LOWER TRENT CONSERVATION

MAYHEW CREEK
State of the Watershed Report

November, 2000

MAYHEW CREEK
State of the Watershed Report

Project completed by
LOWER TRENT CONSERVATION
for the
CITY OF QUINTE WEST

November, 2000

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- City of Quinte West
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1.0 Introduction

The Mayhew Creek watershed has been identified as a top priority for watershed planning by Lower Trent Conservation (LTC) and the Bay of Quinte Remedial Action Plan (QRAP). Located within the City of Quinte West and the Township of Brighton, this 3831 hectare watershed drains into the Trent River at the north end of Trenton (Map 1).

This *State of the Watershed Report*, initiated by Lower Trent Conservation in November 1999, is the first phase of the *Mayhew Creek Watershed Plan.*

1.1 REGIONAL CONTEXT

The arrival of colonists in the late 1700's to the Bay of Quinte area, one of the oldest, settled rural areas in Ontario, marked the beginning of dramatic cultural changes to the natural landscape (QRAP 1990). Over the years, the Bay's watershed has become progressively more developed as a result of urban, industrial and agricultural activity. The many rivers and streams in the Quinte area act as pathways for the disposal of by-products of this human activity into the Bay. The result has been a degraded ecosystem affected by excessive nutrient enrichment, bacteriological and heavy metal contamination, and habitat loss (QRAP 1990).

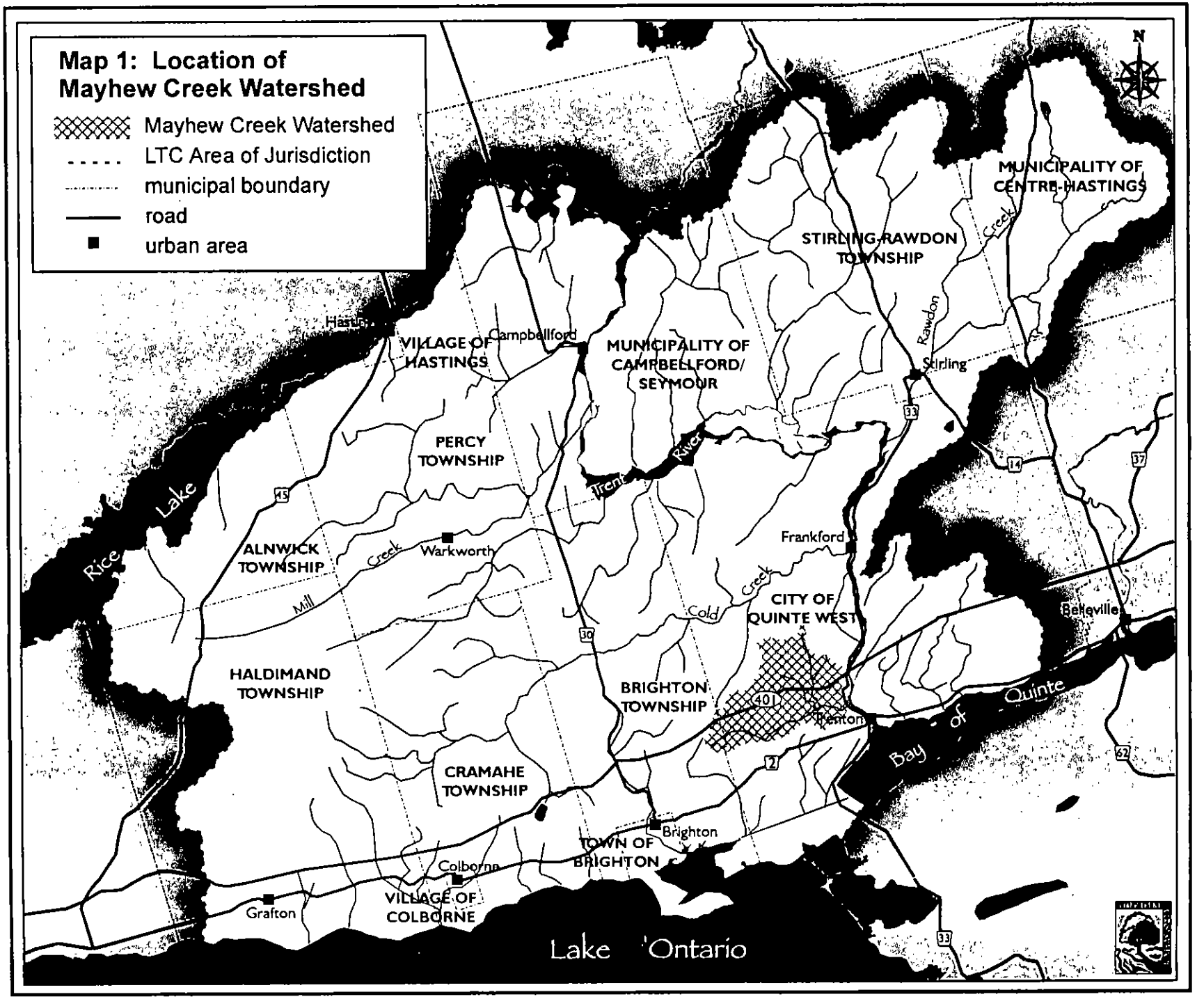
In 1985 the International Joint Commission identified the Bay of Quinte as one of 43 Areas of (Environmental) Concern in the Great Lakes basin (QRAP 1990). The Bay of Quinte Remedial Action Plan was developed to provide recommendations for the reduction of contaminant loading to the Bay, thereby improving, enhancing and protecting the Bay's ecosystem and the surrounding land (QRAP 1993).

