 20 show mean concentrations of parameters in the creeks relative to those in four other streams in the watershed of the Toronto and Region Remedial Action Plan (RAP): Humber River, Don River, Highland Creek and Rouge River. Chapter 12 provides details of the Toronto and Region RAP. Etobicoke and Mimico Creek water quality conditions are comparable to those observed in other urban watercourses, except the Rouge River which tends to be less degraded. Average chloride levels in Etobicoke and Mimico Creeks appear to be higher than in other local watercourses.

MAP 15: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Provincial Water Quality Monitoring Stations and Lake and Stream Sampling Stations



December 1998

DATA SOURCES:

Planimetric, Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Provincial Water Quality Monitoring Stations
Ontario Ministry of the Environment, 1996.

Lake and Stream Sampling Stations
City of Toronto, 1998.

Table 9.4: Rationale for the Selection of Key Water Quality Parameters

Selected Water Quality Parameters	Significance and Sources
Phosphorus	• Phosphorus and other nutrients generally do not have a direct impact on aquatic fauna. However, they do fuel plant and algal growth which may alter stream and lake habitats. As these plants die, they decay and this process consumes oxygen which, in turn, reduces the amount of oxygen available for aquatic life. Excessive plant growth also reduces water clarity and can be aesthetically undesirable. Phosphorus is a nutrient actively taken up by plants and, therefore, is not found in significant concentrations, except in waters receiving abnormally high inputs. The Ministry of the Environment has set a Provincial Water Quality Objective of 0.03 mg/L as the maximum concentration of phosphorus to protect aquatic life and assist in meeting requirements for recreation. • Sources include lawn and garden fertilizers, eroded soil particles from construction sites, stream banks, agricultural fields, and sanitary sewage.
Suspended Solids	• Suspended sediments are the small solid particles carried in water. For fish that rely on sight for feeding, turbidity may pose a problem. Where concentrations of suspended solids are too high, the particles may cause abrasion on the gills and affect the health of the fish. Particularly high suspended sediment concentrations are aesthetically undesirable. They also indicate that the bottom waters are choked with fine material as this sediment eventually settles over the bottom of the stream or lake when slower water velocities occur. Total suspended sediments also provide an indication of the presence of other contaminants such as oils, metals, and bacteria that tend to adhere to sediment particles. Less than 25-80 mg/L total suspended solids are recommended to maintain a good fishery. • Suspended sediments originate from many sources such as areas of soil disturbance (e.g., construction sites or farm fields), eroding streambanks and streambeds, and grit accumulated on urban streets.
Chloride	• Chlorides are usually present in most waters since they may be of natural mineral origin. The North American mean background concentration of chlorides is 8 mg/L. However, the largest contributions of chlorides can be linked to human activities such as road and parking lot salting, industrial wastes, and domestic sewage discharge. The Canadian Water Quality Guidelines identify 250 mg/L as the maximum concentration to protect the aesthetics and taste of drinking water. Chloride levels of 200-500 mg/L may have a limited impact on aquatic life. • Although chlorides are not critical to aquatic or human life at levels commonly observed, they are an important indicator of other sources of contamination. For example, an increase in chloride concentrations often acts as a "signature" for runoff from salted roads and other "urban" surfaces, or leachate from landfills.
Faecal Coliform Bacteria	• Although not of particular concern to aquatic life, bacteria densities impact on human health and the recreation potential of a water body. High bacteria levels in a water body are indicative of loadings of faecal matter of either animal or human origin. Acceptable limits for the bacteria *Escherichia coli* are 100 per 100 mL to protect for recreational water quality. Formerly, however, faecal coliform bacteria were measured as an indicator of health risk with a respective health limit of 100 counts per 100 mL. Therefore, in order to evaluate trends in bacteria levels over time, this former measure must be considered. • Bacterial loadings during dry weather can be attributed to illegal connections between storm and sanitary sewers and inputs from wildlife and domestic animals. During wet weather conditions, stormwater runoff carries bacteria from pet, livestock, and wildlife faeces and bacteria in association with eroded sediment particles to the watercourse.

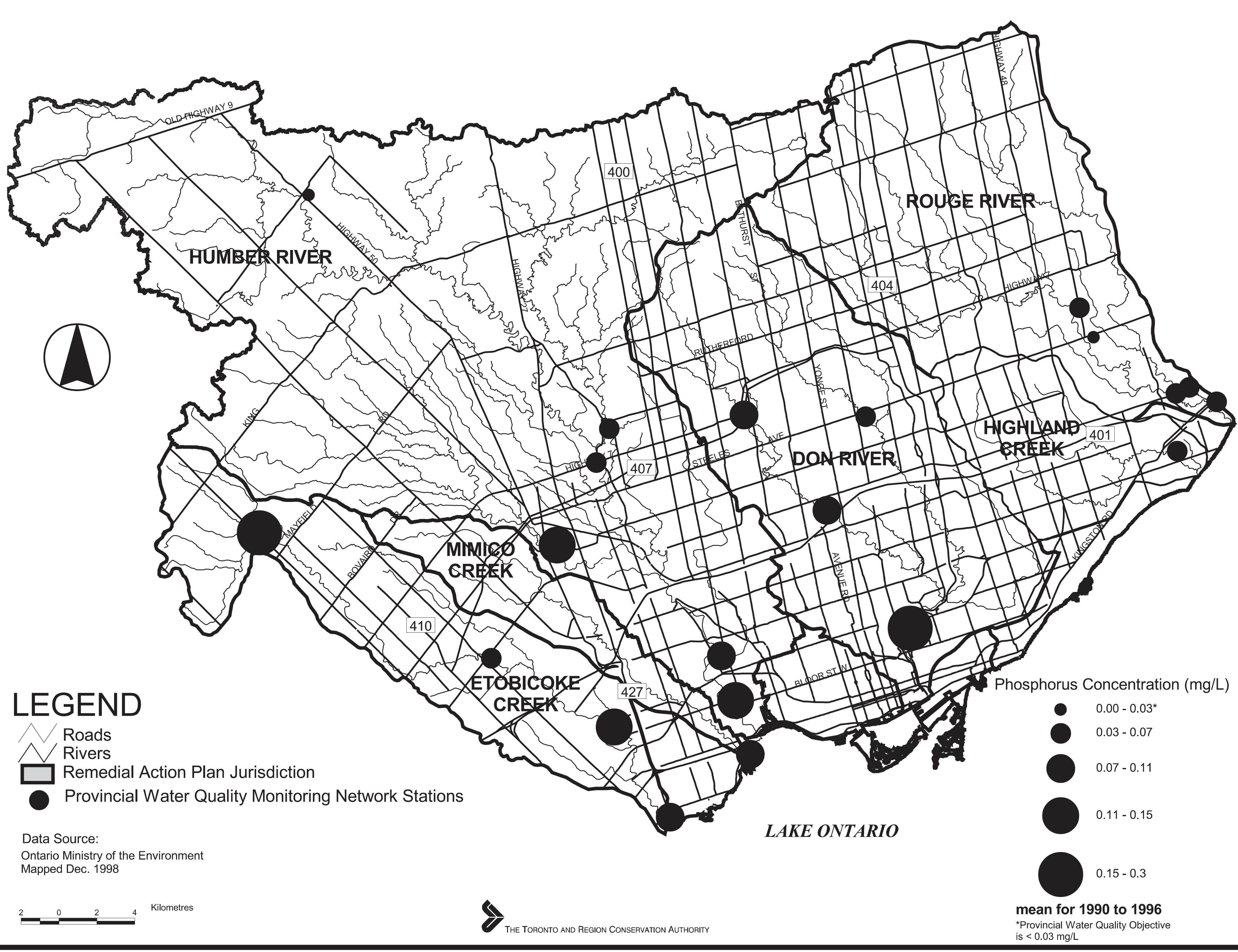
Phosphorus: Mean concentrations for phosphorus in the Etobicoke and Mimico Creeks are relatively consistent among sampling stations within each of the watersheds, ranging from 0.1 to 0.2 mg/L. When examined seasonally, phosphorus is elevated in the spring and fall, but is highest in the spring. These levels of phosphorus may be related to elevated suspended sediment levels. Spring runoff tends to carry more soil particles eroded from areas where vegetation growth has not yet stabilized exposed soils. Spring and fall phosphorus sources could also be associated with fertilizer application on agricultural crops and tillage practices.

Suspended Solids: Mean concentrations of suspended sediment progressively increase towards the mouth, ranging from 20 mg/L in the headwaters to 58 mg/L in the lower reaches of Etobicoke Creek. Mean values range from 19 mg/L in the mid reaches of Mimico Creek to 40 mg/L at Highway #2 (Lake Shore Blvd. West). Seasonally, suspended sediment levels are high in the spring due to increased flow. These sediments accumulate over the winter and are released in the melt waters during spring. Spring runoff also tends to carry soil particles, eroded from areas where vegetative growth has not yet been sufficient to stabilize exposed soils. An elevation in sediment levels also occurs during the summer months when thunderstorms flush sediments to the watercourses and flows erode stream banks.

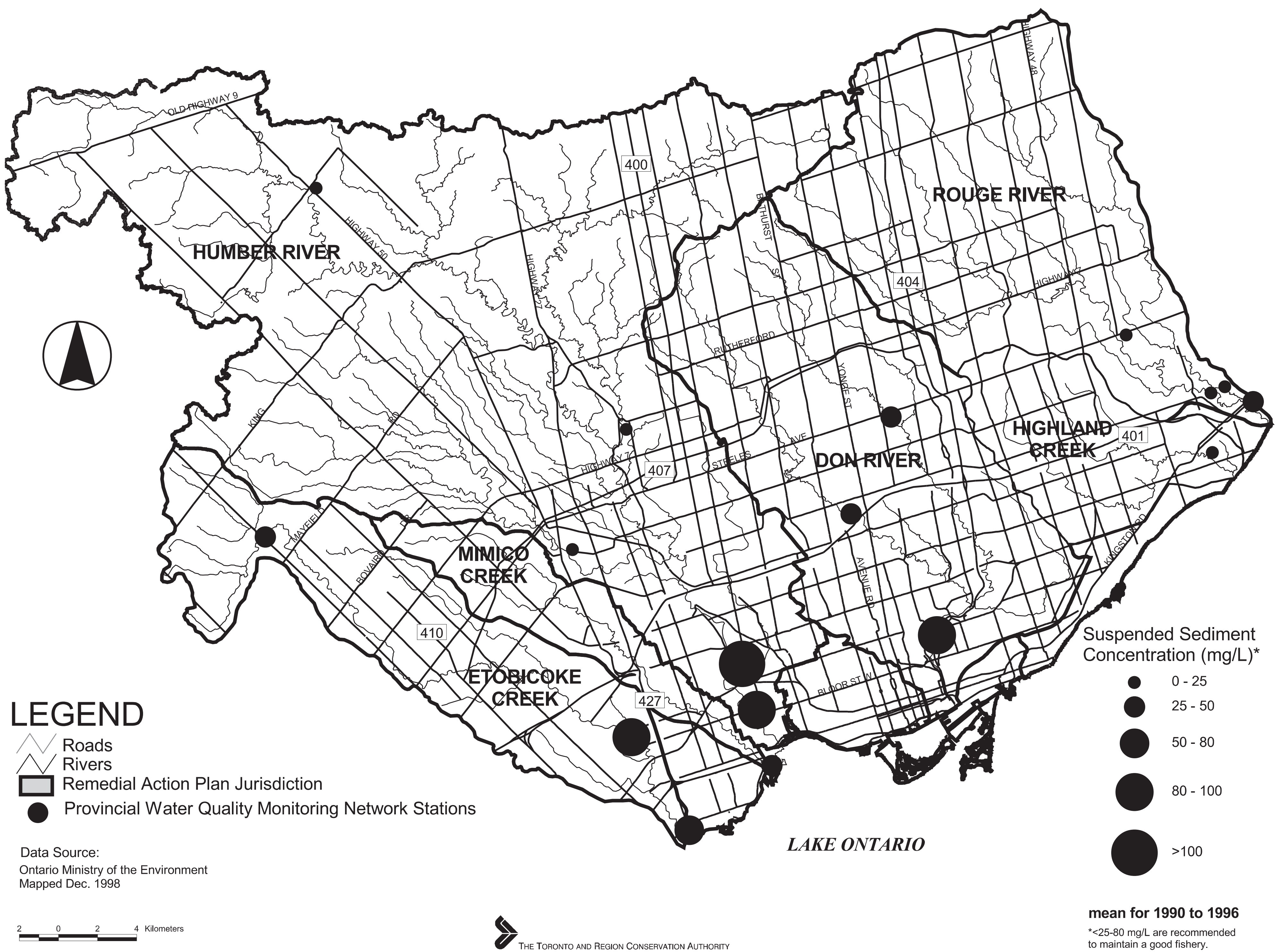
Chlorides: Mean values for chloride within Etobicoke Creek increase steadily from the upstream to the downstream stations. These values range from 218 mg/L at Derry Road to 307 mg/L at Highway #2. Similarly at the two stations on Mimico Creek, the mean values increase towards the mouth. These values range from 333 mg/L at the Richview Side Road in the mid reaches to 464 mg/L at Highway #2. Chloride concentrations tend to be slightly higher on average in Mimico Creek as compared to Etobicoke Creek, but well within the same order of magnitude. Chloride concentrations exhibit a very strong seasonal correlation with much higher levels observed during the December to March period. This directly relates to winter salt use on roads, driveways, and sidewalks.

Bacteria: Faecal coliform values progressively increase towards the mouth. However, in Etobicoke Creek at Burnhamthorpe Road, the mean value reaches 2588 counts/100 mL before dropping to 2213 counts/100 mL at the Highway #2 station. In Mimico Creek, high mean values of 2573 counts/100 mL at the Richview Side Road station jump to 4205 counts/100 mL at the Highway #2 station. Overall, bacteria levels fluctuate widely. Differences between minimum and maximum recorded values in both the Etobicoke and Mimico Creeks span three orders of magnitude.

MAP 16: TORONTO REMEDIAL ACTION PLAN STREAM WATER QUALITY PHOSPHORUS CONCENTRATION



MAP 17: TORONTO REMEDIAL ACTION PLAN STREAM WATER QUALITY SUSPENDED SEDIMENT CONCENTRATION



Data Source:
Ontario Ministry of the Environment
Mapped Dec. 1998

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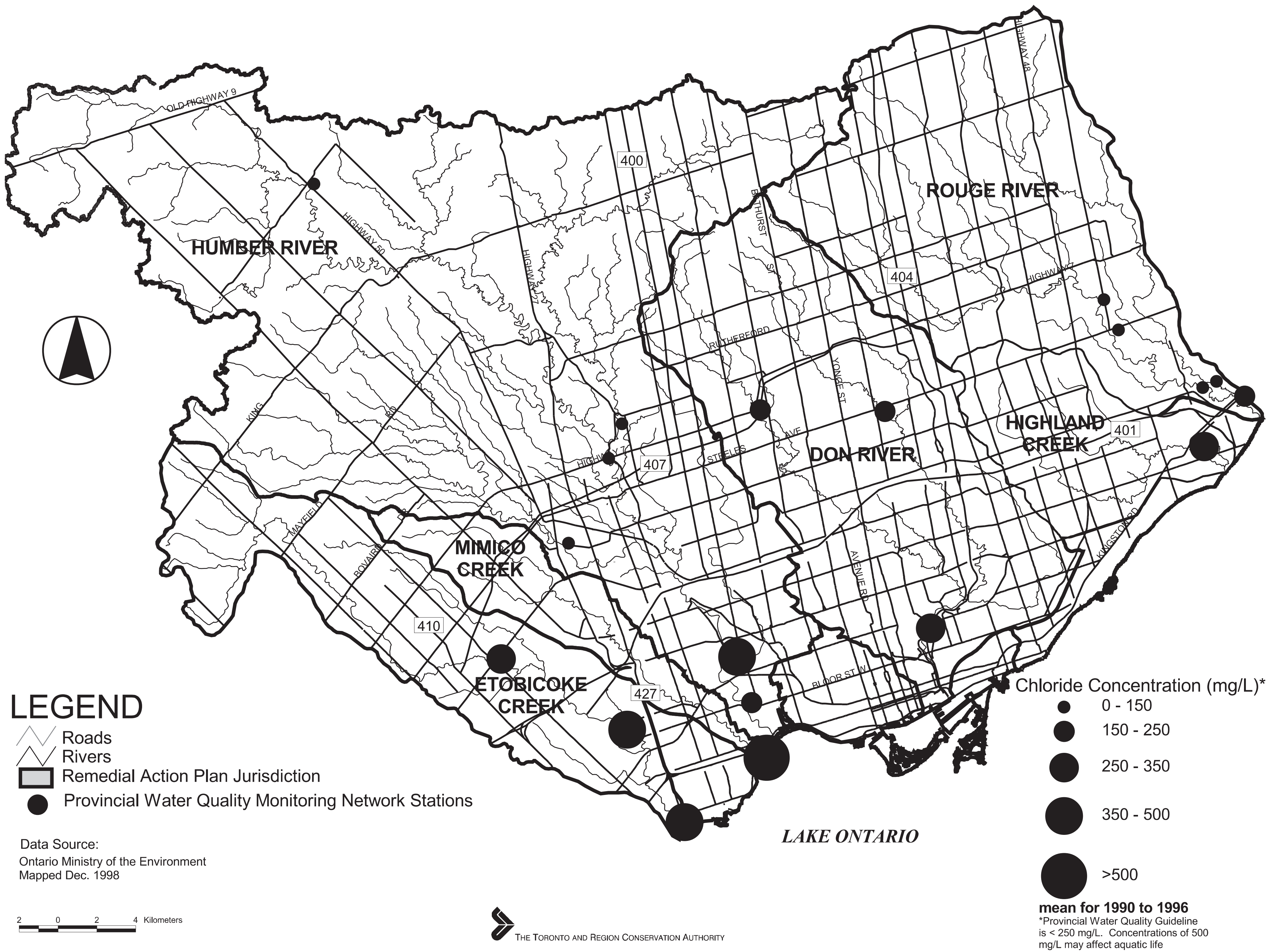
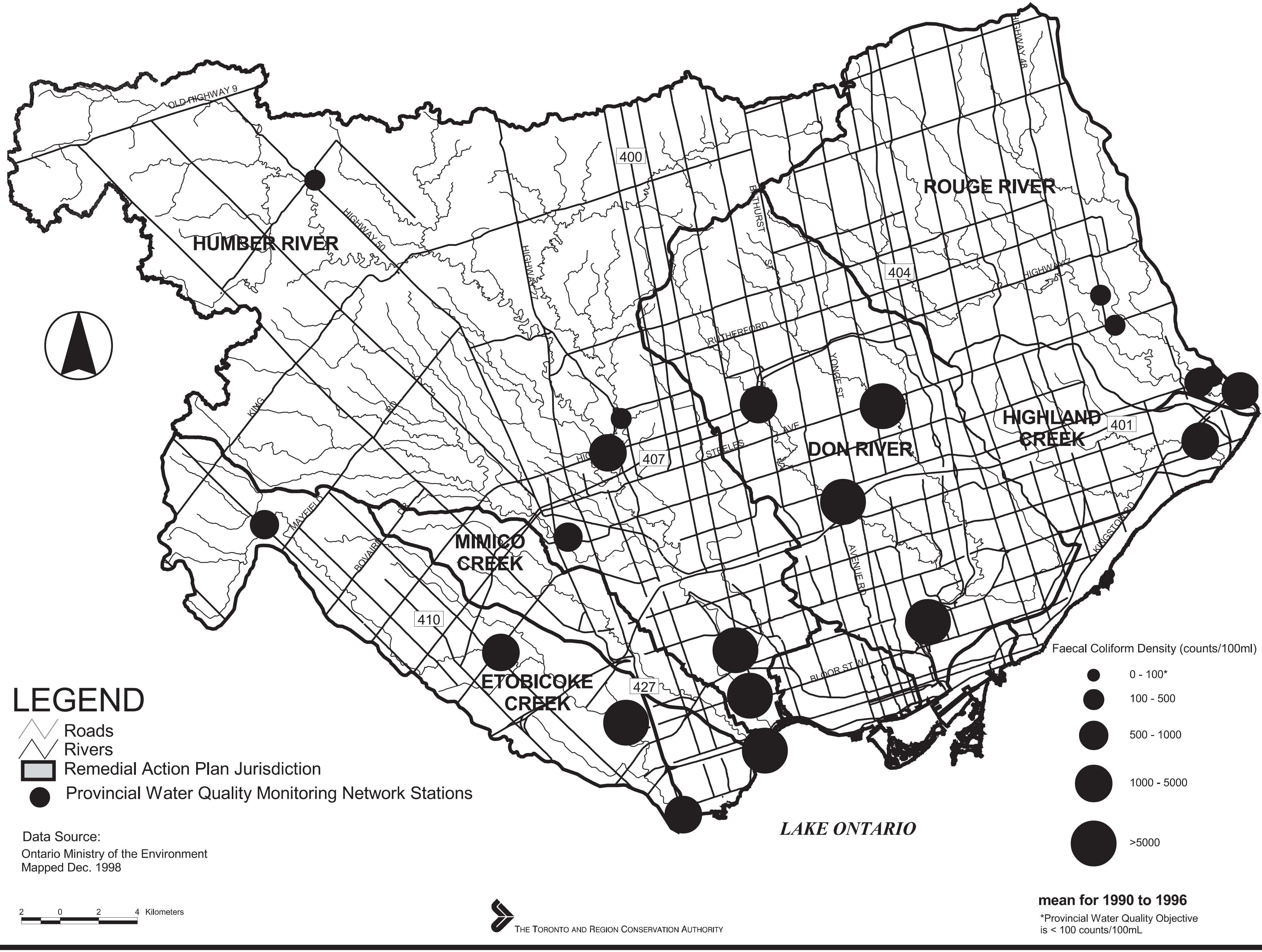
MAP 18: TORONTO REMEDIAL ACTION PLAN STREAM WATER QUALITY CHLORIDE CONCENTRATION



MAP 19: TORONTO REMEDIAL ACTION PLAN STREAM WATER QUALITY FAECAL COLIFORM CONCENTRATION



9.2.2.2 Trends

Water quality has been improving over the last 30 years, as evidenced by decreasing concentrations of phosphorus and suspended sediments. This trend is likely due, in part, to the success of management programs such as those introduced in the early 1970s to reduce phosphorus use in detergents. The decreasing trends in these parameters may also reflect more stable watershed conditions that have followed a period of soil disturbing activity that was associated with the urban growth of Brampton and Mississauga during the 1980s. It should be noted that no statistically significant trends were observed at the headwater station on Etobicoke Creek, which may be due to the continued impacts of active urban development and agricultural activities in the area. A detailed presentation of these findings can be found in the *Etobicoke Creek and Mimico Creek Surface Water Quality Background Technical Report* (TRCA, 1998b).