As the population around the Bay of Quinte is expected to continue growing (QRAP 1993), changes in land use, especially increased urbanization, can be expected. Continued intense development can aggravate a number of environmental problems, including water quality concerns (MOEE 1991). In order to address environmental concerns relating to urbanization, the QRAP (1993) identified the following recommendation in the Stage 2 Report - Time to Act:

> ***The province of Ontario's Subwatershed Planning Process should be adopted and employed by Quinte area municipalities to provide direction for the preparation of Secondary Official Plans for areas slated for new urban development.***

1.2 LAND USE PLANNING ON A WATERSHED BASIS

A watershed is a natural geographic unit, consisting of the land area from which water, sediment and dissolved materials drain into a receiving watercourse or body of water. The hydrologic cycle


Map 1: Location of Mayhew Creek Watershed
Mayhew Creek Watershed
LTC Area of Jurisdiction
municipal boundary
road
urban area
N
MUNICIPALITY OF CENTRE HASTINGS
STIRLING-RAWDON TOWNSHIP
Creek
Rawdon
Stirling
Hastings
VILLAGE OF HASTINGS
Campbellford
MUNICIPALITY OF CAMPBELLFORD/ SEYMOUR
PERCY TOWNSHIP
Trent River
Rice Lake
ALNWICK TOWNSHIP
Creek
Warkworth
Mill
Frankford
Cold Creek
CITY OF QUINTE WEST
Belleville
HALDIMAND TOWNSHIP
BRIGHTON TOWNSHIP
Trenton
Bay of Quinte
CRAMAHE TOWNSHIP
Brighton
TOWN OF BRIGHTON
Colborne
VILLAGE OF COLBORNE
Grafton
Lake Ontario
45
30
401
2
33
14
37
62

is the pathway that integrates the physical, chemical and biological processes of an aquatic ecosystem and its associated terrestrial ecosystem. Water continuously moves through watersheds and influences the numerous physical processes and biological life cycles associated with the watershed.

Traditional municipal land use planning, based upon political boundaries and property ownership, tends not to acknowledge the interconnections and relationships between human activities on the land and the natural features and processes in the watershed (MOEE and MNR 1993). Since actions that occur in one municipality can have impacts on the natural features and processes in other municipalities, a more regional approach to planning is required to address environmental issues.

Watershed planning provides that regional approach. It recognizes the importance of natural processes, and is based on the ecosystem approach, which states: *nothing exists in isolation ... everything is connected to everything else. If we alter one part of the environment, the effects will be felt elsewhere, like ripples on a pond after a stone is thrown in* (MOEE and MNR 1993). Since watersheds follow natural boundaries, they are the ideal unit for planning, managing and protecting vital land and water resources.