Increasing levels of faecal coliform bacteria and chloride have been observed and are attributed to urban growth within the watersheds. Urban growth introduces new bacterial sources, such as pet wastes and goose populations, as well as increased runoff which can carry bacteria to streams. Urban growth also increases the density of roads and paved surfaces that receive salt applications during the winter months. Municipalities try to reduce usage of road salt through better timing and lighter applications, but there are social expectations that roads be clear twenty-four hours a day and in all kinds of weather.

These trends are consistent with those observed in other local urban watersheds, such as the Don River and Highland Creek.

BOX 4: CONTAMINANTS IN FORAGE FISH

The presence of organic contaminants, such as PCBs and pesticides, is better studied by fish tissue analysis than water quality sampling. Of approximately 20 organic contaminants tested in young-of-the-year fish collected in 1992 from Etobicoke and Mimico Creeks, only PCBs and DDT were detected. PCB concentrations in common shiners were in excess of the International Joint Commission Aquatic Life Guideline at six stations on the Etobicoke Creek and at two stations on Mimico Creek. These results indicate that PCB concentrations are biologically available in these watersheds. Shiner samples from Etobicoke Creek, Mimico Creek and the Humber River had significantly higher PCB concentrations than fish from the Don River, Rouge River, and Highland Creek.

A significant decrease in PCB and DDT residues was observed in young-of-the-year spottail shiners over the period 1981 to 1989. This trend indicates that ambient levels of organic contaminants in the creeks, and thus inputs to Lake Ontario, have decreased over the years (Suns and Hitchin, 1994).

9.2.2.3 Violations of Water Quality Criteria

Water quality is generally measured against its ability to sustain uses, such as swimming or drinking, or other values, such as its ability to support a healthy aquatic community. As shown in Table 9.4, Provincial Water Quality Objectives (PWQO) or other guidelines have been established for each key water quality parameter in order to protect a particular use. The percentage of water quality samples that exceed the specified guideline can provide an understanding of present water quality conditions and concerns.

In the Etobicoke and Mimico Creek watersheds, water quality conditions exceed (i.e. fail to meet) Provincial Water Quality Objectives and other guidelines *over half the time* for most parameters.

- Despite significant reductions, phosphorus still exceeds the PWQO of 0.03 mg/L a significant portion of the time. Exceedences range from 57 to 99 percent in Etobicoke Creek, with the most exceedences occurring near the headwaters. Exceedences range from 84 to 90 percent in Mimico Creek. These levels may be fuelling excessive growth of aquatic plants in the creeks and represent a phosphorus load to Lake Ontario.

- Suspended sediment levels exceed the typical expected background level of 25 mg/L about 20 to 30 percent of the time in these watersheds. Some elevation in suspended sediments is natural during wet weather. These conditions do not pose a problem for aquatic life if they do not persist for prolonged periods, and if benthic organisms or sensitive habitats (e.g., fish spawning beds) are not impacted by sedimentation.

- Chloride levels exceed 250 mg/L 14 percent of the time at Derry Road, 35 percent and 54 percent at the lower stations on the Etobicoke and Mimico Creeks respectively. Concentrations of 500 mg/L and greater are sufficient to have an adverse effect on aquatic life if sustained for prolonged periods. Such concentrations are observed seven to 15 percent of the time in Etobicoke Creek and 14 to 20 percent of the time in Mimico Creek.

- Bacteria levels are such that body contact recreation is unsafe over 70 to 80 percent of the time throughout both creeks and almost all the time near the mouths.

9.2.2.4 Sources of Pollution

Although water quality is measured in a river system, it is influenced by the natural conditions and land use in a watershed. The predominance of impermeable soils in the Etobicoke and Mimico Creek watersheds and the associated natural high rates of runoff and limited groundwater contribution to baseflow would suggest that these watercourses would have had limited capacity to reduce the effects of pollutants carried in runoff, even in their natural state. The water temperature would have tended to be warmer in summer, without the cool groundwater inputs.

Currently, Etobicoke Creek is largely rural and agricultural in its upper reaches and urbanized in the lower portions. Mimico Creek is almost entirely urbanized. In the urban areas, industrial and residential land uses dominate, with Lester B. Pearson International Airport also being a major land use (Map 5, Chapter 5). These land uses and their associated activities are reflected in the quality of water in the creeks.

The following discussion focuses on the pollutant sources deemed to be of prime significance in the Etobicoke and Mimico Creek watersheds.

Stormwater Discharges

Stormwater runoff transports sediment, nutrients, bacteria, metals, and synthetic organic chemicals. These pollutants arise from a variety of sources in the urban landscape including pet and wildlife faeces, soil erosion, pesticides and fertilizers, road salt, vehicle use (oil, grease, and exhaust containing metals), and particulate matter from atmospheric deposition.

There are a number of lot-level, conveyance, and end-of-pipe stormwater management methods that may be used to remove pollutants from stormwater. These include pervious pipe systems, filter strips, and oil/grit separators, among others. These methods are briefly described in Box 3.

Stormwater runoff passes through storm sewers or drainage ditches directly to the creeks. Only developments since 1990 have incorporated stormwater ponds with a quality control component to treat stormwater runoff (Box 5). In the Etobicoke Creek watershed, only about 1949 hectares or 16 percent of the existing and future developed area is currently controlled for quality. In the Mimico Creek watershed, 273 hectares or 4.6 percent of the developed portion of the watershed is controlled for quality. Map 14: Areas Controlled by Stormwater Management Ponds in section 9.2.1.4 illustrates the areas within each watershed that have controls in place. Map 5: General Land Use (Chapter 5) shows existing and future development in the watersheds.

In 1996, the City of Mississauga completed a Stormwater Quality Control Strategy which sets out a proactive plan for the incorporation of stormwater management facilities within new developments and for the retrofit of stormwater management infrastructure in existing urban areas. The City of Toronto is preparing a Wet Weather Flow Master Plan which will recommend approaches for improving stormwater management in Toronto. The TRCA is undertaking a GIS-based Stormwater Management Retrofit Study for areas of the Etobicoke and Mimico Creek watersheds outside the Cities of Toronto and Mississauga. Phase I of this study includes identification of all existing stormwater management ponds and drainage areas controlled by these ponds. This was completed in 1998. It is anticipated that work will begin on Phase II in early 1999. Phase II involves preparation of a stormwater management retrofit strategy which identifies ponds that have potential to be retrofitted to provide quality treatment of stormwater. Phase II will also establish and apply criteria to assess the feasibility of retrofitting existing storm sewer outfalls in uncontrolled areas. Phase III involves the development of an implementation strategy based upon the findings of Phase II.

BOX 5: CONSTRUCTING OR “RETROFITTING” PONDS TO TREAT THE QUALITY OF STORMWATER

For new developments, stormwater management facilities are designed to mitigate any or all of the following impacts of urbanization: increased quantity of runoff, lowered water quality, and greater potential for stream bank erosion.

There are a number of stormwater ponds within the Etobicoke and Mimico Creek watersheds that control water quantity, quantity, or both quantity and quality. Stormwater quality ponds mitigate the degraded quality of urban runoff by promoting the settling of suspended solids or particles, and where wetland vegetation is present, some nutrient removal may be provided. Water quality ponds may take various forms including wet ponds, dry ponds, and constructed wetlands. Wet ponds and wetland ponds provide a permanent pool of water which acts to dilute the poor quality inflow, promote settling, and prevent re-suspension of previously settled particles. Wetland ponds are typically of shallower depths and so have a larger portion of their surface area covered by emergent vegetation.

The prevention of stream bank erosion resulting from urbanization is typically incorporated in water quality facilities by allowing for the slow release of runoff volumes from relatively frequent rainfall events, for example, one inch of rainfall or less. In other words, the runoff from such a storm is stored and released over a period of one to two days with the intent of reducing the outflow to the point where the existing stream banks will not experience increased erosion.

Although all three components of quantity, quality, and erosion control are now typically incorporated in a single pond, the design of earlier water quantity ponds did not address the issues of water quality and erosion impacts for a number of reasons: the ponds were generally dry facilities and they released the runoff relatively quickly (typically over a few hours). Without sufficient detention time for those events more frequent than the two year storm, little or no erosion control was afforded by these facilities. Also, lacking a permanent pool of water, these facilities provided limited water quality improvement. Nevertheless, traditional water quantity ponds can provide 'retrofit' opportunities in existing built-up areas. Subject to maintaining their original flood control function these facilities can, in many instances, be re-worked to achieve both improved water quality and erosion control where none previously existed. This is typically undertaken by excavating the pond bottom to create a permanent pool and promote emergent plant growth, and by adjusting the outlet structure to increase the storage time (thereby choking back the outflow) for frequent rainfall events.

In addition to stormwater runoff, storm sewer infrastructure may carry pollutants released through illicit discharges or accidental spills. Municipalities and agencies recognized this concern and began storm sewer outfall monitoring in Mimico Creek as early as 1973. Currently, the Region of Peel and Cities of Mississauga and Toronto monitor storm sewer outfalls during dry weather, to varying degrees, to identify any with high contaminant levels. Such outfalls are often termed “priority outfalls.” Contaminants may be traced back to their sources (e.g., spills or improper connections) so offenders can be warned to change their practises, or can be prosecuted. The identified priority outfalls may differ from one monitoring study to the next as some sources of pollution will be remediated but new sources may occur.

In 1990, the City of Mississauga conducted a dry weather outfall study at all 99 outfalls on Etobicoke and Mimico Creeks in the City. They determined that 21 outfalls regularly discharge high levels of one or more parameters. Arsenic, BOD, copper, and faecal coliform were the most frequently exceeded parameters. Although a subsequent study in 1994 identified improvements to the City’s monitoring methods, the earlier study provides an indication of sewersheds requiring follow-up action. The 1994 study began a process which led to the identification and remediation of pollution sources.

The City of Toronto (the former Metro Works Department), in its regular pollution abatement program, identifies priority outfalls discharging to the Etobicoke and Mimico Creeks within the City in order to locate contaminant sources and take action. In 1994-95 (the most recent report), five out of 85 outfalls were classified as “priority” on Etobicoke Creek. Problem parameters were listed as iron, zinc, phosphorus, ammonia, BOD, and phenols. Of the 70 outfalls on Mimico Creek, nine were classified as “priority” with problem parameters listed as iron, zinc, ammonia, BOD, phenols, and suspended sediment. A more detailed description and mapping of priority outfall locations (1994-1995) within the City of Toronto can be found in the *Etobicoke Creek and Mimico Creek Surface Water Quality Background Technical Report* (TRCA, 1998b).

Although runoff contamination from sources at the Lester B. Pearson International Airport (LBPIA) has been a serious concern, significant progress has been made in recent years to mitigate LBPIA’s impact on water quality. For example, the construction of a central de-icing facility to collect excess de-icing fluid was completed in the fall of 1998. A tank, which drains into Mimico Creek, is designed for quality control. The three ponds in the southern Etobicoke Creek portion of the airport property also accommodate quality. Further, a dry pond, designed for both water quality and quantity, has been constructed in the Etobicoke Creek valley on the airport lands. Another facility, located near a tributary of Spring Creek in the in-field area, will accommodate both water quality and erosion concerns associated with the airport’s expansion (Map 14). With the airport’s expansion and the associated runoff, some of the ponds within the airport will be upsized to accommodate the increased runoff.

Spills

Deliberate discharges or accidental spills are especially prone to occur in densely urbanized areas, particularly in industrial areas and transportation corridors. During the period 1988 to 1996, a total of 92 spills that reached the Etobicoke and Mimico Creeks were reported to the Spills Action Centre at the Ministry of the Environment. Within Etobicoke Creek, approximately 48 percent of the 63 reported spills were oil, petroleum, or diesel fuel. In Mimico Creek, these types of spills represented approximately 55 percent of the 29 reported spills. The percentage of these types of spills is attributable to the fact that petroleum is one of the most common liquids used in urban areas, and as a liquid, it can move easily.

Analyses undertaken as part of the Toronto Area Watershed Management Studies suggest that a petroleum spill of 100 litres may be as toxic to aquatic biota as combined sewer overflows or stormwater runoff, and that the frequency of occurrence may be of more concern than the actual magnitude of a spill. For those spills reported with known volumes, the average volume of spill in the Etobicoke and Mimico Creeks was 342 litres. It should be noted that not all spills are reported and that sources of spills may be unknown.

Map 20 shows the location of reported spills in the Etobicoke and Mimico Creek watersheds. Most spills have occurred in the following industrial areas:

- Dixie Road and Highway 403 area, south of Highway 401;
- Highway 27 and Highway 427 area, north of Highway 401; and
- Highway 410, north of Highway 401.

A number of spills have also occurred on the Lester B. Pearson International Airport lands. These areas with numerous spill occurrences could be considered as the focus of more intensive spills reduction and pollution prevention programs and may be addressed with new stormwater management facilities, such as those to be incorporated in the airport expansion project.

Stream Bank Erosion

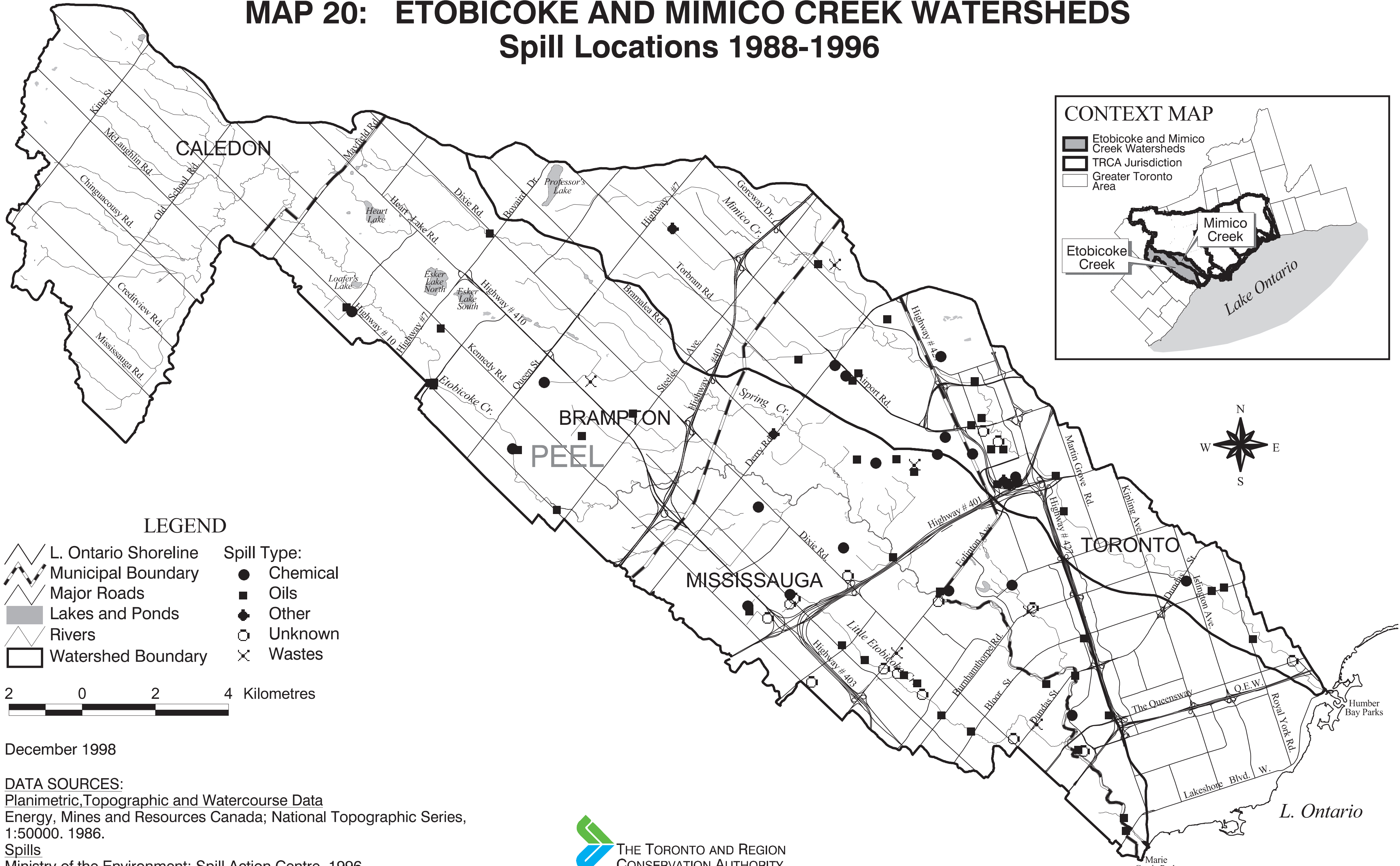
Stormwater runoff not only has a direct impact on river water quality, but it also indirectly affects quality through accelerated stream bank erosion and the associated release of sediment. Although bank erosion is a natural phenomenon, urban development increases the volume of runoff and the frequency of erosive flows. Table 9.5 shows that erosion rates for the Etobicoke and Mimico Creeks and other predominantly urban watercourses are listed among the highest of major tributaries in the Toronto area. Although management practices have improved since these data were collected in 1973, the pattern illustrated by the data underscores the importance of incorporating stormwater management practices in new and existing developments. It should be noted that some differences in erosion rates are due to natural differences in soil erodibility. Map 11 shows where some erosion control works have been completed in these watersheds.

Table 9.5: Erosion Rates of Major Tributaries in the Toronto Area

Tributary Name	Predominant Land Uses	Sediment Yield (t/km^2/yr)	Erosion Yield (mm/yr)
Duffin Creek	rural/urban	110	0.042
Rouge River	urban/rural	128	0.048
Highland Creek	urban	238	0.090
Don River	urban	236	0.089
Humber River	rural/urban	158	0.060
Mimico Creek	urban	241	0.091
Etobicoke Creek	urban/rural	215	0.081
Credit River	rural/urban	108	0.041
Oakville Creek	rural/urban	112	0.042
Fourteen Mile Creek	rural/urban	112	0.042
Bronte Creek	rural/urban	117	0.044

Source: E.D. Ongley, Sediment Discharge from Canadian Basins into Lake Ontario (1973) in RCFTW, 1991.

MAP 20: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Spill Locations 1988-1996



December 1998

DATA SOURCES:
Planimetric,Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.
Spills
Ministry of the Environment; Spill Action Centre. 1996.

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Construction Activity
Newly developing urban areas, infill development, redevelopment, and instream works represent potential sources of sediment loadings to the watercourse--if proper erosion and sediment controls are not employed. The Cities of Mississauga and Brampton have enacted Erosion and Sediment Control By-laws to strengthen their ability to promote and enforce the use of proper controls. Map 5: General Land Use, shows areas committed to future development in the upper Etobicoke Creek watershed.

Rural/Agricultural Sources
Agricultural areas also represent a potential source of pollutants (e.g., suspended sediment, phosphorus, bacteria) if proper practices are not employed. Elevated concentrations of phosphorus and suspended sediment in the upper Etobicoke Creek may be attributed to the lack of adequate erosion and sediment controls during construction activities and farming practices. The Rural Clean Water Program, administered by TRCA, is a remedial action program designed to improve local water quality in rural areas. The emphasis of the program is to educate land owners about rural water quality issues and provide technical and financial assistance to improve management practices and mitigate the levels of bacteria and nutrients entering watercourses. Between 1995 and 1997, three Rural Clean Water Program projects were carried out in the Etobicoke Creek watershed. These included a septic system repair, a manure management project, and a field and streambank erosion project. All of these projects were undertaken in the Town of Caledon.

Landfills and Contaminated Sites
There are approximately eight closed landfill sites in the Etobicoke Creek watershed and five closed sites in the Mimico Creek watershed (Map 9). Most of these sites were operated for the disposal of municipal and domestic waste between 1940 and 1979 (MOE, 1991). Historical records of landfill sites vary considerably in the amount of information available about the site and its operation. Although the locations of many of the closed landfill sites in the Etobicoke and Mimico Creek watersheds are known, it is not known whether they are contributing leachate to ground or surface water systems. Investigations into their impacts on ground and surface water quality are usually conducted on an as needed basis. When a problem is detected through monitoring, remedial actions are taken.

The Region of Peel monitors methane gas and leachate at waste disposal sites on municipal and conservation authority lands. Ground and surface water monitoring is undertaken at selected sites to determine if there is any migration of leachate offsite or other impacts which may be associated with the landfill. Two sites within the Peel portion of the Etobicoke and Mimico Creek watersheds are actively monitored by the Region.

The City of Toronto monitors methane gas and leachate at selected sites. The program is currently under review because of recent amalgamation of the City. The City's priority outfall program may also detect leachate by monitoring outfalls which service landfill sites.

Some contaminated sites have also been identified in the watersheds. These sites represent property or lands that have not been rehabilitated. For reasons of public health or safety or environmental quality, they are unsafe for use as a result of human activities that have left a chemical or radioactive residue (Region of Peel, 1998). These sites have become contaminated from domestic, commercial, industrial, hazardous, or radioactive wastes, which are often associated with previous land uses.

Pet and Wildlife Faeces

Pet and wildlife faeces can represent a significant source of bacteria to urban waters. The *Highland Creek State of the Watershed Report, Draft* (TRCA, 1998) states an estimate of approximately 6900 dogs living in the Highland Creek watershed, which is about one third the area of the Etobicoke and Mimico Creek watersheds combined. These dogs generate the equivalent daily faecal output of 2300 humans. It is interesting to note that under current regulations, a community of that size would be required to have a communal sewage treatment system to manage the waste.

Atmospheric Fallout

Atmospheric sources of various pollutants can be relatively more significant in urban areas than in predominantly rural watersheds. This is due to the large area of impervious surface and the stormwater conveyance systems that collect and convey pollutants to watercourses, often without treatment. A local Toronto outfall monitoring study (D'Andrea et al., 1993) found no significant difference in stormwater quality between drainage areas of different land use types (e.g., industrial, residential) for most parameters. This finding may be explained by a common atmospheric source of pollutants.

Vehicle emissions may be a relatively significant source of certain pollutants. A study characterizing the sources of polycyclic aromatic hydrocarbons (PAHs) in street and creek sediments noted the significance of vehicle emissions relative to other industrial sources, because most of the PAHs in vehicle emissions are deposited on the street/road grid itself or within 40 metres either side of the road (Sharma et al., 1997). Stormwater runoff conveys pollutants directly to drainage systems, without opportunity for filtration as might occur with particles deposited on vegetated surfaces.

Air quality is a result of local, national, and international sources. Generally, air quality has improved in Ontario over the past 25 years, however; there are increasing problems with ground-level ozone and suspended particulates. Of these pollutants, particulates are of most concern to water quality. Particulates are created by industrial processes and are present in motor vehicle exhaust. Further discussion on air quality within the Etobicoke and Mimico Creek watersheds is provided in section 7.2 of this report.

SUMMARY

Water quality in the Etobicoke and Mimico Creeks is degraded with high levels of phosphorus, suspended sediment, chlorides, and bacteria. Concentrations of these parameters progressively increase towards the creek mouths with the exception of phosphorus, which is high throughout the watercourses. Water quality conditions in the watersheds exceed Provincial Water Quality Objectives and other guidelines *over half the time* for most parameters. In terms of trends, water quality has been improving over the last 30 years, as evidenced by decreasing concentrations of phosphorus and suspended sediments. However, increasing levels of faecal coliform bacteria and chloride have been observed. Further, spills of oil, petroleum, diesel fuel, and other substances into the creeks occurred a total of 92 times during the period 1988 to 1996. Similar to other local urban watersheds, water quality in the creeks reflects the impacts of land use.

LIFE

CHAPTER 10

This chapter describes the living component of the natural heritage system. As it is not possible to describe the condition of individual species in the Etobicoke and Mimico Creek watersheds, another approach is needed to categorize the living component of the watersheds into groups of a manageable size. One such approach to describing the condition of living things in the watersheds is through describing the categories of habitat on which living things depend.

The term habitat is used to describe a set of conditions that provide food, shelter, water, and space for a variety of organisms. In turn, the presence of these organisms can modify the physical environment to provide habitat for other organisms. For example, a set of physical conditions such as light, temperature, moisture, and landform provide the conditions to support a plant community. The presence of a plant community modifies the physical conditions (shade, organic matter, humidity) to provide habitat for a variety of other plants and wildlife. Describing habitat in terms of the broad types and amount, infers the condition of habitat for a wide variety of organisms. This chapter is divided into two broad types of habitat: aquatic and terrestrial.

10.1 AQUATIC HABITAT

The aquatic environment is an integral part of the ecosystem as it provides habitat for a wide variety of organisms including invertebrates, fish, and mammals. The health of the aquatic environment, and the condition of the Etobicoke and Mimico Creek watersheds as a whole, are interconnected and interdependent. This is because the aquatic environment is directly affected by the quality and quantity of water that flows over or through the land. Thus, aquatic habitats provide one indication of watershed health.

The aquatic ecosystem is most often recognized or described as fish habitats, since fish communities have a long history of being used as indicators of aquatic ecosystem health. The following sections provide an overview of three broad categories of aquatic habitat found in the Etobicoke and Mimico Creek watersheds: riverine, lacustrine, and estuarine. For each category of habitat, its significance, condition, and changes in its condition over time are described. Activities that have affected the condition of habitats are also identified.

A more comprehensive analysis of these habitats, a description of the physical, biological, and chemical conditions in the watersheds, and an inventory of fish species can be found in *Evaluating the Condition of Fish Communities in the Etobicoke Creek Watershed* (TRCA, Draft, 1998c) and *Evaluating the Condition of Fish Communities in the Mimico Creek Watershed* (TRCA, Draft, 1998d).

10.1.1 Riverine Habitat

Riverine habitat includes two basic habitat categories: coldwater and warmwater. These categories are influenced by a number of watershed characteristics, including surficial geology, land use, and streamflow characteristics, that influence the fish species that are present or could be sustained.

Riparian vegetation along Etobicoke Creek

In the past, a number of combined factors produced good quality riverine habitat in the watersheds. First, there was a high percentage of woody vegetation located along watercourses in the riparian zone. The riparian zone is the area of land adjacent to a creek, pond, or lake that is periodically inundated with water and this influences the type of vegetation community present. This vegetation assists in the stabilization of stream banks, aids in shading watercourses, and provides instream structure for many organisms. Although riparian vegetation does not lower water temperatures, it prevents them from rising which is particularly important in coldwater systems. Second, on the Peel Plain near the headwaters of the creeks, many hectares of wetlands provided for the storage of water and moderated flows. Finally, a forested landscape contributed organic inputs and delayed and reduced a large amount of runoff from entering the watercourses.

The surficial geology in the Etobicoke and Mimico Creek watersheds consists of materials that result in high runoff rates and little groundwater recharge and discharge (Map 8, Chapter 9). Groundwater discharge is an important factor in determining the type of fish community that can be sustained. The more groundwater discharge to the watercourse relative to the average annual flow, the increased potential for coldwater habitat. Research indicates that a ratio of greater than 20 percent groundwater discharge to average annual flow is required to support trout species. Streamflows in the majority of watercourses in the Etobicoke and Mimico Creek watersheds have baseflow ratios around 8 to 14 percent and therefore have very limited coldwater potential.

Historically in the Etobicoke Creek watershed, two watercourses provided coldwater habitats. One coldwater stream was a headwater tributary of the main branch of Etobicoke Creek, while the other was a tributary of Spring Creek associated with the Brampton Esker. Mottled sculpin, an indicator of coldwater conditions, were once found in these areas. There is no evidence that the Mimico Creek ever provided coldwater habitat. Today, there is no coldwater habitat in either the Etobicoke or Mimico Creek.

The remainder of Etobicoke Creek and all of Mimico Creek would have contained healthy warmwater riverine habitats. Both watersheds provided good quality aquatic habitat for a number of sensitive warmwater species including darter species, bass, and perch.

Currently, the Etobicoke Creek watershed contains about 220 kilometres of watercourses and the Mimico Creek watershed contains approximately 59 kilometres. Both of the watersheds are dominated by tolerant warmwater fish communities, although the upper reaches of Etobicoke Creek also has some warmwater species that are more sensitive. In total, the number of fish species presently found in the Etobicoke Creek watershed is 27, three of which are introduced. The number of species found in the Mimico Creek watershed is 14, two of which are introduced. This is considerably less than the 64 species found in the Humber River (TRCA and MNR, 1998), 51 in the Rouge River (MTRCA and MNR, 1992a and b), and 36 in the Credit River (Steedman, 1987). With 18 species, more fish species can be found in the Don River than in Mimico Creek (MTRCA and MNR, 1996). The larger size and, other than the Don River, the better coastal marshes in these other watersheds are probably responsible for more species being found.

Over time, riverine habitat in the Etobicoke and Mimico Creek watersheds has been severely impacted by a number of human activities and land uses, some of which are outlined below.

Land uses that decrease the ability of soil to infiltrate water or speed the movement of water toward the creeks, can alter the hydrologic cycle toward less groundwater infiltration and greater surface runoff. If the change in the surface and groundwater regime is large enough, it can significantly impact both warmwater and coldwater habitats. Historically, the largest change in the hydrologic cycle would have resulted from the clearing of forests that once covered the watersheds. The loss of forest cover allowed more water to flow over land and reach the watercourses faster. The next major change in the hydrologic cycle that has been similar in magnitude is urbanization. The impermeable surfaces and the network of storm sewers associated with urban areas increases the volume of surface runoff and reduces the time it takes for runoff to reach the creeks. For the creeks, this runoff causes flows to be increased and 'flashy,' meaning water levels rise and drop quickly.

There are many other rural and urban activities that affect riverine habitats. To accommodate rural and urban land uses, many watercourses have been straightened, piped, and filled. There is evidence that about 33 percent of watercourses in the Etobicoke Creek watershed and 59 percent of watercourses in the Mimico Creek watershed have been altered (Map 10, Chapter 9). Currently, only 17 percent of watercourses in the Etobicoke Creek watershed and 23 percent of watercourses in the Mimico Creek watershed have woody riparian vegetation that helps to stabilize steambanks and shade watercourses (Map 21). In addition, weirs and other physical instream barriers have been built for milling, flood control, energy dissipation, and other purposes. In 1997, a TRCA survey identified 61 instream barriers in the Etobicoke Creek watershed and 73 instream barriers in the Mimico Creek watershed (TRCA, 1998c and d). In many cases, these barriers have fragmented aquatic habitats for lake resident species moving upstream and river species moving within the watersheds. Another problem is the impairment of water quality through sediment runoff from agricultural lands or construction sites in urban areas. Finally, the loss of most wetlands to accommodate human use of the land has prevented the storage of water which would have moderated flows in the creeks.

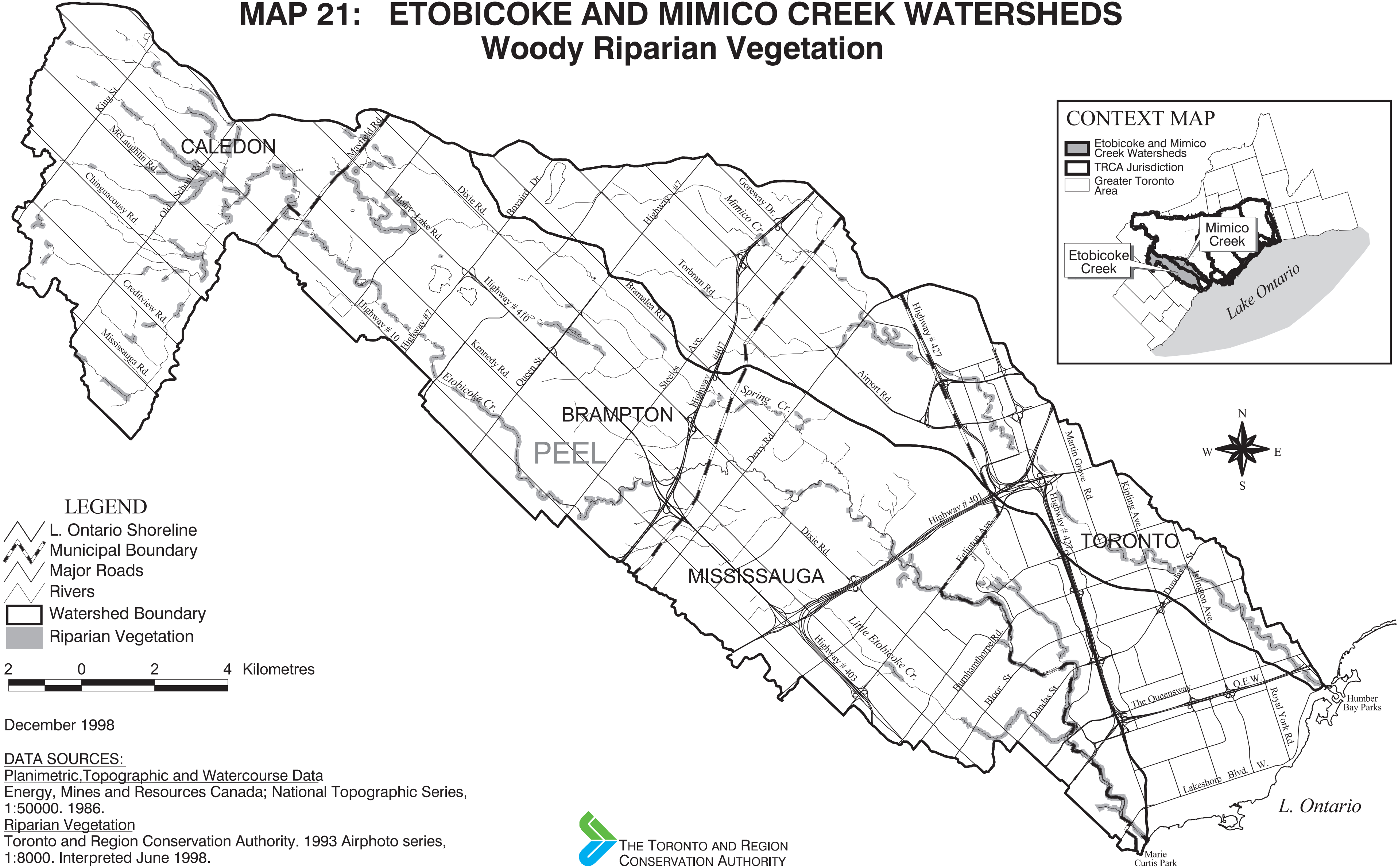
The result is that today, darter species are only found in the upper areas of Etobicoke Creek and mottled sculpin disappeared with the destruction of coldwater riverine habitat. Riverine habitats in both the Etobicoke and Mimico Creek watersheds support a low diversity of fish and the more sensitive species have been replaced by white suckers, black nose dace, fathead minnow, bluntnose minnow, creek chub, and other tolerant warmwater species.

10.1.2 Lacustrine Habitat

Lacustrine habitat is characterized by the presence of standing water. There are two types of lacustrine habitat in the Etobicoke and Mimico Creek watersheds: lakes and ponds. Although other waterbodies such as stormwater management, golf course, and rural farm ponds may provide aquatic habitat, only larger waterbodies are dealt with in this section.

Waterbodies can be on-line or off-line. On-line ponds are directly connected to a stream or river, where the stream or river passes through the waterbody. Off-line ponds may be completely isolated with little or no connection to a stream or river, or indirectly connected where a surface channel or pipe directs some flow from the stream or river to the pond. However, these off-line ponds may have subsurface flow of groundwater which can influence nearby ponds or rivers, for example, the lakes on the Brampton Esker. Both on-line and off-line ponds tend to warm the water and contribute to more evaporation than would be expected in a flowing system.

MAP 21: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Woody Riparian Vegetation



LEGEND
- L. Ontario Shoreline
- Municipal Boundary
- Major Roads
- Rivers
- Watershed Boundary
- Riparian Vegetation

2 0 2 4 Kilometres

December 1998

DATA SOURCES:

Planimetric,Topographic and Watercourse Data

Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Riparian Vegetation

Toronto and Region Conservation Authority. 1993 Airphoto series, 1:8000. Interpreted June 1998.

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Lakes

Historically, there were probably only two significant waterbodies located in the Etobicoke Creek watershed: Teapot Lake and Heart Lake, both of which are kettle lakes. Kettle lakes were formed during the Wisconsin glacial period over 10,000 years ago when blocks of ice that were trapped under glacial overburden melted, causing a natural, steep-sided depression on the surface. There is no evidence of significant waterbodies being present historically in the Mimico Creek watershed.

Teapot Lake is located at the southwest corner of Mayfield and Heart Lake Roads, within the Heart Lake Conservation Area. The lake is an unusually small and deep kettle lake and it provides very limited lacustrine habitat. It is unique as it is meromictic (meaning the deeper waters of the lake are perpetually stagnant as they never mix to the surface to become reoxygenated). This has an enormous impact on the invertebrate and fish communities. For example, the fish population is almost entirely composed of young-of- the-year which do not survive more than seven months. The few adults that survive to reproduce, overwinter in small areas of spring water (Rigler, 1975). Teapot Lake is off-line, and thus is not accessible by riverine species which could potentially replenish the population.

Heart Lake is characteristic of many kettle lakes in that it has limited or no connections to surrounding water bodies. Typically, kettle lake ecosystems support warm water fish species. At present, Heart Lake is a warmwater fishery containing golden shiner, largemouth bass, pumpkinseed, and brown bullhead. It is also stocked with rainbow trout, a coldwater species, to create a put-and-take recreational fishery.

Over time, nutrient enrichment has been a problem in Heart Lake, aggravated by surface runoff and the direct input of nutrients caused by a commercial duck farm which operated during the mid-1900s. The deposits of nutrients on the bottom of the lake are a major cause of blue-green algae during the summer months (M.M. Dillon Ltd., 1991).

In the 1980s, nutrient loading resulted in Heart Lake becoming anoxic: the bottom waters were devoid of oxygen for extended periods of time during the summer and winter months. The lack of oxygen resulted in reduced habitat, particularly for rainbow trout which are dependent on high levels of oxygen. The increased nutrient and bacteria levels in Heart Lake were compounded by few connections to Etobicoke Creek; therefore, once the nutrients entered the lake, there was a slow exchange rate and the excessive quantities of nutrients were not transported downstream. This process of nutrient enrichment is referred to as eutrophication and it results in poor water quality and aquatic habitat conditions. Currently, in an attempt to control algal blooms and improve the fishery, the bottom waters of Heart Lake are aerated by a “lake lung,” a technology developed by the Ontario Ministry of the Environment.

Many other lakes within the Etobicoke Creek watershed were created as a result of aggregate extraction activities in the City of Brampton. Loafer's Lake was created in the 1970s on the site of an old gravel pit. The lake provides habitat for several warmwater fish species including minnows, rock bass, blacknose dace, and creek chub. Four other waterbodies are located on the Brampton Esker and are rehabilitated gravel pits: Major Oaks Lake, Parr Lakes North and South, and Norton Place Park Lake. Currently, the gravel pits containing Esker Lakes North and South are being considered for rehabilitation (Golder Associates, 1994).

Heart Lake: A kettle lake in the City of Brampton

Within the Mimico Creek watershed there are no natural kettle lakes. The only lake is Professor's Lake in the City of Brampton. The lake is off-line and is on the site of an old gravel pit. The lake is now surrounded by residential development and parkland, and is used primarily for recreation. Commonly found recreational fish in Professor's Lake include rock bass and pumpkinseed. It is also possible to find carp, smallmouth bass, largemouth bass, and black crappie (Metro RAP et al., 1993).

Ponds

Natural ponds occur as a result of beaver dams, fallen logs, or other debris blocking the creek channel. Other natural ponds are formed by river movement and the creation of oxbows (meanders in a river that are severed from a watercourse through erosion). There are a number ponds in the watersheds which were created for the watering of livestock, irrigation, aesthetic, recreational, or other purposes.

Within the Mimico Creek watershed, the few created ponds which exist are used primarily for aesthetic and recreational purposes, for example, the off-line ponds located at the Woodbine Racetrack.

Within the Etobicoke Creek watershed, two of the larger created ponds are Centennial Pond located in the City of Toronto, and Chinguacousy Pond located in the City of Brampton. Both ponds are on-line and used for recreational purposes. These ponds support tolerant warmwater fish species such as largemouth bass, and fathead and bluntnose minnows. There are also a number of created ponds located in the headwater areas of Etobicoke Creek in the Town of Caledon. These ponds are used primarily for agricultural purposes, for example, irrigation and livestock watering. A 1996 survey of 10 rural ponds in the Mayfield West area found that these ponds supported a limited warmwater fish community.

Overall, there are few lakes and ponds that were created by natural processes in the watersheds. Today, there are a greater number of waterbodies than in the past, but few provide good aquatic habitat.

In the Etobicoke Creek watershed, rural land uses affect the water quality in lakes and ponds. Agricultural practices, such as applying fertilizers and improper manure storage, generate significant runoff of nutrients and bacteria that can accumulate in lakes and ponds.

In the Etobicoke and Mimico Creek watersheds, water quality is affected by the input of inorganic contaminants from urban land uses and stormwater runoff. For example, lakes and ponds located in close proximity to roads will receive urban stormwater and the associated contaminants (oil and grit) from roads. Once these pollutants enter a waterbody, they can negatively impact aquatic communities.

10.1.3 Estuarine Habitat

Estuarine habitat occurs in the area of transition from the creeks to Lake Ontario. Although they are relatively small in size, estuaries collectively form a critical component in the maintenance of local fisheries resources and healthy ecosystems (Stephenson, 1988). Estuaries create aquatic habitat sheltered from open lake conditions and tend to favour warm water fish species such as largemouth and smallmouth bass, and northern pike (Strus, 1995). Despite their significance, estuarine environments represent some of the most depleted aquatic habitats along the shores of Lake Ontario (Whillans, 1982) and their loss represents a significant impairment of the ability of these areas to support aquatic life (Strus, 1995).

Estuarine habitat in the Etobicoke Creek watershed extends from the mouth of the creek to the CN railway tracks just above Lake Shore Boulevard West, a distance of about 0.8 kilometres. This habitat is characterized by low slope, low water velocities and depths, little aquatic vegetation, and is directly influenced by the water level in Lake Ontario. This part of Etobicoke Creek was once very sinuous, with slow moving waters and likely an abundance of aquatic vegetation.

Historically (from at least 1848 to 1907), Etobicoke Creek had five hectares of wetlands in its estuary (Whillans, 1982). The estuary provided habitat for 35 species, particularly warmwater species such as pike, largemouth bass, perch, and numerous minnow species. The wetlands provided feeding and nursery areas and helped migrating fish move upstream. Both lake and river species would have been found in the estuary.

After 1920, urbanization of the waterfront accelerated concurrent with the filling of streams, marshes, embayments, and sheltered areas, including the estuary of Etobicoke Creek (Strus et al., 1993). After the devastation caused by Hurricane Hazel in 1954, the mouth of Etobicoke Creek was channelized, the land expropriated, and industrial waste was used to raise the elevation of the land for parkland and development (Metro Council Minutes, 1954). This resulted in the obliteration of any remaining wetlands.

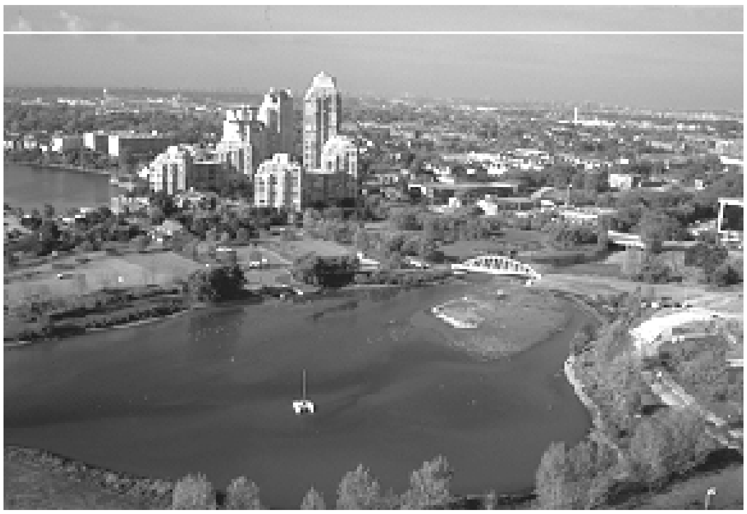
Presently, the mouth of Etobicoke Creek has channelized banks which are protected by vertical concrete breakwalls at the entrance to the lake. The river mouth is shallow (1-2 metres) and the substrate consists of rubble, boulders, and rock ledges (Buchanan, 1989). The estuary in Etobicoke Creek provides habitat for 15 species and is dominated by white suckers. This number of species, 20 less than what was found historically, demonstrates that the estuary is heavily degraded. Fish species that rely on good estuarine habitat are no longer found in this area of Etobicoke Creek.