Watershed plans make recommendations for resource protection in both rural and urban areas. These recommendations must meet the environmental standards set out in regional resource management strategies (e.g. the Bay of Quinte Remedial Action Plan) and must take into account the concerns and interests of the community.

The ultimate goal of watershed planning is to achieve an ecosystem-based approach to environmental protection, water management, and land use planning. By identifying and classifying natural areas and systems requiring protection and delineating areas of natural hazards, opportunities and constraints for development are identified, as well as opportunities to focus conservation and restoration initiatives.

1.3 THE MAYHEW CREEK WATERSHED PLAN

The City of Quinte West is expected to undergo increased pressure for urban growth in the next few years. The Mayhew Creek watershed is one of the potential areas for growth and has been identified as a priority area for watershed planning. While there are other watershed management issues, stormwater management is the driving force for the plan, as new development in the watershed will need to meet the stormwater criteria set out in the Bay of Quinte Remedial Action Plan (QRAP 1993).

1.3.1 Purpose of the State of the Watershed Report

The first phase in developing a watershed plan is the preparation of a *State of the Watershed Report*. The objectives of this report are:

- to provide an inventory of the physical, environmental and social features of the watershed
- to review the available information and identify information gaps
- to consult with watershed residents and agencies to determine issues and concerns in the watershed
- to identify the scope of the watershed plan

1.3.2 Project Support and Approach

Lower Trent Conservation has completed this *State of the Watershed Report* in cooperation with two funding partners: the City of Quinte West and the Ontario Ministry of Natural Resources. Throughout the development of this report, a number of agencies and watershed residents were consulted regarding information on the physical and biotic features of the watershed. Data were also collected using the Ontario Base Map Sheets (Scale 1:10 000), the Department of Energy, Mines and Resources Canada Topographic Map Sheets (Scale 1:25 000 and 1:50 000) and aerial photographs (Flown in 1999; Scale 1:8 000) of the watershed. Maps and air photo overlays were digitized using the PC ArcInfo Geographic Information System. A list of available mapping and aerial photographs for the watershed is included in Appendix 1.

The agencies that provided information or identified concerns within the watershed include the following:

Aggregate Producers Association of Ontario
Bay of Quinte Remedial Action Plan
City of Quinte West
Ontario Ministry of Natural Resources
Ontario Ministry of the Environment
Ontario Ministry of Agriculture, Food and Rural Affairs
Presqu'ile-Brighton Field Naturalists
Quinte West Public Utilities Commission

A list of contacts is provided in Appendix 2.

In addition, conversations with watershed residents and a landowner questionnaire provided local knowledge of the area. The questionnaire was designed to help respondents identify issues and concerns. It was sent to 125 residents/landowners of the area in February, 2000. A total of 13 questionnaires were returned, giving a response rate of 10.4%. The questionnaire and a summary of issues identified through the questionnaire are summarized in Appendix 3. A mailing list of interested citizens was developed from the questionnaire.

1.3.3 Available Information

This report summarizes the available information about the physical characteristics, the water resources, the biotic communities and land use of the watershed. Within each section, a list of existing information and contacts is provided for easy reference. The material referenced and the mapping listed in Appendix 1 are available at the LTC office.

2.0 History of the Mayhew Creek Watershed

Like many areas of southern and south-eastern Ontario, the Mayhew Creek watershed has been extensively altered following the arrival of Europeans in the late 16th century. Large areas of land were cleared of the natural forest cover by the early settlers for homesteads, lumber and agricultural fields. A lumbering mill was constructed on the Trent River at the present site of Trenton in 1806 (Daw and Rutledge 1978) and a settlement was founded to the south of the confluence of Mayhew Creek and the Trent River in 1808. In subsequent years, this small town quickly became an important lumbering and industrial centre in Upper Canada (ERM 1970). The residential area surrounding Trenton did not begin to encroach upon the Mayhew Creek watershed until the early part of the 20th century. Land use changes such as these can have significant negative impacts on the water quantity and quality of small coldwater streams such as Mayhew Creek.