Estuarine habitat in the Mimico Creek watershed extends from the mouth of the creek to the CN railway tracks (above Lakeshore Blvd. West), a distance of about one kilometre. This habitat is characterized by low slope, and is directly influenced by the water level in Lake Ontario.

Historical maps suggest that Mimico Creek once had a limited estuarine wetland (Ontario Archives Map B-46, 1856). These maps indicate pasture land on the west side, south of the CN tracks to the mouth. Pasture land extended north and was probably wet meadow when inundated in the spring. The areas subsequently dried up in early summer, and then the vegetation was harvested (Ernest Rush, 1998). The historical conditions may have been suitable spawning habitat for some species, including northern pike. It is likely that the function of this wetland was intimately tied to the water level fluctuations in Lake Ontario. The estuary in Mimico Creek would likely have provided habitat for some 25 species of fish.

At the mouth of Mimico Creek, deposition of lakefill was completed in 1976, creating Humber Bay Park East and West and extending the mouth of Mimico Creek offshore roughly 500 metres. This situation resulted in the creation of a small watercourse within a large channel. Over the past 20 years, the bedload sediments have filled in half of the new channel. These sediments provided an opportunity to recreate a small coastal wetland.

In 1992, an area at the mouth of Mimico Creek was selected for habitat rehabilitation: the Mimico Creek Estuary Wetland. The project entailed creating 1.93 hectares of estuary wetland habitat, including establishing a vegetation community, creating structural habitat enhancements for fish and wildlife, and improving access to the waterfront through the construction of a pedestrian bridge linking Humber Bay Park East with Humber Bay Park West. An official opening for the project will likely occur in 1999. Currently, 11 fish species are located in the Mimico Creek estuary, 14 less than historical levels. However, the addition of lakefill and the subsequent creation of wetland habitat at the mouth, has enhanced the potential for attracting lacustrine fish species.



The Mimico Creek Estuary Project, 1998

SUMMARY

Riverine, lacustrine, and estuarine habitats in the Etobicoke and Mimico Creek watersheds have been significantly altered and degraded as a result of deforestation, agriculture, and development. Settlement, and later urbanization, caused many watercourses to be filled, piped, channelized or otherwise altered. In the remaining watercourses, there is a general lack of woody riparian vegetation, barriers to fish movement, poor water quality, and unstable flows.

Although currently there are more lakes and ponds present in the Etobicoke and Mimico Creeks then there were historically, many of these waterbodies have been created from former aggregate mining pits and have been rehabilitated for recreational or aesthetic purposes. Generally, these lakes and ponds do not provide good aquatic habitat. In the case of the naturally formed kettle lakes, Heart Lake has been affected by excessive nutrients, but still continues to support some sensitive species. Teapot Lake, because of its unique characteristics, does not provide a suitable habitat for most fish species.

The estuarine habitat located at the mouths of the Etobicoke and Mimico Creeks has been significantly altered from what was present historically. In addition to physical changes to aquatic habitats, poor water quality due to high levels of runoff have made watercourses, waterbodies, and coastal areas appropriate habitat for only the most tolerant warmwater fish species. However, as mentioned in section 9.2.2 (Surface Water Quality), there are some initiatives which are working to improve water quality and thus improve fish habitat in the watersheds, such as the *Mississauga Stormwater Quality Control Study.*

10.2 TERRESTRIAL HABITAT

An aerial view of the Etobicoke and Mimico Creek watersheds shows a heavily fragmented landscape with no remaining large expanses of natural habitat. Natural area remnants typically occur within two main landscape contexts: 1) those which are found in isolated patches on tableland; and 2) those found in association with valley and stream corridors. These can be further divided into areas which are located in an agricultural setting and those which are within urban areas. The Etobicoke and Mimico Creek watersheds comprise a north to south gradient in intensity of land use. It is useful to draw a distinction between the predominantly agricultural landscape of the headwater areas and the urban land use that dominates the remainder of the watersheds because the status of terrestrial habitat and potential for biodiversity conservation differs substantially between the two.

The following sections provide a summary of the condition of each major terrestrial habitat type found in the Etobicoke and Mimico Creek watersheds including forests, meadows and old field, successional, and wetlands. Special designations or treatment of some of these features is also discussed.

The habitat types were measured through remote sensing (i.e. aerial photographs, satellite imagery). The analysis of terrestrial habitat conditions was guided by a set of principles based on the objectives of biodiversity conservation and the maintenance of ecosystem health and integrity. These principles are particularly relevant in landscapes where natural habitats are fragmented and isolated by surrounding land use. A number of these principles (modified from MNR, 1997 and MNR 1998) are summarized in Box 6. A more detailed study and assessment of terrestrial habitat in the Etobicoke and Mimico Creek watersheds can be found in the *Terrestrial Habitat Analysis of the Etobicoke and Mimico Creek Watersheds, Draft* (TRCA, 1998f).

BOX 6: PRINCIPLES FOR HABITAT EVALUATION

Habitat Type and Representation All open areas provide habitat that is of use for some species. "Natural" habitats are of greatest concern since these and their associated species are rapidly disappearing as humans modify the landscape. While a natural heritage system typically attempts to maintain representation of all indigenous habitat types and species within a given region, in a heavily settled landscape it may not be possible to maintain a natural ratio of habitat types.

Naturalness/Disturbance The concept of "natural" is problematic because it often assumes a lack of human influence, and few such areas exist in a settled landscape. A more appropriate approach may be to consider the degree to which an area has remained unaltered or unmanaged over a period of time. Generally, the more pristine and less disturbed a natural area is, the better its capacity will be for representation and maintenance of biodiversity. Undisturbed areas can also act as historical baselines for ecological restoration, and can be important for scientific study. However, regenerating habitats that support many native species of plants and animals such as old field, can also be considered as "natural"--especially in agricultural and urban landscapes.

Habitat Size Large patches of habitat are typically of greater value than small patches. Larger areas are more likely to sustain ecological functions such as nutrient recycling. Some species are "area sensitive" and need large blocks of a particular habitat type. Large blocks also help to maintain species richness (total number of species in a given landscape). However, in areas where small patches of habitat are all that remains, they perform many useful functions, for example, being stopover habitat for migratory birds and butterflies.

Forest interior is used to describe parts of a forest block that are 100 metres or further from the forest edge. This is considered to be the minimum distance in which "negative edge effects" will penetrate a forest block.

Habitat Shape In part, habitat shape determines the degree a forest is exposed to edge effects. These are negative external influences that affect the structure and species composition of a forest fragment. They include wind damage, increased predation by opportunistic "edge" species, brood parasitism of native songbirds by the brown-headed cowbird, and exotic plant invasions.

The amount of edge compared to the amount of interior habitat in a forest fragment is measured as the edge-to-interior (or edge-to-area) ratio. Long, thin, or irregularly shaped forest fragments tend to have a great deal of edge and no interior. In contrast, compact blocks have a greater capacity to support interior habitat, and will have less edge. A circle has the lowest edge-to-interior ratio (Payne and Bryant, 1994; Forman, 1995).

continued. . .

BOX 6: PRINCIPLES FOR HABITAT EVALUATION (CONTINUED)

Fragmentation/Connectedness The long term viability of wildlife populations is largely based on the ability of individuals to find adequate resources and to maintain fitness through genetic exchange. These are enhanced by dispersal capacity of a species, meaning the capacity of a species to move freely. The dispersal capacity of wildlife can be restricted according to the degree to which a species is a habitat specialist and the measure of isolation of its habitat in the landscape. Forest patches that are close together will be easier to reach than those which are far apart. A natural connection between habitats that provides cover can act as a corridor that helps to allow movement. In settled landscapes, valley and stream corridors are often the best candidates for maintaining connectivity between natural habitats.

Arrangement/Proximity Closely clustered habitat patches are better than those which are far apart (Noss, 1995). The ability of wildlife to move, or for seeds to be dispersed between suitable habitats is in part dependent on how close together the habitats are. Hydrological and biochemical functions are also more likely to be maintained if patches are in close proximity (MNR, 1997).

At the landscape level, the concepts of arrangement and proximity involves the concept of interspersion, meaning the interface between natural habitat types (Forman, 1995). Zones of interspersion are high in biodiversity because several habitat types are represented in one small area; therefore, they have the capacity for maintaining a high representation of species.

Habitat Diversity/Complexity Vertical structure is a fundamental feature of forest ecosystems. A healthy forest typically has several vegetation layers, including the canopy of mature trees, an understorey of young trees or shrubs, and the herbaceous ground layer made up of wildflowers, ferns, and other plants. Woody debris on the forest floor can also be considered a structural feature. The presence of these layers helps to explain why forests tend to have a higher degree of biodiversity than other ecosystems, since each layer provides habitat (a niche) for different species (Hunter, 1990; Adams, 1994).

Horizontal structure also affects biodiversity. For example, an untouched forest is typically a shifting mosaic of different age classes and regenerating areas that provide a variety of habitats for wildlife (Sauer, 1998).

Species Diversity Sites that have a high species diversity could have the capacity to maintain representation of more species and habitat types. To a large degree this capacity depends on habitat size, shape, and relationship to other natural areas in the landscape.

Species Rarity Special attention should be given to rare species and their habitats since these are most at risk of disappearing. Many species have been officially designated as significant because they are vulnerable or endangered, although many rare species have yet to be officially recognized. At the watershed level, National, Provincial, regional, and local significance should be considered.

10.2.1 Forested Land

Based on dominant vegetation community type, Canada has been divided into nine floristic regions. The Etobicoke and Mimico Creek watersheds are located in a transition zone between the Carolinian (deciduous forest) and Great Lakes-St. Lawrence (mixed forest) regions. Habitats typical of each of these floristic regions are unevenly distributed in the watersheds according to local conditions of soil, drainage, and microclimate.

Europeans who first visited the Etobicoke and Mimico Creek watersheds would have found them blanketed in forests that featured many large "old growth" trees. Uplands were dominated by such deciduous species as sugar maple, American beech, red oak, and basswood. Yellow birch and patches of eastern hemlock were typical of cool, damp lowlands. Forests in southern Ontario were likely to be similar to those in northeastern New England where average canopy height was around 24 metres (80 feet) with towering white pines reaching heights of 46 to 55 metres (150 to 180 feet) or more (Whitney, 1994).

Wildlife present in the region at the time of European settlement would have included such large mammals as gray wolf, cougar, black bear, elk, and possibly bison (Kurta, 1995). All of these are now extirpated (locally extinct), presumably as a result of habitat loss and hunting pressure.

The process of settlement included establishing saw mills to take advantage of the abundance of commercially valuable trees. Good growing conditions led to the subsequent clearing of forests and draining of wetlands to make way for cattle grazing and agriculture (ODPD, 1947). Continuous agricultural use left a fragmented landscape in which mere remnants of the original habitat types and their component species are found in isolated patches. These survived because they were unsuitable for crop production, or were set aside for other values such as supply of firewood, recreational use, and water retention.

For the past few decades, the major development trend in the watersheds has been the process of rapid urbanization. The consequences of this process for terrestrial habitat are numerous and complex. While urbanization can result in direct loss of habitat remnants, the greatest concern may be indirect impacts of such intensive land use on wildlife and natural areas.

Because forests were once the dominant terrestrial habitat type in most of southern Ontario, their conservation and restoration is of highest priority for restoring biodiversity and watershed health. The Canada-Ontario Remedial Action Plan Steering Committee has developed a number of guidelines for forest habitat. One of these guidelines suggests that 30 percent of a watershed should be forest covered as a minimum ecological requirement for watershed health or rehabilitation (Environment Canada et al., 1998).

The Etobicoke Creek watershed is 211 square kilometres and the Mimico Creek watershed is 77 square kilometres. Currently, only 4.3 percent of the Etobicoke and 1.7 percent of the Mimico Creek watershed are forest covered (Map 22). That the watersheds were probably close to 100 percent forest covered prior to European settlement suggests that almost all of the forest cover has been lost. These amounts fall well short of the 30 percent forest cover guideline that is suggested as a minimum ecological requirement for watershed health or rehabilitation (Environment Canada et al., 1998). However, given the extent of urbanization in the watersheds, it is unlikely this target would be reached in these watersheds.

In terms of habitat type and representation, Table 10.1 demonstrates that the most abundant forest type in the watersheds is deciduous. In mixed deciduous and coniferous forests, the evergreen component usually consists of individuals or small stands of eastern white pine, eastern white cedar, or eastern hemlock. True coniferous forest is rare, particularly in the Mimico Creek watershed. Riparian deciduous forest dominated by willows, elm, or Manitoba Maple is also found in patches along stream edges throughout the watersheds.

TABLE 10.1: Forest Cover Type by Watershed

Forest Cover Type	Etobicoke Creek (Hectares)	Mimico Creek (Hectares)
Deciduous	594	92
Coniferous	52	1
Mixed	259	41
Total	***905***	***134***

Source: Information Management Group, TRCA, 1998.

The relationship between forests and biodiversity is important with respect to forest values. Forests are highly complex systems composed of thousands of individual species, all of which have evolved together by interacting over time. The health of the entire system and the other ecosystems that interact with it is dependent upon the sustaining of these species and their interaction. All human values of forests are ultimately based on maintenance of this ecological web.

Considering the value of forests, the loss of forest cover is an issue of concern. For example, forests are known to act as sponges, absorbing and retaining rainfall before releasing it slowly to continuously replenish streams and rivers. In doing so, forests maintain water quality by reducing erosion and resulting siltation. By providing shade, forests keep waters cool and clear, reducing algal growth and associated eutrophication. In summary, removal of forest cover can lead to rapid runoff, soil erosion, siltation of streams, and loss of water quality.

The role of forests in the production of oxygen is well recognized, as is their value in climate control. Both local and global climates are moderated by the presence of trees which absorb heat energy and provide shade. Forests are also widely appreciated for aesthetic qualities.

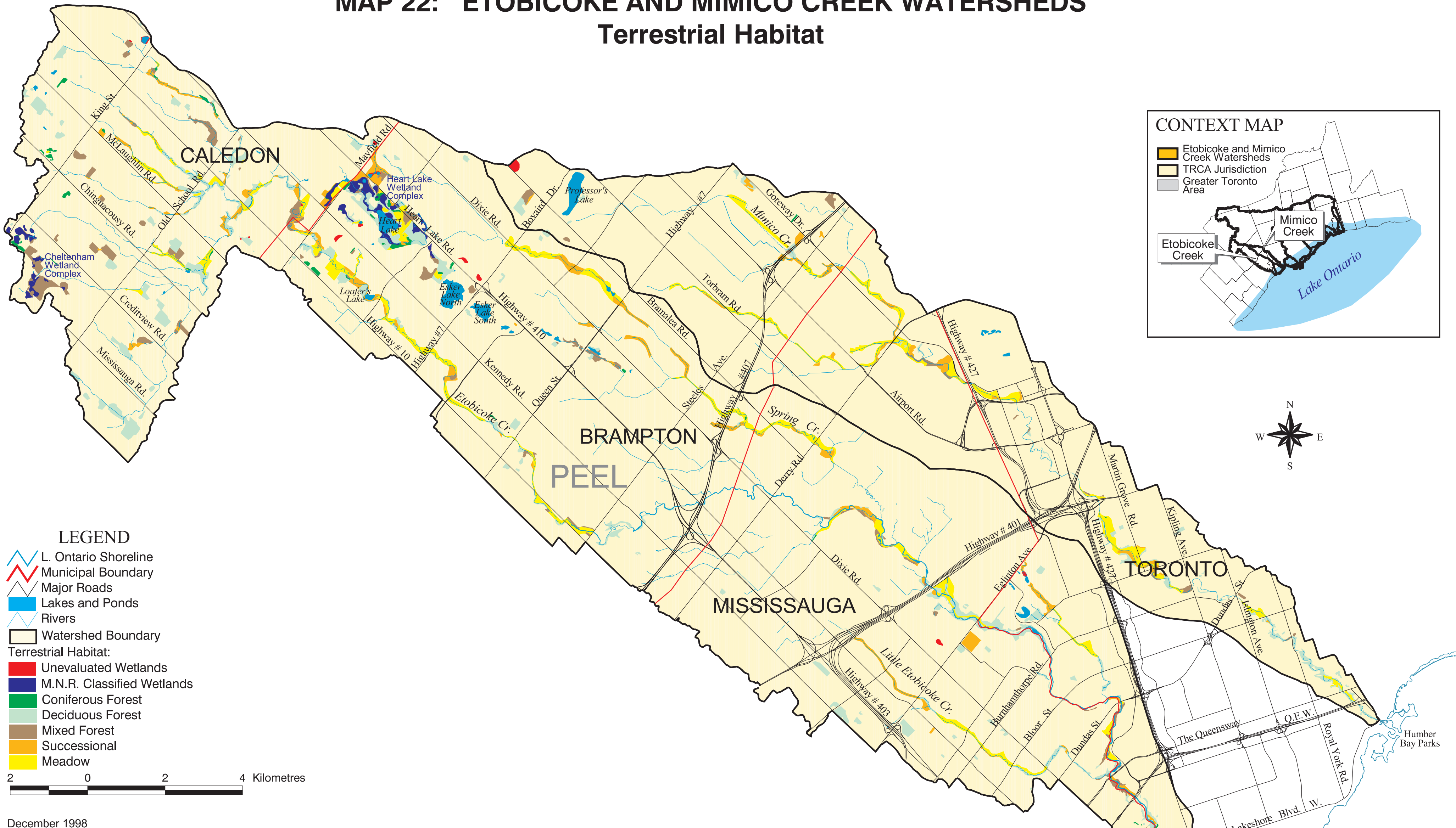
In the watersheds, forests are subjected to different degrees of disturbance. Private woodlots, especially those in the agricultural landscape, are typically used for fuelwood collection or recreation. Those forests that are well-managed tend to have a healthy vegetation structure. This includes good canopy cover, a thick understorey of shrubs and young trees, and a herbaceous ground layer that features typical forest wildflowers such as trilliums, trout lily, and jack-in-the pulpit. Horizontal structure is also important, with tree stands of varying species groups and age classes represented. The diversity of these and vegetation communities in general tends to be lower in small forest patches.

Forests within the urban setting, especially those on public lands, tend to be heavily used for recreation. The presence of many pedestrians, dogs, and mountain bikes causes damage to the understorey, the herbaceous ground layer, and woody debris through trampling and soil compaction. Wildflowers, fiddleheads, and small vertebrates are subject to collection, and the latter also suffer increased predation by domestic cats and dogs. This may explain why only isolated pockets of relatively undisturbed forest with a healthy vegetation structure are found in the southern portions of the watersheds.

Related to structure and disturbance is the stage of ecological succession which a forest has reached. Successional habitats that represent a stage between meadow or old field and forest are considered separately in section 10.2.3. Woodlands characterized by old growth, the “climax” stage of succession, are now rare in southern Ontario since much of the forest was cut within the past 150 years. However, a few isolated stands of old trees are known to persist within forest patches in the Etobicoke Creek watershed, and these may be of high value for species associated with old growth. For example, some mature American beech and eastern hemlock stands occur in private woodlots in Mayfield West, as do scattered old growth burr oak trees. Growth rings counted on one burr oak that had been felled in 1996 indicated that it was 179 years old (TRCA, 1998). Scattered individual old growth sugar maple, red oak, American beech, and black cherry occur in urban ravines.

Since the forest habitats in the Etobicoke and Mimico Creek watersheds are heavily fragmented, the habitats and the species they would typically support are subject to the many problems associated with fragmentation. These include the negative external influences categorized as edge effects, and problems related to dispersal capacity and population viability of wildlife.

MAP 22: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Terrestrial Habitat



December 1998

DATA SOURCES:
Planimetric,Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.
Terrestrial Habitat
Toronto and Region Conservation Authority. 1993 Airphoto series, 1:8000. June 1998.
Triathlon Mapping Corporation. 1995 orthophotography, 1m pixel. summer 1995.
Field work by TRCA staff.

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The largest remaining blocks of forest are found in the upper Etobicoke Creek watershed. Of these, the largest individual block of continuous forest is found in the Heart Lake Conservation Area. This site of 43.5 hectares is composed of deciduous, coniferous, and mixed forest. That this is only one of several distinct woodlands in the conservation area, which together make up a total of over 90 hectares, suggests this site's importance.

Forest fragmentation and encroaching development: the W-5 Woodlot in the Mimico Creek Watershed

The largest remaining forest block in the Mimico Creek watershed is 14.1 hectares. This forest fragment, known as the W-5 woodlot, is located north of Bovaird Drive in the City of Brampton. The site features the now uncommon association of shagbark hickory and blue beech, as well as a lowland area dominated by large burr oak trees. Wood thrush and woodcock, two species sensitive to urbanization, were found here in 1998. Both Heart Lake and the W-5 woodlot are being encroached upon by housing and other developments.

Despite the presence of several relatively large forest blocks, the average size of forest patches is only 2.4 hectares in the Etobicoke Creek watershed and 1.5 hectares in the Mimico Creek watershed. Fragments this small are entirely composed of edge habitat and, therefore, are unlikely to support area sensitive species. Woodlots that are less than 2.3 hectares tend to be dominated by edge species (Levenson, 1976). These include specialists that rely on edge habitat such as white-tailed deer and indigo bunting, as well as habitat generalists that make use of the habitat types on either side of the edge such as racoon, coyote, and striped skunk.

Because of the artificially high degree of edge habitat resulting from forest fragmentation, edge specialists and habitat generalists are common throughout much of the Etobicoke and Mimico Creek watersheds, while area-sensitive forest specialists tend to be uncommon or absent. The large amount of edge habitat also accounts for the prevalence of invasive exotic plants. Garlic mustard, tartarian honeysuckle and common buckthorn are now well established in many wooded areas in both watersheds. Dog-strangling vine, a severe problem in parts of Toronto, is just beginning to invade natural areas in the Etobicoke and Mimico Creek watersheds. Norway maple is also becoming prevalent in urban ravines.

Long, narrow strips of forest have a higher edge-to-interior ratio than compact blocks such as circles or squares. Thus, the shape of valley and stream corridors reduces capacity to support forest interior conditions. The strong influence of negative edge effects associated with urbanization are therefore a concern over a large portion of the existing forest habitat in the lower part of the watersheds.

In the Etobicoke and Mimico Creek watersheds, the valley and stream corridors offer the best opportunity to maintain or restore forest and non-forested wetlands in close proximity. Nevertheless, some of the tableland forests in the headwaters contain important swamp habitat, or are associated with small open water wetlands. These areas are crucial for amphibians that require forest and wetland habitat such as wood frog, spring peeper, and eastern newt.

That forests are heavily fragmented and make up only 4.3 percent of the Etobicoke and 1.8 percent of the Mimico Creek watershed does not imply that they are no longer significant. In fact, their rarity implies a degree of significance. According to the Ontario Ministry of Natural Resources Draft Natural Heritage Reference Manual (1998), "woodland size should be evaluated in the context of the percent forest cover in the planning area and/or regional landscape." This document suggests that "in planning areas where woodland cover is less than 5 percent of the land base, even the smallest woodlands may be important to biological diversity of the local area since they provide the only habitat for woodland dependent species." Thus, these areas could be considered significant wildlife habitat.

It has been suggested that, when properly managed, small woodlots can sustain much of their soil, plant, and insect diversity, as well as threatened species or vegetation communities (Reznicek, 1987; Bricker and Reader, 1990). In agricultural and urban areas, forest patches can also provide "stepping stone" habitat for species moving between larger forested areas (Levenson, 1981).

Woodlands in both agricultural and urban landscapes are vital stopover areas for many species of Neotropical migratory songbirds such as warblers, vireos, thrushes, and tanagers. When close to large bodies of water such as Lake Ontario, these habitats can be especially important as staging or resting areas (Towle, 1994). During the peak of spring and autumn migrations, even small patches of natural forest habitat can be crowded with many individual species. Running parallel to the migration route, the north-south direction of river valley corridors in the Toronto Region help to "channel" the birds through the urban landscape. Most of these birds feed on insects which are specific to indigenous trees. The birds also have foraging strategies that are based on natural vegetation structure. Natural woodland is more capable of providing these needs than manicured parks or yards.

In addition to acting as important wildlife habitat, natural forest remnants that are in good condition can help maintain local representation of wildlife, and especially plants. These habitats can also be considered ecological baselines and act as seed sources for habitat restoration projects.

10.2.2 Meadow and Old Field

Prior to settlement, open meadows were probably rare, with these and successional forest growth being limited to areas that had been subjected to natural fires, or areas where soil and water conditions were unsuitable for tree growth. The process of urbanization can create a temporary profusion of meadow and early successional habitats as land is taken out of agricultural production and held in speculation for urban development. Whether or not this habitat type and the species populations it supports can be considered natural is open to debate.

A number of essentially different habitat types are often grouped under the general heading of "grassland" including prairie, savannah, meadow, and old field. Tall grass prairie is a very specific and rare habitat type that is found sporadically in southern Ontario where local soil and climate conditions result in regular fires. Savannah is a mixture of prairie with fire resistant trees. Oak savannah is known to occur at only a few sites in southern Ontario, one of them being High Park in Toronto. The term meadow is so widely applied that it is difficult to define. Generally, this habitat is created by natural disturbance such as fire or windthrow. An old field, by contrast, is essentially an area that is regenerating following an anthropogenic use such as agriculture or pasture (Geomatics International, 1995).

The above definitions suggest that meadow is a natural habitat as opposed to old field which is unnatural. However, within the context of the Greater Toronto Area (GTA), meadow and old field can be considered together since the landscape has such a long history of human use that natural meadow is now seldom encountered, and old field provides habitat for many meadow species.

Disturbance by humans has also altered the composition of such open habitats through the accidental or deliberate introduction of many exotic species. While some sites may be dominated by native goldenrods and asters, many of the most common and "typical" wildflowers of old fields and meadow are exotic including Queen Anne's lace, chicory, burdock, oxe-eye daisy, teasel, bull thistle, and common mullein. Many grass species are also exotic. Reed canary grass is highly invasive and now dominates many flood plain meadow areas throughout the GTA.

Site conditions for meadows and old fields can vary dramatically from rich flood plain soils to poor, contaminated fill in industrial areas. The diversity of native vegetation and wildlife present at individual sites is largely determined by these soil quality conditions, as well as the degree of local disturbance. Sites with poor soil may be in a permanent condition of old field since drainage conditions, the presence of contaminants, or the lack of vital nutrients may retard ecological succession.

Meadows and old fields can support a high diversity of herbaceous plants and are the exclusive habitat of many species of wildlife. Higher quality meadows feature numerous grassland birds including savannah sparrow, field sparrow, vesper sparrow, bobolink, eastern meadowlark and upland sandpiper--all of which have been experiencing population declines in eastern North America (DeGraaf and Rappole, 1995). Although populations of these species may have been artificially inflated to begin with as a result of forest clearance, the need to maintain representation of the quality meadows which support them may be of some concern. Meadow and old field habitats also support a high diversity of butterflies, and provide the milkweed food source of the Monarch, a nationally vulnerable species according to the federal Committee on the Status of Endangered Wildlife.

Meadow and old field cover only 404 hectares or 1.9 percent of the Etobicoke Creek watershed, and 178 hectares or 2.3 percent of the Mimico Creek watershed. However, because meadow habitat was probably quite rare during pre-settlement times, the degree to which this can be considered a conservation concern is open to debate. Some measure of good quality upland and lowland meadow is desirable to maintain local representation of species associated with these habitats, as well as to provide interpretation opportunities.

Almost all of the meadow and old field habitats in the watersheds are associated with valley and stream corridors. This suggests a high degree of connectivity and a good potential for movement of species between habitats. Nevertheless, it also suggests that very little of such habitat is available as “stepping stones” for species on the move. This is more of a concern in urban landscapes than in rural areas where there is better representation of these habitat types, and surrounding land use is less inhospitable. Fragments of meadow and old field habitat in the urban landscape will have a high value as stopover or staging areas for migratory grassland birds and Monarch butterflies. This is especially the case where these habitats occur in proximity to Lake Ontario, which these wildlife species cross.

Large meadows in urban areas may also support species of concern. For example, in 1998 a woodcock was recorded by a TRCA biologist in a large field east of Dixie Road between Eglinton Avenue and Aimco Drive in Mississauga. Since suitable habitat and isolation are found here, the bird may breed at the site.

10.2.3 Successional Habitats

The idea of ecological succession--a process involving a series of predictable habitat stages leading to a more complex “climax” habitat that characterizes a region--has been challenged by some ecologists (Botkin, 1990). Nevertheless, while the sequence of change may be unpredictable due to the complexity of natural systems, the stages themselves are often predictable. For example, because they tend to be fast growing, shade-intolerant, and short-lived, “pioneer” tree species such as aspen are typically the first to colonize a disturbed site. If soil and moisture conditions are adequate, shade tolerant tree species such as maple and beech will probably grow in underneath these over time, eventually forming a so-called “climax” maple-beech forest that is typical of the GTA.

In a forest-dominated landscape, all upland habitats can be considered successional as each represents a particular ecological stage between disturbance and old growth forest of the type that is considered the climax ecosystem. However, the term "successional" is usually used to refer to a habitat stage that lies between meadow and the mature trees typical of climax forest. This should not be confused with a forest of mature pioneer tree species.

In a primary (unmanaged) forest, areas comprising successional growth of varying ages are typically scattered throughout the landscape (Sauer, 1998). These are the result of previous disturbances such as fire, windthrow, and disease. This varied matrix contributes to overall biodiversity of the forest. The actual amount of successional habitat that is typical for a given area is impossible to define because of the unpredictability of disturbance.

Earlier stages of succession, including shrub land and young, even-aged deciduous forest, is found in patches throughout the Etobicoke and Mimico Creek watersheds. Generally, this occurs on agricultural land that has been left fallow or on areas that are under speculation for development. In short, "successional" habitat is old field that has regenerated to the point of domination by woody vegetation such as shrubs or young trees of pioneer species such as hawthorn, elm, poplar, and aspen. Depending on the soil quality and degree of outside disturbance, some of these areas have the potential to become quality forest habitat if left alone for several decades.

The total amount of successional habitat in the watersheds is about 330 hectares. This includes 261 hectares, or 1.2 percent, of the Etobicoke Creek watershed and 68.5 hectares, or 0.88 percent, of the Mimico Creek watershed. In a landscape that was originally forest-dominated, successional growth of various stages would have contributed to the overall diversity of the habitat matrix. Shrub land was probably only found in isolated patches. Therefore, as with meadow habitat, the extent to which this small amount of successional habitat is of a local conservation concern is debatable. Again, the issue is one of species and habitat representation.

Depending on the size and density of shrubs or trees, this habitat can support a variety of vertebrate species associated with open areas or edge habitat. For example, white-tailed deer regularly make use of recently cleared or early successional habitats (Kurta, 1995). If the successional growth is found in proximity to large forest blocks, it may have the capacity to support locally uncommon species such as porcupine, or ruffed grouse, which has an affinity for aspen groves (Ehrlich et al., 1988).

In a heavily settled landscape, successional habitat can provide important places of refuge for wildlife and greatly benefit migratory birds in passage. Where it occurs in natural valley and stream corridors or unnatural corridors, such as rail or hydro lines, it can be of high value for species dispersal because of the cover it provides.

The majority of successional habitat in the watersheds is associated with valley and stream corridors. Considering the value of this habitat for wildlife, and the dispersal cover that shrub land provides for species more typical of forests, this degree of connectivity can help to sustain populations of many species. As with meadow habitat, however, the value of isolated fragments of successional growth as stepping stone or stopover habitat should not be underestimated. Further, successional habitats have great ecological potential as future forests and they are essentially a step ahead of public naturalization projects.

10.2.4 Wetlands

Next to forest, wetlands may have been the most abundant natural habitat type in the watersheds. The Canada-Ontario Remedial Action Plan (Environment Canada et al., 1998) has developed a series of guidelines for wetlands within watersheds. While the suggested guideline for wetland coverage is 10 percent of a watershed, decisions with respect to the appropriate total area should take into account historical records where they exist. Ultimately, the appropriate amount will be based on current land use and the availability of sites that have suitable soil and drainage conditions.

The Canadian Wetland Classification System (National Wetlands Working Group, 1988) recognizes five main wetland types: bog, fen, swamp, marsh, and shallow open water. The Mimico Creek watershed is currently lacking any substantial wetland habitats. Although limited, marsh, swamp, and shallow open water habitats are all currently represented in the Etobicoke Creek watershed. In addition, some bog features are associated with swamp habitat in the Heart Lake wetland complex.

Wetlands have a number of important hydrological and ecological values:

- Controlling runoff following precipitation, thus reducing flood potential and erosion;
- Acting as reservoirs, thus helping to regulate stream flow;
- Filtering or trapping sediments to reduce downstream sedimentation;
- Acting as sources for groundwater recharge;
- Providing opportunities for nutrient exchange between aquatic and terrestrial ecosystems;
- Acting as nutrient sinks by accumulating organic soils;
- Acting as filters by storing excess nutrients or toxins;
- Acting as sinks for methane gas; and
- Providing habitat for a high diversity of species.

Wetlands also have considerable aesthetic, recreational, educational, and economic value. They are often appreciated for their beauty; can provide opportunities for nature interpretation, hunting, or fishing; are excellent sites for bird watching; and sometimes they are used for peat extraction. Once considered wastelands, wetlands are now widely recognized as important habitats that should be conserved wherever possible.

Outside of the Heart Lake area (discussed below), a small number of wetlands are found in the Etobicoke and Mimico Creek watersheds. Some of these are deciduous forest swamps and thicket swamps in the Mayfield West and other headwater sites. A number of remnant tableland marshes are found along the Brampton Esker east and west of Heart Lake Road and north of Bovaird Drive. Additional marshland has been created by reclaimed gravel pits in this vicinity.

A large tableland marsh is located on the east side of Bramalea Road, north of Bovaird Drive. This site features an area of open water with numerous standing dead trees, surrounded by an extensive expanse of cattails. A pair of common moorhens, a green heron, and wood ducks were recorded at this site by a TRCA biologist in 1998. These locally uncommon birds may all be breeding at the site. The marsh is also regularly used by great blue herons, many mallard, and Canada geese. Residential development is now rapidly encroaching on the site.

A marsh in the headwater area of Mimico Creek

Wetlands in the more heavily urbanized portion of the watersheds appear to be restricted to a few isolated shallow pools that exhibit some marsh features. However, even these can support species that are uncommon in heavily used landscapes. For example, in addition to typical species such as Canada goose, mallard, eastern kingbird, and spotted sandpiper; swamp sparrows were found at a small marsh located in an old field environment east of Dixie Road and south of Aimco Boulevard in Mississauga.

Based on geographical features and soil types, Snell (1989) has suggested that over 80 percent of the wetlands in the Greater Toronto Area have disappeared since pre-settlement times. The original extent of cover for the Etobicoke Creek watershed area was estimated to be 1,559 hectares, or 7.4 percent of the watershed (Snell, 1989). Currently 104 hectares of evaluated wetlands remain, representing only 0.5 percent of the watershed, and a loss of 93 percent. This figure is not entirely accurate considering that several small, unclassified wetlands are known to exist in the watershed. Although the total area of these is unknown, it is not likely to cover more than 20 hectares. In contrast, the Mimico Creek watershed historically supported about 1866.5 hectares of wetland covering as much as 24 percent of the watershed (Snell, 1989).There are currently no evaluated wetlands in the Mimico Creek watershed.

Current coverage figures are based only on wetlands that have been evaluated through the Wetland Evaluation System of the Ontario Ministry of Natural Resources. Because few unclassified wetlands remain, these figures should be a fairly accurate representation of present wetland status. It is difficult to record all other wetlands in the watersheds (for example, swamps appear as forest on aerial photos). Nevertheless, several unclassified open water and marsh wetlands are included on Map 22.

Early maps indicate that a marsh of approximately five hectares originally existed at the mouth of Etobicoke Creek (Strus et al., 1993). Lake Ontario coastal marshland is now rare, and many of the species typically associated with it, including American bittern, least bittern, black tern, and northern water snake, have experienced dramatic population declines as this habitat has disappeared.

The Ontario Ministry of Natural Resources' wetland evaluation system is based on biological, hydrological, social, and special feature values. Evaluated wetlands are scored and ranked according to their degree of significance. Two wetland areas have been classified as significant within the Etobicoke Creek watershed (Map 22). One of these is the provincially significant Heart Lake Wetland Complex which comprises about 58 hectares of swamp and marsh habitat. The site is one of the last remaining peatlands in the region and features many flora and fauna that are associated with bog conditions. Among these are numerous rare plants and *Sphagnum* moss that is typical of bog habitat. The Heart Lake Wetland Complex also includes sites that are outside of the conservation area.

The second classified wetland in the Etobicoke Creek watershed is the Cheltenham Wetland Complex, in the Town of Caledon. A portion of the complex is located within the Credit River watershed. In total, the site is comprised of 18 individual wetlands covering about 40 hectares. Of this, 97 percent is swamp and the remainder is marsh habitat.

Wetland conservation is important for maintaining local and regional representation of many species. Amphibians, in particular, use wetlands for breeding and often require a close association between wetland and terrestrial habitat such as forest or shrub land. This association is difficult to maintain in a fragmented landscape and may be absent in the urbanized portions of the Etobicoke and Mimico Creek watersheds.

Currently, five species of anuran (frogs and toads) and one salamander species are known to exist in the upper part of the Etobicoke Creek watershed (TRCA, 1998). These include American toad, spring peeper, wood frog, leopard frog, green frog, and red-backed salamander. Further inventories could reveal the presence of other species such as striped chorus frog, gray tree frog, bullfrog, eastern newt, spotted salamander, and members of the Jefferson/blue-spotted salamander complex. However, other than the chorus frog, these species tend to be uncommon in heavily developed landscapes. This may be due to the lack of quality habitat associations and linkages, collection of the animals for pets, or the presence of toxins in the environment to which amphibians may be especially sensitive.

Many bird species are also associated with wetlands, especially marshes and areas with shallow open water. Familiar species such as red-winged blackbird, mallard duck, Canada goose, and great-blue heron are commonly seen in the watersheds of the GTA. All of these are highly urban tolerant. However, the great-blue heron is typically a colonial breeder and requires isolated undisturbed wetlands where it nests in tall shrubs or trees.

A number of wetland birds are considered to be area-sensitive, and require marsh habitat that is at least several hectares in size to provide enough food resources, or to support a population large enough to maintain required social behaviour. These are unlikely to breed anywhere in the watersheds. Others, such as common yellowthroat and swamp sparrow, are common breeders in the upper watershed and could be encouraged to breed more often in the urban landscape if enough cover was provided and sites were left relatively undisturbed. The current practice of manicuring the landscape up to the water's edge will ensure that such species remain absent while problem species, such as Canada goose, will remain abundant.

While size or connectivity between wetland and upland habitats is important for many wildlife species, as with other habitat types, isolated islands of wetland within the developed landscape do provide important refuges for wildlife, and are especially valuable as stopover habitats for migratory birds that prefer this kind of habitat.

In summary, wetland habitats are greatly under-represented in the Etobicoke and Mimico Creek watersheds. Most of the marsh sites that remain in the Etobicoke Creek watershed, especially those in the urban landscape, suffer from water pollution, loss of associated habitat, disturbance by humans, and invasions by exotic species such as purple loosestrife. Nevertheless, these habitats do provide refuge for many species. In contrast, forest swamp habitat is largely restricted to the upper watershed. That this type of wetland tends to have limited use for humans is, in part, why vestiges of it remain and why, in many cases, it still supports a high diversity of associated species.

10.2.5 Special Designations

Through official plans and other mechanisms, many municipalities make an effort to identify and protect significant natural areas such as wetlands and valley and stream corridors. For example, the Town of Caledon protects valley and stream corridors, wetlands, and other natural features by designating them Environmental Policy Areas in their official plan. The City of Mississauga provides varying degrees of protection for natural features that are within their Natural Areas System. The Mississauga *City Plan*, adopted in 1997, discourages new development within this system. Furthermore, it requires all proposals within or adjacent to the Natural Areas System to submit an Environmental Impact Study to demonstrate that ecological function is being maintained or enhanced. The City also designates valley and stream corridors as greenbelt and considers them not suitable for development; therefore, the corridors are protected.

At the regional level, with the participation of the TRCA, the Region of Peel developed a set of policies in its official plan around a Regional Greenlands System. These policies include, for example, a general prohibition on development within core valley and stream corridors in Peel, including much of the area around the main branches of the Mimico, Etobicoke, and Spring Creeks.

The official plan of the former Municipality of Metropolitan Toronto (1994) provides policies regarding the planning and management of the Metropolitan Greenspace System as a connected system of greenspaces. This greenspace system includes valley, stream, and waterfront corridors as well as contiguous tableland greenspaces. It also includes hazard lands and significant natural and recreational areas.

Due to the major losses of forests and wetlands, the fragmented nature of terrestrial habitats, and the high percentage of each habitat type being located within valley and stream corridors, the designation and protection of locally significant natural areas through the municipal planning process is significant for these two watersheds.

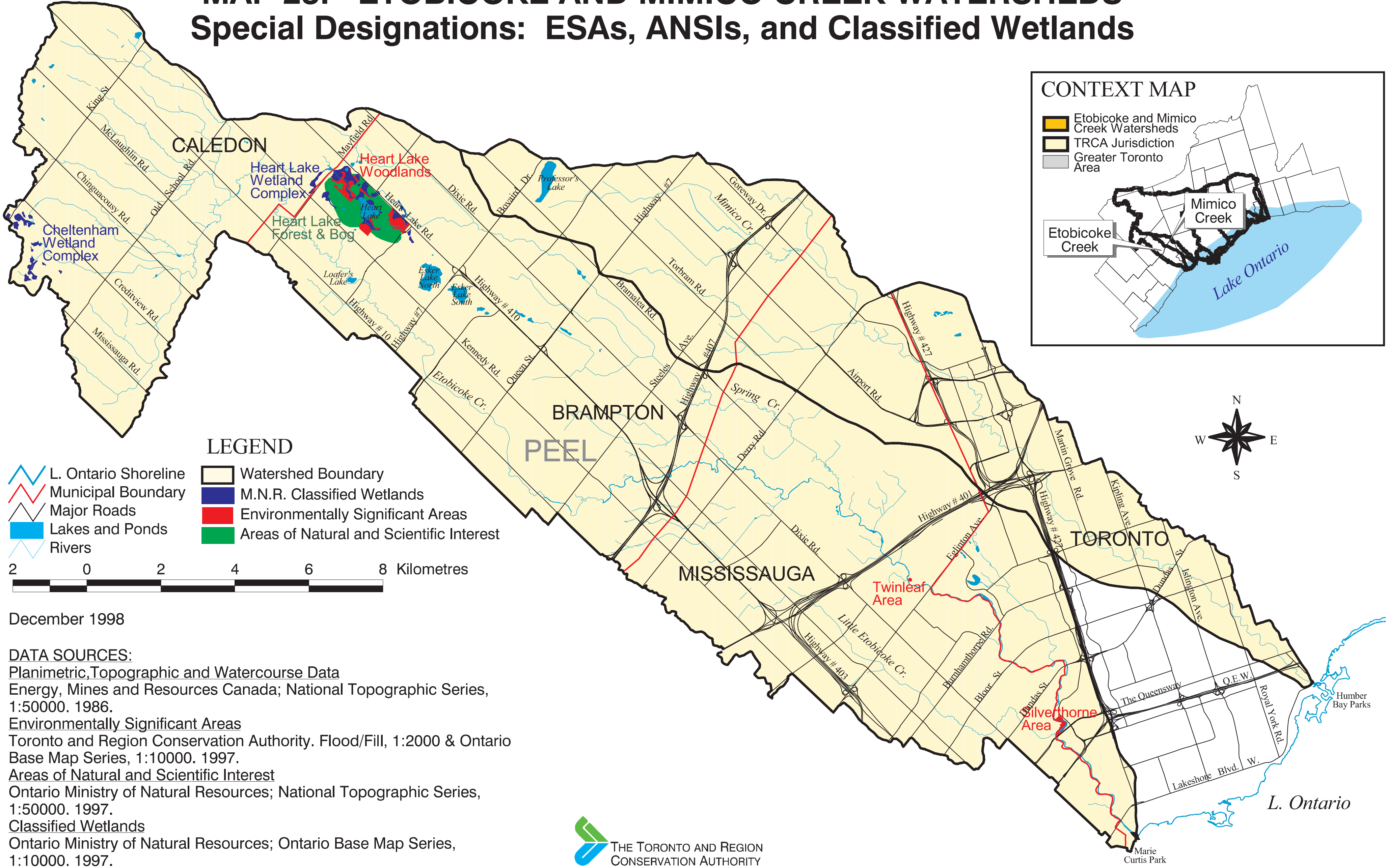
In addition to municipal designations and classified wetlands (see section 10.2.4) , other measures of habitat significance are used. These are the TRCA's Environmentally Significant Area (ESA) system, and the system for identifying Areas of Natural and Scientific Interest (ANSI) developed by the Ontario Ministry of Natural Resources.