With the development of the watershed, the creek itself was also altered in numerous locations to suit the needs of the growing population. A number of small impoundments are currently located along the length of Mayhew Creek, and a man-made lake, known as Tremur Lake, was created in 1967 at the Wooler Road (County Road 40) crossing by the Trenton Public Utilities Commission. The Old Mill Dam, which is located approximately 500 m east of Wooler Road, supported an existing mill pond, and Tremur Lake was created by a second weir located at the base of Wooler Road. The lake is used as a source of water for the urbanized area of Trenton.

In other locations, the stream has been diverted or channelized in the past. The section downstream of the Old Mill Dam was modified in 1984/85 by Lower Trent Conservation to reduce the magnitude, extent and frequency of flooding in the urbanized area of Trenton. A portion of the creek was channelized and a bypass channel was constructed with the goal of attenuating floods up to and including the 100 year storm event. Other small scale activities have occurred in the headwaters of the stream.

AVAILABLE INFORMATION
Daw and Rutledge 1978. *A Resource Guide to the Trent-Severn Waterway.*
ERM 1970. *Lower Trent Region Conservation Report - Volume 1.*

3.0 The Mayhew Creek Watershed

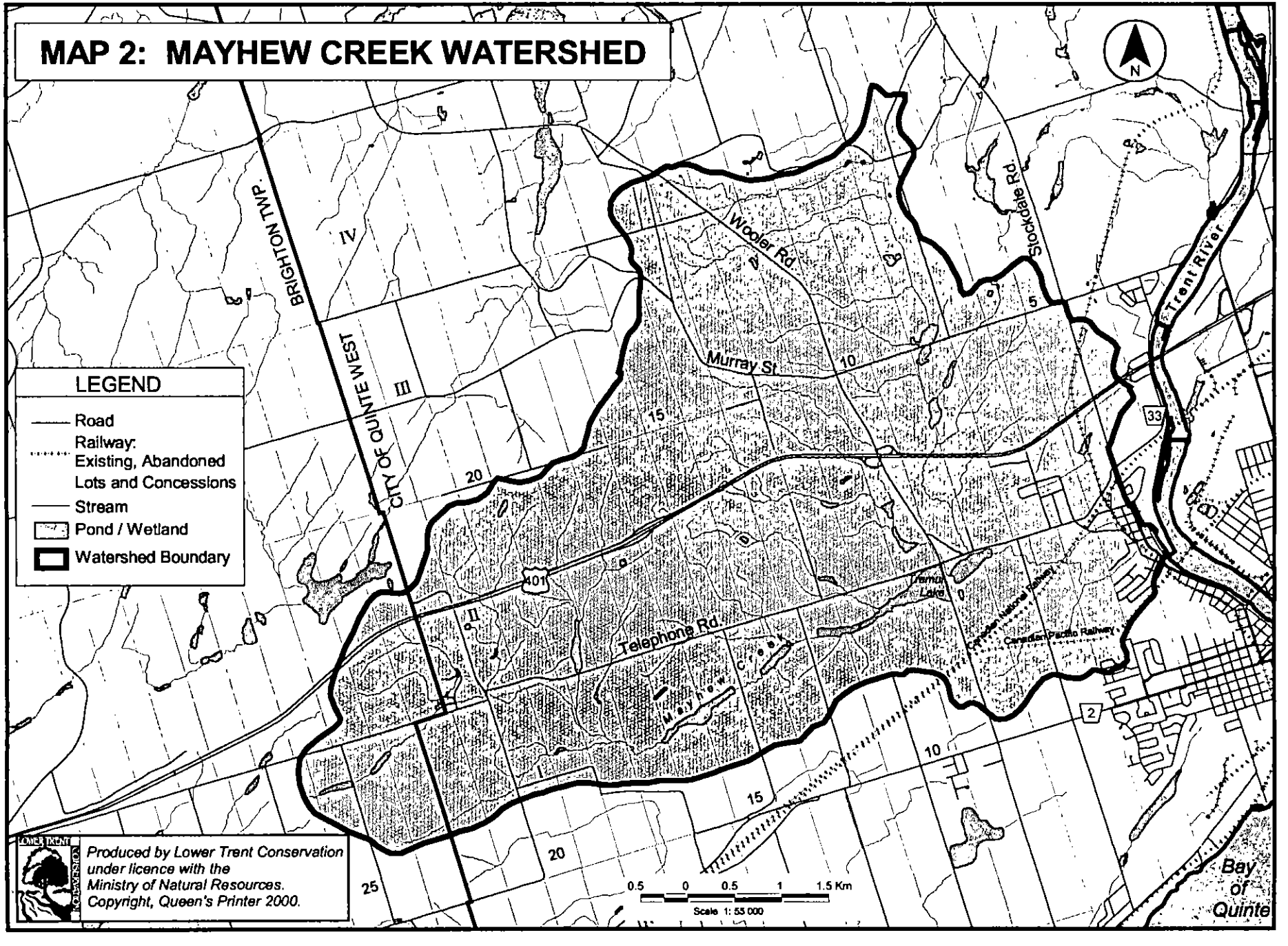
The Mayhew Creek watershed is principally located within the political boundaries of the City of Quinte West just north of the Bay of Quinte (Lake Ontario). A small portion of the headwaters are also located in the Township of Brighton. Mayhew Creek has a total drainage area of 3831 hectares. A number of groundwater springs, located north of the hamlet of Smithfield and adjacent to the steep cliffs of the Murray Hills, are the source of the creek. Mayhew Creek flows from west to east through an agricultural setting and into the urbanized north end of Trenton. At this point, the creek empties into the Trent River approximately two kilometres upstream of the Trent's confluence with the Bay of Quinte.