The ESA program was developed to identify and protect the lands and waters which are vital to the health of the ecosystem in the TRCA region. Criteria used in the selection of ESAs include:

- Distinctive and unusual landform or geological feature;
- Significant water storage function and/or a groundwater recharge/discharge function;
- Linkages and corridors between significant habitats;
- Essential habitats for significant species and populations;
- Rare, vulnerable, threatened or endangered species;
- High quality habitats;
- Habitats of limited representation;
- Habitats of considerable size; and
- Habitats previously classified as an Area of Natural and Scientific Interest, or as a Provincially Significant Wetland.

There are three TRCA designated ESAs located within the Etobicoke Creek watershed. These include the Silverthorne Area, Twinleaf Area, and the Heart Lake Woodlands (Map 23). There are no ESAs in the Mimico Creek watershed. Future updates of the ESA program based on land use trends or more extensive biological inventories could result in the designation of new sites.

MAP 23: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Special Designations: ESAs, ANSIs, and Classified Wetlands



December 1998

DATA SOURCES:

Planimetric,Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Environmentally Significant Areas
Toronto and Region Conservation Authority. Flood/Fill, 1:2000 & Ontario Base Map Series, 1:10000. 1997.

Areas of Natural and Scientific Interest
Ontario Ministry of Natural Resources; National Topographic Series, 1:50000. 1997.

Classified Wetlands
Ontario Ministry of Natural Resources; Ontario Base Map Series, 1:10000. 1997.

THE TORONTO AND REGION CONSERVATION AUTHORITY

The Silverthorne Area is located north of the Queensway on the border of Mississauga and Etobicoke. The area is characterized by willow shrub, a small woodlot of sugar maple, red oak, white ash, and riparian meadow. Old records of pickerel frog and the regionally rare wood turtle exist for this site.

Shagbark Hickory, found in the Twinleaf ESA

The Twinleaf Area is located north of Eglinton Avenue and east of Dixie Road in the City of Mississauga. This site features a population of twinleaf, a nationally and provincially rare wildflower, within a mature forest dominated by sugar maple. Shagbark hickory, a regionally uncommon tree species typical of the Carolinian life zone, is also found at this site. The features on this reach of the valley have also resulted in an Environmentally Significant Area designation by the Toronto Field Naturalists (Varga, 1982). A field visit in 1998 indicated that the Twinleaf ESA is being invaded by garlic mustard, which has likely been transported by people and wildlife using the existing trail network.

The Heart Lake Woodlands are located on the southwest corner of Mayfield Road and Heart Lake Road in the City of Brampton. The site contains healthy upland and lowland deciduous forest, a small meromictic kettle lake, marsh, and swamp habitat with bog affinities. The latter includes regionally rare shrubs such as leather-leaf, and black chokeberry, as well as such unusual wildflowers as pitcher plant and rose pogonia. Despite its high degree of significance, terrestrial habitats within the Heart Conservation Area are exposed to a number of disturbances for example, public use of the lands and the establishment of invasive exotic plants.

The Ontario Ministry of Natural Resources identifies Areas of Natural and Scientific Interest (ANSI). ANSIs are 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. There are two categories of ANSI: Life Science and Earth Science. The Heart Lake Forest and Bog is the only regional life science ANSI within the two watersheds. The only Earth Science ANSI in the watersheds, the Brampton Buried Esker, is described in section 8.2.

SUMMARY

Terrestrial habitats within the Etobicoke and Mimico Creek watersheds are mere remnants of what existed before settlement. Remaining natural areas are highly fragmented and for the most part, relatively small. Connectivity between upland sites is poor, although valley and stream corridors provide some opportunities in this regard.

The fragmented nature of natural habitats within the landscape suggests many problems are present in these watersheds. These include the difficulty of maintaining viable wildlife populations because of the limitations on dispersal which isolated habitat fragments present. In essence, many of the disconnected habitat sites may be acting as population sinks in which species that are specific to that habitat site, and which have limited dispersal capacity, are at risk of disappearing. The size and shape of remaining forest fragments also suggests that negative edge effects are probably having a serious impact. Lack of breeding populations of area sensitive birds reinforces this conclusion.

Over the past few decades, the Mimico Creek Watershed has become completely urbanized. As the urbanization front expands into the upper reaches of the Etobicoke Creek watershed, the pressures associated with this intensive form of land use may have significant effects on remaining terrestrial habitats. Even if direct habitat loss does not occur, indirect impacts of development related to recreational use and pollution, including noise, may occur. Road expansion (e.g., Highway 410) will likely add further noise, limit wildlife dispersal, and result in an increase of road kills. However, the impacts of urbanization on terrestrial habitats may be mitigated. Increasingly, mechanisms for the protection of natural areas are being incorporated into municipal official plans.

Part IV is divided into two chapters. Chapter 11 suggests some watershed management issues the future task force for the Etobicoke and Mimico Creek watersheds may wish to address in their efforts to guide strategy development. A summary is provided of the key environmental, social, and economic issues identified in Parts II and III of this report. A brief overview of some current monitoring initiatives is also provided as monitoring is an integral part of watershed management. Finally, as dividing the watersheds into manageable units may assist regeneration efforts, a brief description of subwatershed and reach planning is provided.

Chapter 12 highlights some initiatives that are currently taking place to regenerate the Etobicoke and Mimico Creek watersheds. As water quality will likely be a key issue, the Great Lakes Water Quality Agreement and the Toronto and Region Remedial Action Plan are briefly described. The chapter also summarizes some site specific regeneration projects which are on-going or proposed in the watersheds. In addition, broader scale projects that document resources or assess the condition of various parts of the watersheds are highlighted. These reports and studies provide information that could be used by the future task force, watershed residents, and others to assist their regeneration efforts.

DIRECTIONS FOR MANAGEMENT

DIRECTIONS FOR STRATEGY DEVELOPMENT

CHAPTER 11

This chapter identifies key watershed issues which may be considered during strategy development by the future task force for the Etobicoke and Mimico Creek watersheds.

With previous watershed strategies[15] adopted by The Toronto and Region Conservation Authority, task forces have undertaken the following activities:

- Developed a vision for a healthy watershed;
- Discussed, refined, and prioritized key watershed issues;
- Set goals to achieve the vision;
- Set measurable, definable objectives to achieve goals and provide benchmarks for success;
- Established specific actions that are needed to achieve objectives; and
- Set priorities for regeneration.

To assist the future task force in carrying out their work, section 11.1 summarizes key environmental, social, and economic issues that have been discussed in this report. As monitoring is an integral part of watershed management, a brief overview of some monitoring initiatives is provided. Finally, since dividing the watersheds into subwatersheds or reaches may assist management efforts, a brief explanation of subwatershed and reach planning is provided.

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[15] Specifically, watershed management strategies for the Don and Humber Rivers: *Forty Steps to a New Don* and *Legacy: A Strategy for a Healthy Humber* respectively.

11.1 WATERSHED HEALTH: SUMMARY OF KEY ISSUES

Watershed health is a complex concept. It is a relative term, relevant only within a specific context. For example, the number of fish species present in a "healthy" river environment can be expected to be lower in an urbanized watershed than the number which constitutes a "healthy" river environment in an undeveloped or forested watershed. As both the Etobicoke and Mimico Creek watersheds are highly developed, this will need to be considered in the strategy development process. Also, some contextual factors change over time and can alter a definition of health. These factors include changes in community values or scientific knowledge.

A management strategy for the Etobicoke and Mimico Creek watersheds will be developed to guide efforts to achieve watershed health. The strategy will identify key issues in the watersheds which will need to be addressed in order to restore the watersheds. As well, appropriate indicators will need to be selected which can be used to monitor progress toward restoring the health of the Etobicoke and Mimico Creek watersheds.

The following summarizes key environmental, social, and economic issues that have been discussed in this report. While these issues will likely be considered by the future task force, it is anticipated that as strategy development progresses, the list will become more refined and new issues will be added.

Environmental Issues

Air:

- The climate of the Etobicoke and Mimico Creek watersheds affects vegetation communities, wildlife, the hydrologic cycle, and other components of the natural heritage system. Within the watersheds, global climate change could have implications for a number of watershed management activities including fisheries and forest management and flood and erosion control. The Authority and the future task force for the Etobicoke and Mimico Creek watersheds are in a unique position to recognize and incorporate techniques into the watershed management strategy process that allow for adaptive management. For example, when carrying out regeneration projects, planting species of trees and shrubs that will likely be able to adapt to climate change.

- In terms of micro-climate, the extensive urban development in the watersheds may be affecting the local climate through contributing to the "urban heat island" effect. In turn, these changes may influence air quality and affect the health of humans, vegetation, and wildlife.

- Air quality within the watersheds is very good the majority of the time. However, particulate pollutants and ground-level ozone exceeded provincial air quality standards on a number of occasions in 1995. Impaired air quality is largely a consequence of vehicle, industrial, and residential emissions, with a large amount of ground-level ozone and its precursors originating from outside of the watersheds.

Land:

- The plains, the Brampton Esker, and the valley and stream corridors have important hydrological functions and provide benefits to humans. However, agricultural settlement, and more recent extensive urban development, have impacted the functioning of these landforms.

- Plains: The South Slope and Iroquois Plain recharge groundwater and provide baseflow to streams while historically the Peel Plain provided wetland habitat. The plains provided the basis for prosperity in the watersheds as the Peel Plain's fertile soils were suitable for agriculture, and extraction occurred on the South Slope. These functions have diminished as urban development has occurred. The exception is the South Slope in the headwaters of Etobicoke Creek which remains rural.

- The Brampton Esker: The Brampton Esker is an aquifer, a source of water for Spring Creek, and an important source of aggregate. It is likely that both development and aggregate extraction on the esker have had negative impacts on groundwater and potentially, baseflow.

- Valley and Stream Corridors: Despite the numerous benefits valley and stream corridors provide, filling, burying, piping, and other watercourse alterations have resulted in a loss of these corridors and a reduction in riparian vegetation, aquatic habitat, species diversity, natural corridors for the movement of wildlife, and a disruption of the hydrologic cycle.

Water:

- Groundwater is a key component of the hydrologic cycle. However, uncontrolled land use may result in reduced recharge rates and extraction may cause the depletion of groundwater resources. In turn, this can reduce baseflow to streams and dry up shallow wells. Within the urbanized portions of the watersheds, impermeable surfaces have likely had a negative effect on recharge, and thus the discharge of groundwater or baseflow to streams, because a lot of rainfall is lost as runoff and there is less potential for infiltration. Although agricultural lands have been graded to drain water quickly off of the land, it is likely that within the more rural headwaters of Etobicoke Creek, the effects of land use are not as severe since open farmland and pastures generally allow for more infiltration than urban land uses. However, historically these watersheds had lower rates of recharge when compared to others with coarser soils.

- Although there have been no studies specifically on groundwater resources within the Etobicoke and Mimico Creek watersheds, nitrates and bacteria, pesticides, chlorides, and complex contamination are potential forms of groundwater contamination in the watersheds due to past and present land uses.

- The natural flow of water in the watersheds would have been greatly affected when the forested landscape was cleared to accommodate settlement and agriculture. More recently, the flow regime has been affected by extensive urbanization. As urban development has progressed over the past 25 years, the total yearly volume of flows in Etobicoke Creek has increased by 19 percent, and by 22 percent in Mimico Creek. In recent years, a variety of methods have been used to mitigate the effects of stormwater runoff.

- Erosion and flooding are natural processes. However, a number of factors may accelerate or increase the severity of these processes. The amount of urban development, the degree of stormwater management and development controls, and location within a watershed, all affect the amount and severity of erosion in the creeks. Generally, erosion is concentrated in three areas: the lower portions of the Etobicoke and Mimico Creeks, and along the main branch of Etobicoke Creek.

- Development within a flood plain, combined with increasing imperviousness of a watershed due to reduction in forest cover and urban development, may increase the severity of flooding. There are many structures and facilities which exist in the flood plain which are vulnerable to flooding.

- Water quality in the Etobicoke and Mimico Creeks is degraded with high levels of phosphorous, suspended sediment, chlorides, bacteria, and phenols. Concentrations of these parameters progressively increase toward the mouth of each creek with the exception of phosphorous which is high throughout the watercourses. Water quality conditions in the watersheds exceed Provincial Water Quality Objectives and other guidelines over half the time for most parameters. In terms of trends, water quality has been improving over the last 30 years, as evidenced by decreasing concentrations of phosphorous, suspended sediments, and phenols. However, increasing levels of faecal coliform bacteria and chloride have been observed. Further, spills of oil, petroleum, diesel fuel, and other substances into the creeks occurred a total of 92 times during the period from 1988 to 1996. The characteristics of water quality in the creeks is similar to other local urban watersheds, such as the Don River and Highland Creek.

- Water quality has been impaired largely because of urban development combined with insufficient stormwater control. Only recent developments have incorporated stormwater detention facilities with a quality control component to treat stormwater runoff. In the Etobicoke Creek watershed, 16 percent of the existing and future developed area is currently controlled for quality. In the Mimico Creek watershed, 4.6 percent of the developed portion of the watershed is controlled for quality. Spills, streambank erosion, construction activity, agricultural sources, and landfills, are other pollutant sources.

Life:

- Only 4.3 percent of the Etobicoke Creek watershed and 1.7 percent of the Mimico Creek watershed are forest covered. The fact that the watersheds were probably close to 100 percent forest covered prior to European settlement indicates that almost all of the forest cover has been lost. Remaining natural areas are highly fragmented, and for the most part, relatively small. There are few large natural core areas. Connectivity between upland sites is poor, although valley and stream corridors provide some opportunities for linkages. The largest remaining forest blocks are found in or at the edge of the agricultural landscape in the Etobicoke Creek watershed. As urbanization expands into the upper Etobicoke Creek watershed, the pressures associated with this intensive form of land use are likely to have significant effects on remaining terrestrial habitats.

- Wetland habitats are greatly under-represented in the Etobicoke and Mimico Creek watersheds. Most of the marsh sites that remain in the Etobicoke Creek watershed--especially those in the urban landscape--suffer from water pollution, loss of associated habitat, disturbance by humans, and invasions by exotic species. Forest swamp, which would have been extensive at one time, is not well represented and is largely restricted to the upper reaches of the Etobicoke Creek watershed. The original extent of cover for the Etobicoke Creek watershed was estimated to be 1,559 hectares, or 7.4 percent of the total watershed (Snell, 1989). Currently, only 104 hectares of classified wetlands remain in this watershed, representing only 0.5 percent of the watershed, and a loss of 93 percent. However, there are several small, unclassified wetlands that exist in the watershed. Although the total areas of these are unknown, they are not likely to cover more than 20 hectares. In contrast, the Mimico Creek watershed historically supported some 1,866.5 hectares of wetland covering as much as 24 percent of the watershed (Snell, 1989). Despite this large percentage, these habitats have disappeared.

- Aquatic habitats in the Etobicoke and Mimico Creek watersheds have also been significantly altered and degraded as a result of past development practices. Settlement and later urbanization caused many watercourses to be filled, piped, channelized, or otherwise altered. There is evidence that at least 33 percent of watercourses in the Etobicoke Creek watershed and 59 percent of watercourses in the Mimico Creek watershed have been altered. Further, only 17 percent of watercourses in the Etobicoke Creek watershed and 23 percent of watercourses in the Mimico Creek watershed have woody riparian vegetation. Other factors that affect aquatic habitats are barriers to fish movement (e.g., weirs), poor water quality, and unstable flows.

- Although presently there are more lakes and ponds present in the Etobicoke and Mimico Creek watersheds then there were historically, these waterbodies have been created from former aggregate mining activities and have been rehabilitated for recreational and aesthetic purposes. These lakes and ponds generally do not provide good aquatic habitat. In the case of the naturally formed kettle lakes, Heart Lake has been affected by excessive nutrients but still continues to support some sensitive species. Teapot Lake, because of its unique characteristics, does not provide a suitable habitat for most fish species. The estuarine habitat located at the mouths of the Etobicoke and Mimico Creeks has been significantly altered from what was present historically. In addition to physical changes to aquatic habitats, poor water quality due to high levels of runoff have made watercourses, waterbodies, and coastal areas appropriate habitat for only the most tolerant warmwater fish species.

Social Issues

Cultural Heritage:

- Although 52 archaeological sites have been found and documented in the Etobicoke and Mimico Creek watersheds, other sites have not been discovered, excavated, or have been destroyed by development. Past losses have likely occurred because of a lack of awareness, identification, and documentation of the value of these archaeological resources.

Diversity:

- Because the watersheds' population is culturally diverse, the needs and preferences of the various ethnic groups will need to be considered in watershed management activities. For example, different cultural backgrounds may create different recreational demands, or have different landscaping traditions and thus may help to define the community through their use of open space and landscaping. Further, the different languages used by watershed residents may be important to consider when communicating watershed information to the public.

Outdoor Recreation:

- Greenspace in the watersheds is used for outdoor recreation. However, there is little publicly accessible open space, particularly in the industrial portions of the watersheds. If infill development or redevelopment of lands occurs in the urbanized portions of the watersheds to meet future population increases, publicly accessible open space for outdoor recreation may become more scarce and pressure from public use may increase on existing greenspaces.

- There are approximately 54 kilometres of trails in the Etobicoke Creek watershed and 23 kilometres of trails in the Mimico Creek watershed. There are a number of missing links in the greenspace and trail systems. Highways, railways, and private ownership of lands are significant barriers to the development of a linked greenspace and trail system.

- There are few developed major attractions and no conservation education facilities in the watersheds.

- Wildlife viewing, angling, and similar recreational activities are limited to a few areas because of the degraded aquatic and terrestrial habitats and the subsequent loss of species.

Economic Issues

Land Use:

- In terms of land use, the watersheds are highly developed with significant residential, industrial, and institutional areas. Since the Mimico Creek watershed is highly urbanized and nearly all developed, most future development will likely be accommodated through redevelopment or conversion of existing land uses (i.e. infill development). In contrast, the headwaters of the Etobicoke Creek watershed remain undeveloped. The rapid growth in the watershed is occurring primarily in the City of Brampton. The existence of remnant natural areas may be threatened by infill development and urbanization.

- Particularly in the lower sections of the Etobicoke and Mimico Creek watersheds, where the developed areas are older, there are issues relating to the costs of regenerating the watersheds. In these areas many of the creeks have been channelized or piped, stormwater issues are paramount, and tableland vegetation is minimal. The short-term high cost of regeneration efforts is therefore often viewed as a limiting factor. Also, acquiring greenspace and developing trails through these areas is limited where the corridor is privately owned, land values prevent acquisition, and funding is limited for implementing greenspace and trail improvements. However, community outreach and environmental stewardship programs, as well as private landowner stewardship agreements, conservation easements, and donations of land provide options for overcoming these limitations.

Resource Use:

- Resource-based land uses, such as agriculture, forestry, and aggregate extraction can affect the quality of life within a community because they are often aesthetically displeasing or can cause odour, noise, or health concerns. While these industries have historically contributed to the prosperity of the Etobicoke and Mimico Creek watersheds, their economic importance has declined, often because of resource depletion or competition between uses of the resource. The depletion of these forest, aggregate, and soil resources has contributed to the poor environmental condition of the watersheds today.

- Currently, approximately 21 percent of the land in the Etobicoke Creek watershed is used for agricultural purposes. In Ontario, significant progress has been made in agriculture to reduce soil erosion through practices such as conservation tillage, crop rotations, and tree plantings (to reduce wind velocities). Similar efforts have improved soil structure (Ontario Federation of Agriculture, 1995). However, the application of pesticides, fertilizers, and manure can contaminate ground and surface water with nitrates, phosphates, and bacteria. In addition, underground tile drainage and irrigation may alter the normal seasonal pattern of water flow in streams and rivers.

11.2 MONITORING

As our understanding of ecosystem health is incomplete, one challenge is to first develop acceptable indicators of ecosystem health and then develop targets so it will be possible to measure whether management, policy, or other initiatives are making progress toward goals. Monitoring, therefore, is an integral part of watershed management as it provides a base for determining progress toward ecological health, community well-being, and a sustainable and viable economy.

Watershed monitoring programs often encourage the participation of residents, academic institutions, schools, and other individuals and groups to assist with data collection and interpretation. This participation can help build community environmental stewardship and can be a cost effective way to gather data.

Establishing targets and indicators is essential for monitoring and evaluating progress toward regeneration goals. Analysing and communicating this information (i.e. publishing a report card) may also help to celebrate progress, stimulate action, and educate communities about watershed health.

Targets and Indicators

An *indicator* can be considered a signal: a quantitative or qualitative measure which points to watershed health. Indicators measure progress toward goals and objectives. They reflect the status of some system over time, and they focus on a manageable, tangible, and telling point of the system.

A *target* is a specific aim that will be achieved in the future. Targets may be set for the short, medium, or long term (DWTF and MTRCA, 1997). For example, in *Turning the Corner, The Don Watershed Report Card*, targets were set for each indicator using the years 2000, 2010, and 2030.

Indicators and targets can be developed in tandem with the watershed strategy or they can be developed through a separate process. While many of these will be integrative indicators, meaning they will measure progress toward the achievement of more than one objective, they will likely be based on the components set out in the ecosystem model:

Environment - air, land, water, life
Society - cultural heritage and recreation
Economy - urban development and resource use

Some key points should be considered when selecting indicators. Knowing what makes a "good" indicator is not only important for monitoring, it can also assist in the development of goals and objectives. In general, an indicator should be:

- relevant to the objectives of the watershed strategy;
- consistent with other agencies' needs and objectives;
- integrative, reflecting multiple aspects of watershed health;
- credible and defensible;
- clear, so that targets can be set;
- understandable to all audiences;
- compelling, to tell a story; and
- measured by reasonable and available data sources.

Other criteria might include the ability of the indicator to be measured and analysed by community groups. Direct community involvement in data collection and analysis can reinforce stewardship and foster community action.

Ensuring Compatibility with Other Monitoring Initiatives
Other relevant monitoring initiatives need to be reviewed before developing a monitoring program for the Etobicoke and Mimico Creek watersheds. In addition to it being a more cost effective approach, it may help to ensure consistency between indicators for the Etobicoke and Mimico Creek watersheds and other watershed monitoring programs. Consistency is important as it provides the basis for making comparisons.

A number of initiatives will need to be considered at the outset of a monitoring program for the Etobicoke and Mimico Creek watersheds. Most relevant are the following:

- *Turning the Corner, The Don Watershed Report Card* (1997). Produced by The Don Watershed Regeneration Council and The Metropolitan Toronto and Region Conservation Authority in 1997;
- The Humber River Watershed Report Card (in progress);
- The Toronto and Region Remedial Action Plan Stage 2 document, *Clean Water, Clear Choices: Recommendations for Action* (1994), which contains indicators and specific targets ("delisting criteria") for the Toronto and Region Area of Concern; and
- Municipal initiatives, for example, state of the ecosystem reporting by the Region of Peel and the City of Toronto.

Currently, the TRCA and partners are developing a watershed monitoring program for the Toronto and Region Remedial Action Plan. The program will allow for reporting on the status of each beneficial use impairment in Areas of Concern (see section 12.2 for further discussion). The program will allow for the identification of changes in condition through time. It will also provide direction for selecting the remedial actions necessary for restoring impaired beneficial uses and thus eventually "delisting" an Area of Concern.

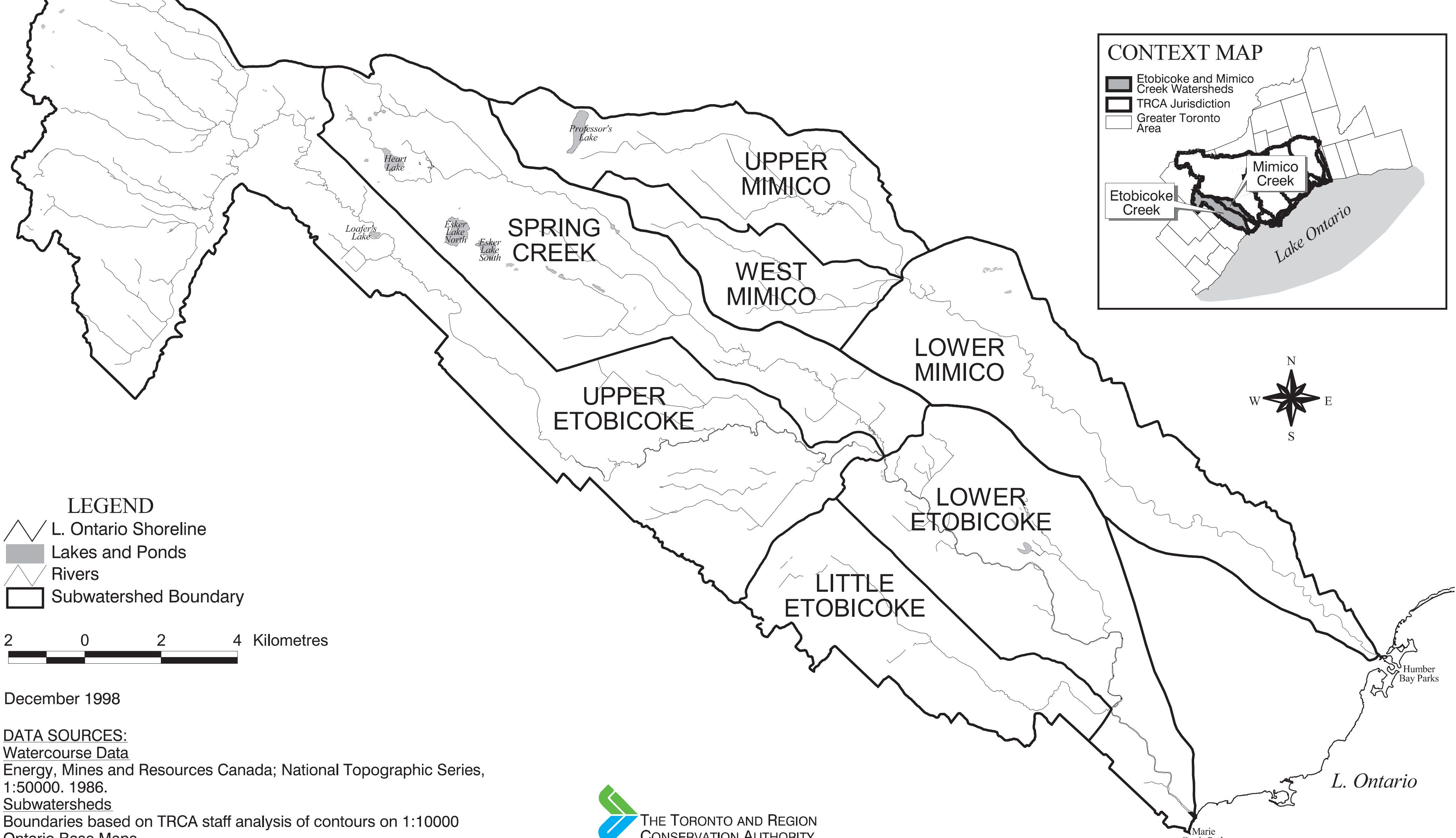
11.3 SUBWATERSHED AND REACH PLANNING

Planning and managing on the basis of watersheds is critical for establishing overall watershed condition, a vision of the watershed in the future, and setting out the context for actions to work toward that vision. It is for these reasons that *The State of the Watershed Report* describes the Etobicoke and Mimico Creek watersheds as a whole. However, dividing the watersheds conceptually may assist management efforts. Subwatersheds were delineated in anticipation that subwatershed or reach plans may be undertaken by the task force.

Subwatershed Planning

To facilitate future study, planning, and implementation of watershed management strategy objectives and actions, the watersheds were divided into smaller units based on subwatershed boundaries. Etobicoke Creek can be separated into three subwatersheds: the main branch and two major tributaries--the East Branch and Little Etobicoke Creek. To make the task of regeneration more manageable, the main branch can be further subdivided into the Upper Etobicoke Subwatershed and the Lower Etobicoke Subwatershed. Mimico Creek was also divided into more manageable subwatershed units: the Lower and Upper Mimico Subwatersheds and the West Mimico Subwatershed (Map 24).

MAP 24: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Subwatersheds



LEGEND

- L. Ontario Shoreline
- Lakes and Ponds
- Rivers
- Subwatershed Boundary

2 0 2 4 Kilometres

December 1998

DATA SOURCES:

Watercourse Data

Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Subwatersheds

Boundaries based on TRCA staff analysis of contours on 1:10000 Ontario Base Maps.

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Subwatershed plans allow for a more detailed analysis of watershed issues, the impacts of different land uses, and the identification of regeneration opportunities. For example, the amount and type of contaminants contributed to the creek from the urban Little Etobicoke Creek Subwatershed would be different from the amount and type of contaminants from the Main Etobicoke Creek Subwatershed which has its headwaters in the largely rural Town of Caledon.

Subwatershed Action Plans were developed for *Legacy: A Strategy for a Healthy Humber*. To implement the strategy, it was indicated that units smaller than the entire 908 square kilometre watershed would be useful. The Humber watershed is composed of five subwatersheds: the Main, West, East, Black Creek, and Lower. Each of these subwatersheds is unique. They have different landforms, soils, land uses, environmental conditions, and opportunities. Some of the actions recommended in the strategy apply to only one, or a few of these subwatersheds. In each subwatershed action plan, key issues and actions specific to the subwatershed were highlighted.

Reach Planning

The majority of regeneration actions will likely occur at the level of specific reaches--smaller tributaries or neighbourhood-sized sections of watercourses. Reach plans can present existing conditions and opportunities for regeneration in greater detail. For the Don River watershed, reach plans were developed to assist management efforts and provide, at a glance, information showing which areas in each subwatershed require the greatest or least amount of regeneration. These "reach plans" were based upon technical information, input from agencies, and information from task force members and local communities.

In *Forty Steps To A New Don*, reach plans show opportunities for regeneration, outlined under eight categories:

- water quality;
- water quantity;
- aquatic habitat;
- terrestrial habitat;
- management practices;
- recreation opportunities and improvements;
- education and interpretation; and
- special areas (such as Environmentally Significant Areas or areas of cultural significance).

Specific regeneration actions were suggested for each reach. Actions were assigned a "level of effort," ranked as limited, moderate, or extensive. The ranking was based upon constraints that would have to be dealt with to accomplish an action. These included cost, simplicity, extent of coverage, and methods of undertaking the action. Capital works were mostly considered an extensive level of effort due to their high costs.

Many reach plans focus on watercourses and the associated valley and stream corridors. However, drainage area characteristics also need to be considered so that water quality and quantity issues are adequately addressed.

Reach plans can be developed and implemented in a number of ways. However, local community involvement in plan development, implementation, and monitoring progress toward regeneration goals usually takes place. Reach plans can include both structural and non-structural works. They can also be implemented in partnership with government agencies, the private sector, and other groups; and they can provide meaningful opportunities for community involvement.

SUMMARY

To assist the future task force in developing a management strategy to guide efforts to achieve watershed health, key environmental, social, and economic issues in the watersheds were summarized in this chapter. Further, as monitoring provides a base for determining progress toward ecological health, community well-being, and a sustainable and viable economy, the chapter provided an overview of key points related to monitoring that will likely be considered when developing a watershed strategy. Finally, to make the task of regeneration more manageable, an overview was provided of subwatershed and reach planning as they have been practised in TRCA watersheds.

WHAT'S HAPPENING NOW

CHAPTER 12

Impaired water quality is a key issue for Lake Ontario and all river systems within The Toronto and Region Conservation Authority's jurisdiction. Management recommendations for the Etobicoke and Mimico Creek watersheds will likely include actions to improve water quality. This chapter outlines two initiatives relevant for water quality management in the Etobicoke and Mimico Creek watersheds: the Great Lakes Water Quality Agreement and the Remedial Action Plan program. Also, a listing of regeneration projects and programs that have been initiated by a variety of watershed stakeholders is summarized. More details on these projects are included in Appendix A and B. The list is based upon a questionnaire that was sent by The Toronto and Region Conservation Authority to government agencies, community and interest groups, and interested individuals.

12.1 THE GREAT LAKES WATER QUALITY AGREEMENT

The Great Lakes Water Quality Agreement is a joint commitment between Canada and the United States. It was signed by the two federal governments in 1972, in response to concerns about water quality degradation in the Great Lakes. The Agreement's purpose is "...to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem." Both governments are responsible for meeting their obligations under the Agreement.

In response to Canada's obligations under the Agreement, the federal and Ontario governments signed the Canada-Ontario Agreement (COA) respecting the Great Lakes Basin Ecosystem. The Canada-Ontario Agreement describes shared responsibilities and establishes targets for Great Lakes restoration and protection, including the development and implementation of RAPs.

12.2 REMEDIAL ACTION PLANS

The Canada-United States Great Lakes Water Quality Agreement was amended in 1987 to include the Remedial Action Plan Program. Remedial Action Plans (RAPs) are underway in 42 Areas of Concern (AOC), which are some of the most severely degraded areas of the Great Lakes. Currently, there are 16[16] Areas of Concern located in Canada including the Toronto and Region AOC, which contains the Etobicoke and Mimico Creek watersheds. Restoration of beneficial uses in Areas of Concern is the primary mission of RAPs. Included in the Agreement is an Annex on Remedial Action Plans which lists impaired beneficial uses (Box 7).

BOX 7: FROM ANNEX 2 OF THE GREAT LAKES WATER QUALITY AGREEMENT

"Impairment of beneficial use(s)" means a change in the chemical, physical or biological integrity of the Great Lakes System sufficient to cause any of the following:

I. restrictions on fish and wildlife consumption;
ii. tainting of fish and wildlife flavour;
iii. degradation of fish wildlife populations;
iv. fish tumors or other deformities;
v. bird or animal deformities or reproduction problems;
vi. degradation of benthos;
vii. restrictions on dredging activities;
viii. eutrophication or undesirable algae;
ix. restrictions on drinking water consumption, or taste and odour problems;
x. beach closings;
xi. degradation of aesthetics;
xii. added costs to agriculture and industry;
xiii. degradation of phytoplankton and zooplankton populations; and
xiv. loss of fish and wildlife habitat.

Remedial Action Plans are an iterative, action-planning process which identify the responsibility and time frame for implementing remedial and preventative actions necessary to restore beneficial uses in Areas of Concern. Presently, documents are developed at each stage of the RAP process and forwarded to the International Joint Commission (IJC)[17] for review and comment. The following description of the RAP process is summarized from the *Canadian Great Lakes Remedial Action Plan Update* (October 1997).

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16 Originally, there were 17 Canadian Areas of Concern. Collingwood Harbour was considered restored and removed from the list in 1996.

17 The International Joint Commission (IJC) is an independent international organization established under the Boundary Waters Treaty of 1909. The Commission advises the United States and Canadian governments on boundary water issues. The Commission has three members appointed from each federal government.

The RAP process is carried out in three stages. **Stage 1** includes the collection of information by agency experts to define and identify environmental problems, sources, and causes. This information is discussed with the community. A Public Advisory Committee (PAC) is also formed during this stage.

In **Stage 2,** the Public Advisory Committee develops a common vision for their Area of Concern**,** sets goals, and determines the uses the area should support. Subsequently, a strategy is developed to recommend remedial actions to restore and protect these goals and uses.

Upon completion of implementation, **Stage 3** confirms the effectiveness of those measures in restoring beneficial uses and attaining clean-up targets.

Experience has shown that implementing clean-up and protection measures often occurs during the completion of Stage 2. Further, real progress in RAPs occurs in a step-wise fashion, with incremental improvements in environmental quality throughout the evolution of the RAP.

12.2.1 Toronto and Region Remedial Action Plan

The Toronto and Region Remedial Action Plan[18] was conceived as a strategy for cleaning up the waterfront between Etobicoke Creek and the Rouge River. As it became clear that restoring the waterfront would be impossible without cleaning up the rivers that drain into the area, the Toronto and Region Remedial Action Plan's geographic area expanded to include the Etobicoke, Mimico, Humber, Don, Highland, and Rouge watersheds, and the waterfront.

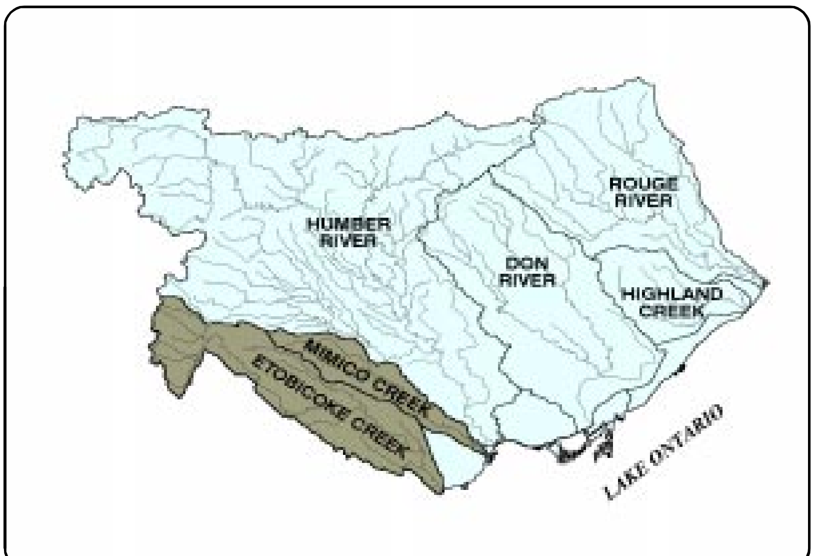


Figure 10: The Toronto and Region Remedial Action Plan Area of Concern

The Toronto and Region RAP Stage 1 document, *Environmental Conditions and Problem Definition*, was released in September 1988. The Stage 2 plan, *Clean Waters, Clear Choices (1994),* sets goals, and identifies remedial actions, responsible agencies, costs, timetables, and establishes monitoring programs to track progress. Stages 1 and 2 of the RAP were developed through the work of the Metro Toronto and Region RAP Team and supported by Public, Scientific, and Technical Advisory Committees.

18 Formerly the Metro Toronto and Region Remedial Action Plan.

The Toronto and Region RAP is currently in Stage 3, the implementation stage. Fifty-three recommended actions work toward addressing the twelve goals of the Toronto and Region Remedial Action Plan. Most of the RAP goals have established specific targets (delisting criteria). When these targets are met, the ecosystem is considered restored (Metro Toronto RAP, 1994). As outlined in *Clean Waters, Clear Choices*, these goals are concerned with the following issues:

- ecosystem health;
- fishable, swimmable, drinkable waters and nearshore zones;
- discharges to waterbodies;
- costs of clean-up; cost-effectiveness;
- public access;
- sediments;
- lakefilling;
- atmospheric deposition;
- coordination with other programs;
- navigation and recreation;
- public awareness and consultation; and
- monitoring and review.

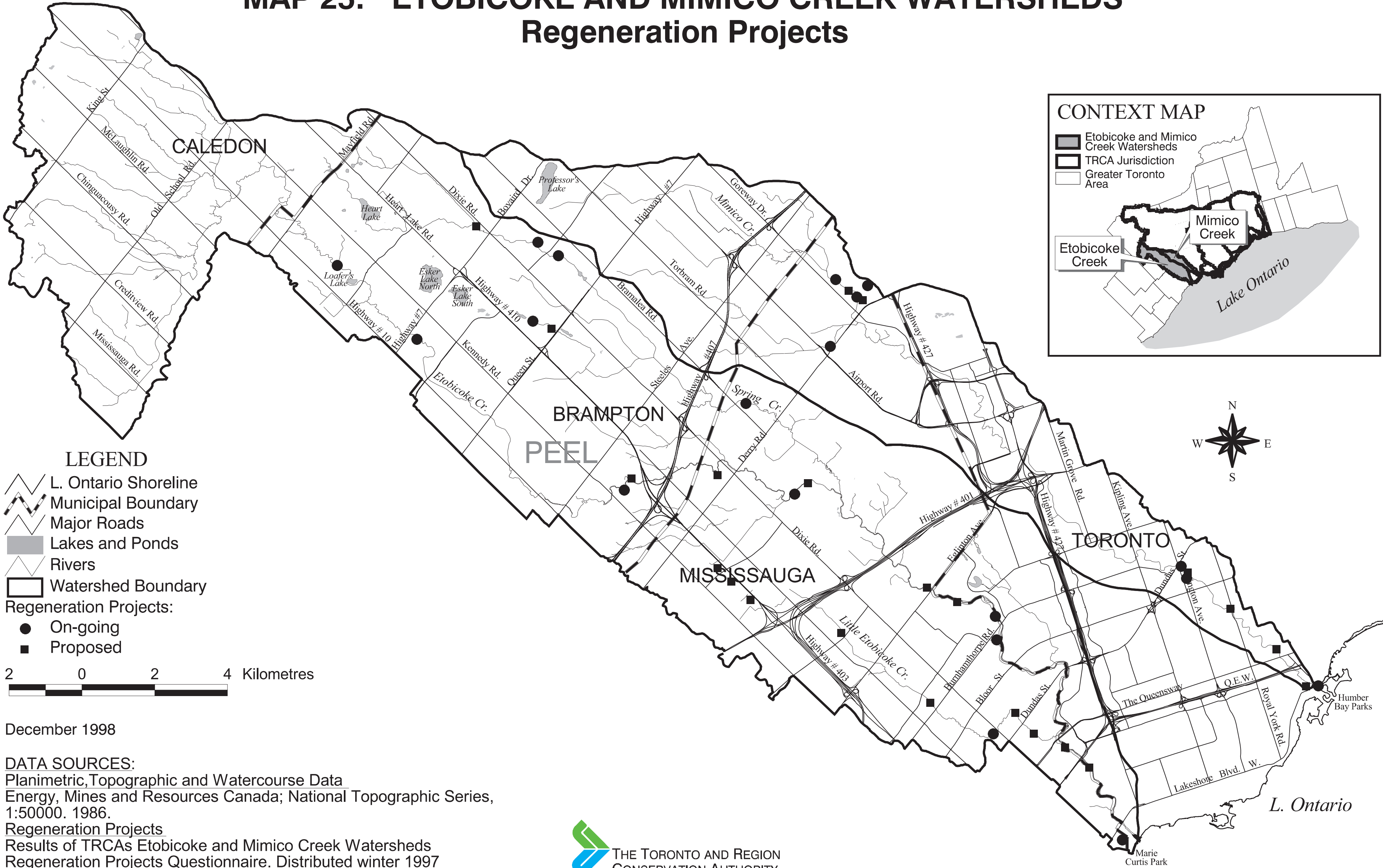
Currently, The Toronto and Region Conservation Authority and the Waterfront Regeneration Trust are the local coordinating agencies for the Toronto and Region RAP's implementation. Under the terms of a Memorandum of Understanding signed in October 1997, the two agencies are taking on the coordination and public involvement responsibilities to help implement the Toronto and Region Remedial Action Plan. Both Environment Canada and the Ministry of the Environment will remain the responsible agencies throughout Stage 3. Local community participation and volunteer efforts are also important for the successful implementation of the Toronto and Region RAP.

12.3 REGENERATION PROJECTS

In winter 1997 and spring 1998, The Toronto and Region Conservation Authority sent a questionnaire to municipal departments, various agencies, individuals, and community and interest groups in the watersheds. The questionnaire requested that respondents identify any regeneration projects they were involved with in the watersheds. A summary of current and proposed site specific regeneration projects are listed in Appendix A and B and shown on Map 25. Based on this information, there are currently 6 regeneration projects underway in the Mimico Creek watershed, with 7 more proposed. In the Etobicoke Creek watershed, there are currently 11 site specific regeneration projects with 15 more proposed.

Regeneration projects are active, in-the-ground initiatives that aim to improve the health of the Etobicoke or Mimico Creek watersheds. Many individual projects address a number of issues such as improving stormwater control, enhancing aquatic and terrestrial habitats, and constructing trails. Also, many projects are being accomplished through partnerships.