3.1 BOUNDARY DELINEATION

The watershed is defined as all the land area that drains into Mayhew Creek and its tributaries. Watershed boundaries for the study were delineated using Ontario Base Map Sheets (Scale 1:10,000), the Department of Energy, Mines and Resources Canada Topographic Map Sheets (Scale 1:25,000 and 1:50,000), aerial photographs (Flown in 1999; Scale 1:8 000) of the watershed and field observations. In addition, municipal staff provided information on stormwater and roadside drainage in the urbanized area of Trenton. The extent of the watershed is shown on Map 2.

The southern boundary of the Mayhew Creek watershed is just to the north of County Road 2 (formerly Highway 2), with the Dead and York Creek Watersheds located to the south (see the *Dead Creek State of the Watershed Report*, White 1996; and the *Dead & York Creek Subwatershed Plan*, LTC 1998). A kame moraine, which extends westward from Mount Pelion, marks the height of land that separates the two watersheds. The western end of the watershed extends just beyond the municipal boundary that separates the City of Quinte West and the Township of Brighton, to an area that is located just north of the hamlet of Smithfield. The watershed boundary includes a small portion of the Brighton Provincial Wildlife Area, and then continues in a northeasterly direction to the Mount Zion crossroads. From here, the watershed boundary heads in a southeasterly direction to an area near the intersection of County Road 33 (formerly Highway 33) and Highway 401. The eastern watershed boundary is a height of land located just west of the Trent River. In the urban area of Trenton, the watershed boundary approximately follows the path of Water Street.

The land immediately west of the Mayhew Creek watershed drains to Presqu'ile Bay via Smithfield Creek, while the area north of the watershed is drained by several tributaries of Cold Creek. To the east of the Mayhew Creek watershed, there is a narrow strip of land that drains to the Trent River either by direct overland flow or through a number of small unnamed watercourses. As mentioned previously, the lands south of the Mayhew Creek watershed are drained by Dead and York Creeks.


MAP 2: MAYHEW CREEK WATERSHED
LEGEND
Road
Railway: Existing, Abandoned
Lots and Concessions
Stream
Pond / Wetland
Watershed Boundary
BRIGHTON TWP.
CITY OF QUINTE WEST
IV
III
II
Wooler Rd.
Stockdale Rd.
Trent River
Murray St.
Telephone Rd.
401
33
2
Trenton Lake
Canadian National Railway
Canadian Pacific Railway
Mayhew Creek
Bay of Quinte
10
15
20
25
N
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Produced by Lower Trent Conservation
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AVAILABLE INFORMATION
LTC 1998. *Dead & York Creek Subwatershed Plan.*
White 1996. *Dead Creek State of the Watershed Report.*
OBM and NTS mapping is available for the entire study area at the LTC office.

4.0 Physical Features

Bedrock geology, surface topography and soil type influence the distribution of natural communities on the landscape as well as human land use patterns. Understanding these landform features is an important consideration in determining the suitability of a site for land use activities such as stormwater management, urban development, waste disposal (e.g. septic systems) and agriculture.

4.1 *BEDROCK GEOLOGY*

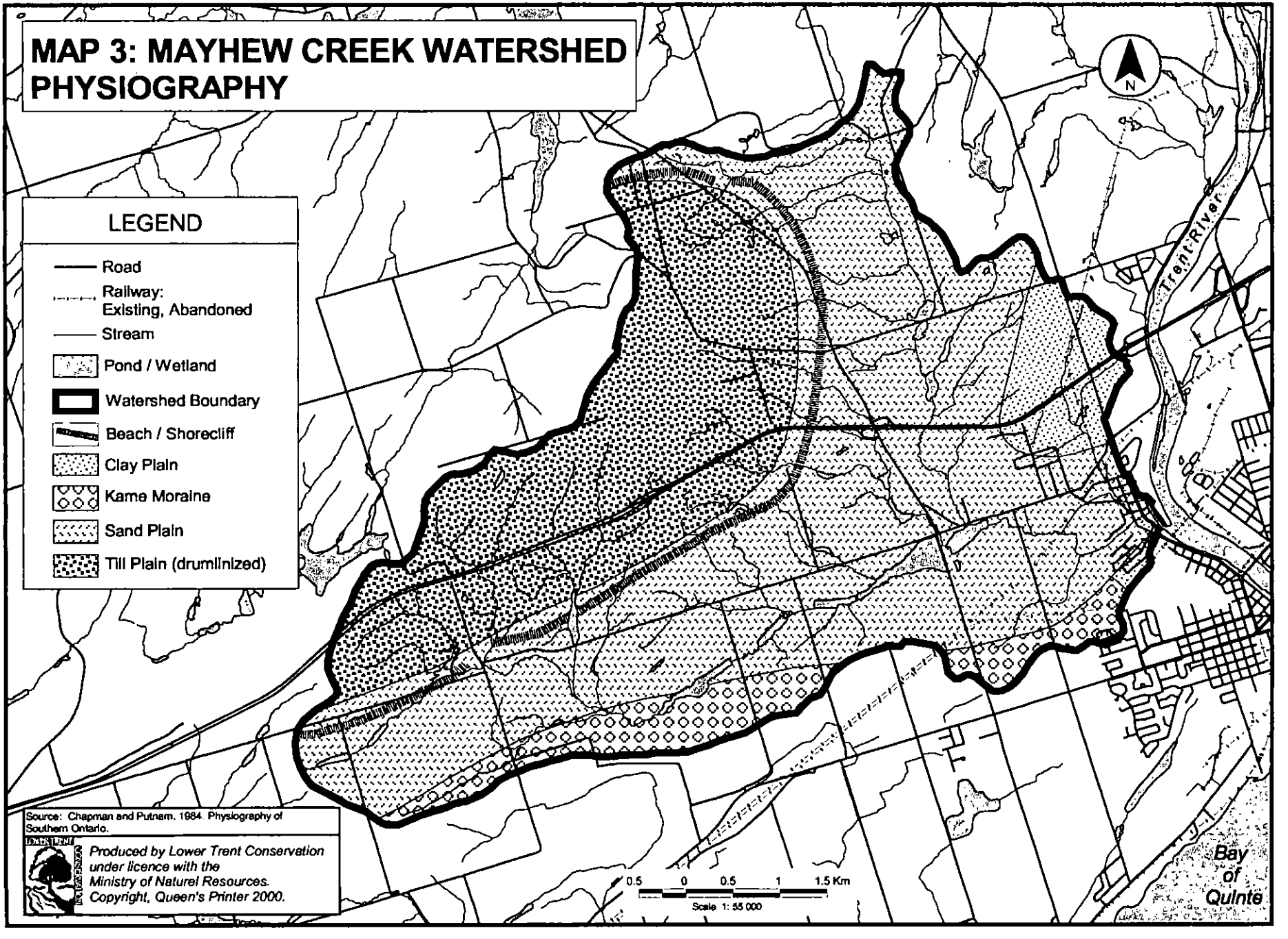
The limestone bedrock underlying the Mayhew Creek watershed was created by the deposition and compaction of calcareous sediments originating from seas that engulfed eastern Ontario during the Middle Ordovician Period, approximately 500 million years ago (Proctor & Redfern and Gartner Lee 1975, Chapman and Putnam 1984). The limestone is considered part of the Ordovician Black River Series and is interspersed with shaley interbeds and partings (Hoffman and Acton 1974, Totten Sims Hubicki Associates 1995). Well water records (MOE 1999) indicate that the bedrock is highly fractured with many seams of dark grey clay.