MAP 25: ETOBICOKE AND MIMICO CREEK WATERSHEDS
Regeneration Projects



December 1998

DATA SOURCES:

Planimetric,Topographic and Watercourse Data
Energy, Mines and Resources Canada; National Topographic Series, 1:50000. 1986.

Regeneration Projects
Results of TRCAs Etobicoke and Mimico Creek Watersheds Regeneration Projects Questionnaire. Distributed winter 1997 and spring 1998.
Municipal staff input.

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In addition to the projects listed in Appendix A and B, a number of respondents to the questionnaire indicated they wanted to be kept informed of activities in the Etobicoke and Mimico Creek watersheds. Others expressed an interest in participating in future watershed regeneration activities.

A number of broader scale projects were also identified, including studies, inventories, and reports that will assist the future task force, watershed residents, and others in their regeneration efforts (Appendix C). In some cases, these documents identify areas in need of protection or enhancement. Most of these recent studies and reports were used as background in the production of this report.

SUMMARY

There are many projects that are contributing to the regeneration of the Etobicoke and Mimico Creek watersheds. These have been initiated by municipalities, agencies, individuals, community and interest groups, and other organizations. They range in size from site specific projects to regional wide studies of the environment. There is also a great diversity of projects, from cultural heritage inventories to stormwater management studies. It is anticipated that the development of a watershed management strategy by the future task force will stimulate the development of many more initiatives and help to focus and coordinate planning, management, consultation, regeneration, and monitoring efforts.

Regenerating Mimico Creek with the Malton Residents Association

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APPENDIX A: Regeneration Projects in the Mimico Creek Watershed

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Mimico Creek	Mimico Creek Estuary Wetland Creation Project Phase III and Pedestrian Bridge Project	City of Toronto Mimico Creek Mouth South of Lakeshore Blvd. West in Humber Bay Parks	The creation of an estuary wetland at the mouth of Mimico Creek using a "drowned levy" habitat scenario. The construction of a pedestrian bridge over Mimico Creek as a part of the Toronto Waterfront Trail.	Underway Opening of the project is anticipated for 1999.	TRCA (wetland creation) City of Toronto Parks Dept. (bridge construction) Environment Canada Great Lakes 2000 Cleanup Fund, CCFEW, Canada Trust Friends of the Environment	TRCA Laura Stephenson 5 Shoreham Drive Downsview, ON M3N 1S4 (416)661-6600 City of Toronto Garth Armour
Mimico Creek	Bonar Wetland	City of Toronto Main Branch East of Legion Rd., north of Lakeshore Blvd. West	Proposal for the development of a wetland and native forest on the lands east of Legion Road, north of Lake Shore Blvd. West	Proposed	Citizens Concerned About the Future of the Toronto Waterfront (CCFEW)	CCFEW Michael Harrison 43 Symons Street Etobicoke, ON M8V 1T7
Mimico Creek	Mimico Creek Renaturalisation	City of Toronto Main Branch Near Reid Manor Park	Naturalize creek, create wetland habitat, provide safe public access, community outreach.	Proposed (1999)	Friends of Mimico Creek	Friends of Mimico Creek Rhona Swarbrick 416-233-1786

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Mimico Creek	Mimico Creek Valley Trail	City of Toronto Main Branch Linkage between Etobicoke City Centre along Bloor St., west of Royal York Rd., and the Waterfront Trail	Proposed trail along the Mimico Creek valley	Proposed	City of Toronto	Dave McKillop City of Toronto (416) 394-8217
Mimico Creek	Montgomery Meadow Wildflower Project	City of Toronto Main Branch Behind Montgomery's Inn, south east corner of Islington Ave. and Dundas St.	Locally appropriate native flowers and grasses, native shrubs, Chipmunk habitat, butterfly garden.	On-going	Etobicoke Parks and Forestry Citizens Advisory Committee	Etobicoke Parks and Forestry Advisory Committee Trish Murphy 1 Thorndale Avenue Toronto, ON M8X 1W6 Tel: 416-233-6507
Mimico Creek	Ste. Marguerite d'Youville School Ravine Naturalization	City of Toronto Main Branch School by Royal York Road	Ravine naturalization at the school with the community. Mitigating erosion, creating wetland pockets, sediment control, planting, outdoor education.	On-going	Ste. Marguerite d'Youville School and others	Ste. Marguerite d'Youville School 775 Royal York Road 416-393-5418
Mimico Creek	Mimico Creek Enhancements	City of Toronto Main Branch North of Lake Shore Blvd. on the west side of Mimico Creek	This property could be used to restore the Mimico Creek Oxbow (wetland) habitat and forest cover. Trail development and naturalization could occur along the Mimico Creek Valley.	Proposed	Citizens Concerned About the Future of the Toronto Waterfront	Michael Harrison Citizens Concerned About the Future of the Etobicoke Waterfront (CCFEW) 43 Symons Street Etobicoke, ON M8V 1T7

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Mimico Creek	Etobicoke Collegiate	City of Toronto Main Branch At a school south east of Islington Ave. and Dundas St.	Environmental Enhancements.	Proposed	Etobicoke Collegiate	Ruth Durward 416-394-7840 x 380
Mimico Creek	Malton Greenway Trail	City of Mississauga (Malton) Main Branch	A master plan is proposed for the year 1999. Trail construction would be phased.	Proposed	City of Mississauga	City of Mississauga Community Services Richard Roberts 905-615-4210
Mimico Creek	Malton/Derry Greenway Westwood Secondary School -Valley and Stream Regeneration	City of Mississauga Main Branch Malton/Derry Greenway Westwood Secondary School	Ceremonial tree planting (of 21 trees and shrubs)by the City of Mississauga to mark Arbour Day	On-going	City of Mississauga, TRCA, Westwood Secondary School	City of Mississauga Community Services Eugene Furgiuele 3235 Mavis Road Mississauga, ON L5C 1T7
Mimico Creek	Multicultural Environmental Stewardship Project -Valley and Stream Regeneration	City of Mississauga (Malton) Main Branch By Etude Road	Planting along Mimico Creek to enhance vegetation and help slope stability and litter clean up.	Complete d Fall 1998	Malton Residents Association, City of Mississauga, and TRCA	Doug McRonney Malton Residents Assoc. 905-678-0708 Chandra Sharma TRCA 416-661-6600 ext. 237
Mimico Creek	Malton/Derry Greenway-Valley and Stream Regeneration	City of Mississauga Upper Main Branch 2 sites between Derry Rd. and Steeles Ave. West Branch 1 site by the intersection of Derry and Airport Roads	Valley and stream corridor habitat enhancement projects. Riparian plantings, sediment and erosion control, bioengineering, reforestation, etc.	On-going	TRCA and City of Mississauga	TRCA Dave Rogalsky 905-851-2809 City of Mississauga Community Services Eugene Furguiele 3235 Mavis Road Mississauga, ON L5C 1T7

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Mimico Creek	Mimico Creek Erosion Control: Morningstar Drive	City of Mississauga Main Branch Morningstar Dr. to South of Derry Rd.	Stabilize creek bed and banks, reduce downstream excessive sedimentation using a combination of methods including bio-engineering.	Proposed for 2001	City of Mississauga	City of Mississauga Transportation and Works Department Robert Levesque, P.Eng 3484 Semenyk Court Mississauga, ON L5C 4R1 Tel: 905-896-5144

APPENDIX B: Regeneration Projects in the Etobicoke Creek Watershed

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Etobicoke Creek	Etobicoke Creek Valley Habitat Enhancements	City of Toronto Lower Main Branch Etobicoke Creek Valley up to QEW	Potential projects include plantings of Carolinian species, naturalization of valley system, and wier modification.	Proposed	Citizens Concerned About the Future of the Etobicoke Waterfront	Citizens Concerned About the Future of the Etobicoke Watefront (CCFEW) Michael Harrison 43 Symons Street Etobicoke, ON M8V 1T7
Etobicoke Creek	Etobicoke Creek Trail	City of Toronto and City of Mississauga Lower Main Branch North of the QEW to Derry Road	Develop trail system along Etobicoke Creek. Joint feasibility study for Phase I-II (QEW to HWY 401) will be undertaken in 1999. Phase III -IV (Hwy 401 to Derry Rd.) is proposed beyond the 10 year Mississauga plan and is subject to approval of GTAA.	Proposed	City of Toronto Parks and Recreation and City of Mississauga Community Services	City of Mississauga Richard Roberts 905-615-4210 City of Toronto Mark Edelman Supervisor, Open Space and System Planning. Parks and Recreation 416-394-8514
Etobicoke Creek	The Arsenal Lands	City of Mississauga Lower Main Branch South of Lakeshore Rd., adjacent to Marie Curtis Park, on the border of Toronto	Ecological restoration and development of a major regional park, which bridges the waterfront from Mississauga to Toronto. A master plan and site remediation plan have been developed for the park. Site remediation began in 1998 and will be completed in 1999. The City of Mississauga budget year for design work is 1999 and construction is 2000.	Proposed	TRCA, Region of Peel, City of Toronto, City of Mississauga, Province of Ontario	TRCA Larry Field, Waterfront Specialist (416) 661-6600 ext. 243

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Etobicoke Creek	Valley and Stream Regeneration Projects - Fleetwood Park	City of Mississauga Lower Main Branch By Burhamthorpe Rd.	Community/school planting event in partnership with the City of Mississauga. 170 trees and shrubs planted.	On-going	TRCA, City of Mississauga, and community partners.	TRCA Dave Rogalsky 905-851-2809 City of Mississauga Community Services Eugene Furgiuele 3235 Mavis Road Mississauga, ON L5C 1T7
Etobicoke Creek	Naturalization of Creek Banks and Riparian Zone along Etobicoke Creek: Burnhamthorpe Road.	City of Mississauga Lower Main Branch Highway 401 to Burnhamthorpe Rd.	Plant riparian zones along the creek banks and top of banks for wildlife habitat. Introduction of native trees/shrubs and wildflowers. Establish a no-mow zone along top of bank to reduce erosion and modify the velocity of stormwater during peak periods.	On-going	City of Mississauga and TRCA	City of Mississauga Community Services Eugene Furgiuele 3235 Mavis Road Mississauga, ON L5C 1T7
Etobicoke Creek	Etobicoke Creek Stabilization: Eglinton Avenue	City of Mississauga Lower Main Branch Etobicoke Creek North of Eglinton Ave.	Stabilization of creek using natural techniques	Proposed for 2006	City of Mississauga	City of Mississauga Transportation and Works Department Robert Levesque, P.Eng 3484 Semenyk Court Mississauga, ON L5C 4R1 Tel: 905- 896-5144

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Etobicoke Creek	Etobicoke Creek Erosion Control: Palisades Lane	City of Mississauga Lower Main Branch South of Eglinton Ave., east of Palisades Lane.	Stabilize valley wall and prevent further erosion on Etobicoke Creek.	Proposed for 2003	City of Mississauga	City of Mississauga Transportation and Works Department Robert Levesque, P.Eng 3484 Semenyk Court Mississauga, ON L5C 4R1 Tel: 905-896-5144
Etobicoke Creek	Little Etobicoke Creek Channelization Improvements	City of Mississauga Little Etobicoke Creek North of Dundas St., behind The Brick.	Erosion control and channel improvements include deepening of the channel.	Proposed	City of Mississauga	City of Mississauga Transportation and Works Department Robert Levesque, P.Eng 3484 Semenyk Court Mississauga, ON L5C 4R1 Tel: 905-896-5144
Etobicoke Creek	Little Etobicoke Creek Erosion Control: Dundas Street	City of Mississauga Little Etobicoke Creek Dundas St. to the CPR	Stabilize channel to prevent bed and bank erosion.	Proposed for 2002	City of Mississauga	City of Mississauga Transportation and Works Department Robert Levesque, P.Eng 3484 Semenyk Court Mississauga, ON L5C 4R1 Tel: 905- 896-5144
Etobicoke Creek	Little Etobicoke Creek Erosion Control: Eglinton Avenue	City of Mississauga Little Etobicoke Creek Eglinton Ave. to Highway 401	Channel stabilization works required to protect watermain and reduce downstream sedimentation problems.	Proposed for 2006	City of Mississauga	City of Mississauga Transportation and Works Department Robert Levesque, P.Eng 3484 Semenyk Court Mississauga, ON L5C 4R1 Tel: 905-896-5144

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Etobicoke Creek	Retrofit of existing stormwater quantity ponds	City of Mississauga Little Etobicoke Creek or Main Branch	Retrofit of one or more existing off-line stormwater quantity ponds to provide quality and erosion control.	Proposed for 1999	City of Mississauga and TRCA	City of Mississauga Janice Teare
Etobicoke Creek	Applewood Trail - Phase I	City of Mississauga Little Etobicoke Creek Connects with Burnhamthorpe Rd.	Development of Applewood Trail within the next 5-10 years. Length of the trail runs from Burnhamthorpe Rd. By Little Etobicoke Creek	Proposed	City of Mississauga	City of Mississauga Community Services Richard Roberts 905-615-4210
Etobicoke Creek	Little Etobicoke Creek - Valley and Stream Regeneration	City of Mississauga Little Etobicoke Creek By Dixie Rd., north of Dundas St.	Valley and stream corridor habitat enhancement projects, channel naturalization plantings, sediment and erosion control, bioengineering, and reforestation.	On-going	TRCA and City of Mississauga	TRCA Dave Rogalsky 905-851-2809 City of Mississauga Community Services Eugene Furgiuele 3235 Mavis Road Mississauga, ON L5C 1T7
Etobicoke Creek	Etobicoke Creek Erosion Control: Netherheart Road	City of Mississauga Upper Main Branch East of Dixie Rd., just east of Netherheart Rd.	Stabilize valley wall and prevent further erosion.	Proposed for 2000	City of Mississauga	City of Mississauga Transportation and Works Department Robert Levesque, P.Eng 3484 Semenyk Court Mississauga, ON L5C 4R1 Tel: 905-896-5144

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Etobicoke Creek	Etobicoke Creek Stabilization: Cardiff Blvd.	City of Mississauga Upper Main Branch By Derry and Dixie Roads, behind Cardiff Blvd.	Excessive erosion encroaching a parking lot. Use of natural techniques where possible.	Proposed for 1999	City of Mississauga	City of Mississauga Transportation and Works Department Robert Levesque, P.Eng. 3484 Semenyk Court Mississauga, ON L5C 4R1 Tel: 905-896-5144
Etobicoke Creek	East Scarlett Greenbelt Planting/Pratt and Whitney Aircraft-Valley and Stream Regeneration	City of Mississauga Upper Main Branch By Courtney Park Dr. east of Dixie Rd.	Valley and stream corridor habitat enhancement projects including riparian plantings, sediment and erosion control, bioengineering, reforestation, etc.	On-going	TRCA, City of Mississauga, Pratt and Whitney Aircraft	TRCA Dave Rogalsky 905-851-2809 City of Mississauga Community Services Eugene Furgiuele 3235 Mavis Road Mississauga, ON L5C 1T7
Etobicoke Creek	Brampton Brick Valleylands-Valley and Stream Regeneration	City of Brampton Upper Main Branch South of Bovaird Drive	Valley and stream corridor habitat enhancement projects including riparian plantings, sediment and erosion control, bioengineering, reforestation, etc.	On-going	TRCA and the City of Brampton	TRCA Dave Rogalsky 905-851-2809
Etobicoke Creek	Etobicoke Creek Trail Link - by Brampton Sports Park	City of Brampton Upper Main Branch	Trail development along Etobicoke Creek to City of Mississauga	Proposed	City of Brampton	City of Brampton Parks Planning and Development Walter Fisher 905-874-2240

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Etobicoke Creek	Conservation Valleylands-Valley and Stream Regeneration	City of Brampton Upper Main Branch Between Conservation Dr. and Mayfield Rd.	Valley and stream corridor habitat enhancement projects including riparian plantings, sediment and erosion control, bioengineering, reforestation, etc.	On-going	TRCA and the City of Brampton	TRCA Dave Rogalsky 905-851-2809
Etobicoke Creek	The Etobicoke Creek Project: Turner Fenton Secondary School	City of Brampton Upper Main Branch Between Kennedy Rd. and Highway 410	Forest and meadow planting to benefit wildlife, aquatic habitat enhancement, water quality monitoring	On-going	Turner Fenton Secondary School, CWIP, Canada Trust, Urban Forest Associates	Turner-Fenton Secondary School, Contact: Peter Hill Urban Forest Assoc. Stephen Smith 331 Linsmore Cr. Toronto, ON M4J 4M1
Etobicoke Creek	Terry Miller NRAC Reforestation	City of Brampton Spring Creek South of Williams Parkway and west of Bramalea Rd.	Reforestaton planting was completed in 1995. Site is being monitored and maintained occasionally.	On-going	Urban Forest Associates	Urban Forest Associates Stephen Smith 331 Linsmore Cres. Toronto, ON M4J 4M1
Etobicoke Creek	Massey Street Park Edge Planting	City of Brampton Spring Creek Southwest of Bovaird Dr. and Bramalea Rd.	Edge planting was completed in 1992-3. Site is being monitored and maintained occasionally.	On-going	Urban Forest Associates	Urban Forest Associates Stephen Smith 331 Linsmore Cres. Toronto, ON M4J 4M1

Watershed	Project Title	Location	Description	Status	Lead Agency and Partners	Contact
Etobicoke Creek	Naturalization of Creek Banks and Riparian Zone along Spring Creek, North of Derry Road.	City of Mississauga Spring Creek North of Derry Rd.	Planting riparian zones along the creek banks and top of banks for wildlife habitat and introduction of native trees /shrubs and wildflowers. Establish a no-mow zone along top of Bank to reduce erosion and modify the velocity of stormwater during peak periods.	On-going	City of Mississauga and TRCA	City of Mississauga Community Services Eugene Furgiuele 3235 Mavis Road Mississauga, ON L5C 1T7
Etobicoke Creek	Trail North of Bovaird Drive Along Spring Creek	City of Brampton Spring Creek North of Bovaird Drive and West of Dixie Road	Trail development along Spring Creek	Proposed	City of Brampton	City of Brampton Parks Planning and Development Walter Fisher 905-874-2240
Etobicoke Creek	Trail By Esker Lakes and along Spring Creek	City of Brampton Spring Creek By Esker Lakes	Trail development along Spring Creek.	Proposed	City of Brampton	City of Brampton Parks Planning and Development Walter Fisher 905-874-2240
Etobicoke Creek	Parr Lake South Park Reforestation /Edge Enhancement	City of Brampton Spring Creek Northeast of Highway 410 and Highway 7	Reforestation and edge enhancement planting was completed in 1994. Site is being monitored and maintained occasionally.	On-going	Urban Forest Associates	Urban Forest Associates Stephen Smith 331 Linsmore Cres. Toronto, ON M4J 4M1

APPENDIX C: Recent Studies and Reports

NAME OF PROJECT	BRIEF DESCRIPTION	ORGANIZATION
Mississauga Storm Water Quality Control Study (1995)	The study includes a comprehensive review of background information, alternative control techniques, and a stormwater quality control strategy. The strategy sets out a plan for incorporating stormwater management facilities within new developments and for the retrofit of stormwater management infrastructure in existing urban areas.	City of Mississauga (prepared by Gore & Storrie Ltd., and R.E. Winter & Associates Ltd.)
State of the Environment Reports Atmosphere Report (1995) Water Report (1996) Land Report (1998)	These reports establish baseline conditions within the Region of Peel for future use in monitoring.	Region of Peel, Planning Department
Toward the Ecological Restoration of South Etobicoke (1997)	Identifies a number of potential restoration projects in South Etobicoke	Citizens Concerned About the Future of the Etobicoke Waterfront
Heritage Inventory	Built Heritage Resources Inventory and Monitoring of Designated Properties Under Part IV of the Ontario Heritage Act.	City of Mississauga
Natural Areas Survey (1996)	Inventories all remnant natural areas in the City of Mississauga and makes recommendations for their protection.	City of Mississauga
Mimic Creek Watershed Report (1994)	Reviewed previous reports pertaining to Mimico Creek and its watershed, and provided an overall assessment of the creek s environmental state	Waterfront Regeneration Trust
Mayfield West Natural Features Study (March, 1998)	(For the Mayfield West area bounded by: Old School Road and Mayfield Road to the north and south and Dixie Road and Chinguacousy Road to the east and West). This report represents Phase 1 of the preparation of a Comprehensive Environmental Impact Study and Management Plan which is being carried out as a component of the Mayfield West Community Development Plan. It includes a detailed inventory and assessment of terrestrial and aquatic flora, fauna, and habitat.	The Toronto and Region Conservation Authority and Town of Caledon
Etobicoke and Mimico Creek Surface Water Quality Background Technical Report (Draft, 1998)	Provides a general understanding of current water quality conditions and the factors affecting these conditions.	The Toronto and Region Conservation Authority
Etobicoke and Mimico Creek Watersheds Heritage Study (1998)	Details the known heritage resources of the Etobicoke and Mimico Creek watersheds.	The Toronto and Region Conservation Authority

NAME OF PROJECT	BRIEF DESCRIPTION	ORGANIZATION
Evaluating the Condition of Fish Communities in the Mimico Creek Watershed (Draft, 1998)	Provides an evaluation of aquatic conditions and physical habitat in the Mimico Creek watershed.	The Toronto and Region Conservation Authority
Evaluating the Condition of Fish Communities in the Etobicoke Creek Watershed (Draft, 1998)	Provides an evaluation of aquatic conditions and physical habitat in the Etobicoke Creek watershed.	The Toronto and Region Conservation Authority
Terrestrial Habitat Analysis of the Etobicoke and Mimico Creek Watersheds (Draft, 1998)	The report summarizes the current extent, size, and condition of terrestrial habitats. It also assesses the importance of these habitats for biodiversity and watershed health and identifies priorities and opportunities for protection and restoration.	The Toronto and Region Conservation Authority
Etobicoke and Mimico Creek Watersheds Stormwater Management Study (Phase 1)-- Draft	Phase I of the study includes data collection and a review of background information on ponds and study areas to create a GIS based Stormwater Management Study	The Toronto and Region Conservation Authority
State of the Environment Report: Metropolitan Toronto (1995)	Presents baseline information on the land, water and air aspects of the environment in and around (the former) Metro Toronto. Documents environmental conditions, human pressures that impact the environment, and actions presently in place to address these issues.	The Municipality of Metropolitan Toronto (Planning Department)