In southeastern Ontario, the topography of the bedrock can be described as a series of large flat upland blocks that are separated by flat bottomed bedrock valleys. This entire bedrock formation dips gently to the south-southwest in this area, with a grade of approximately 4 m/km (Mirynech 1963). Along the southern boundary of the watershed, an exposed bedrock plateau runs in an east-west direction, coming to a point in Trenton known as Mount Pelion.

4.2 SURFICIAL LANDFORMS

The surficial landforms of the Mayhew Creek watershed are characterized by gently rolling hills with a number of steep drumlins interspersed. This landscape was formed by the scraping action of ice and the sorting of sediments by glacial meltwater during the recession of the Wisconsinan ice front during the Pleistocene Epoch (approximately 12 500 years ago). As the glaciers receded, the meltwaters created Glacial Lake Iroquois, which covered the lowlands surrounding present day Lake Ontario, eventually forming a flat plain (Chapman and Putnam 1984). The northern boundary of the Mayhew Creek watershed is flanked by the steep shorecliffs of the glacial lake. This area has come to be known as the Murray Hills.

According to the physiographic regions defined by Chapman and Putnam (1984), the Mayhew Creek watershed lies within the Iroquois Plain and South Slope Regions. The land within the watershed can be divided into five distinct landform features that are related to the two physiographic regions. These features are shown on Map 3.


MAP 3: MAYHEW CREEK WATERSHED PHYSIOGRAPHY
LEGEND
Road
Railway: Existing, Abandoned
Stream
Pond / Wetland
Watershed Boundary
Beach / Shorecliff
Clay Plain
Kame Moraine
Sand Plain
Till Plain (drumlinized)
N
Trent River
Bay of Quinte
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Source: Chapman and Putnam. 1984. Physiography of Southern Ontario.
Produced by Lower Trent Conservation under licence with the Ministry of Naturel Resources. Copyright, Queen's Printer 2000.

4.2.1 Trenton Kame Moraine

A ridge of sand and gravel, known as the Trenton kame moraine, extends from Trenton to Smithfield (Chapman and Putnam 1984). This deposit marks the boundary between the watersheds of Mayhew Creek and Dead & York Creek. Formed by glacial meltwater streams, this ridge was smoothed over when the area was submerged under Lake Iroquois. The north side of the deposit is very steep, particularly near Mount Pelion, while the south side of the moraine (part of the Dead & York Creek Watershed) forms a gently rolling hill. Gravel and sand have been extracted at several locations along the formation. An operating gravel pit exists at the southern boundary of the watershed, east of Second Dug Hill Road.

4.2.2 Sand Plain

A sand plain, created by glacio-lacustrine activity, extends northward from the kame moraine to the base of the Murray Hills (Chapman and Putnam, 1984). The surficial deposits, consisting of a deep layer of glacial till, are overlain by post-glacial sand. Some wells in this area extend through approximately 28 m of overburden (MOE 1975, MOE 1999).

4.2.3 Beach and Shoreline Cliffs

The shoreline cliffs at the base of the Murray Hills are one of the most recognizable landforms in the lower Trent region. The continuous wave action from Lake Iroquois carved the steep cliffs from the drumlinized till plain that forms the crest of the Murray Hills. In some places, the difference in elevation between the top of the Murray Hills and Highway 401 is as much as 75 m, with the bottom portion of the slopes being extremely steep due to the cut of the shoreline cliffs (Chapman and Putnam 1984).

Below the shoreline cliffs is a sandy beach deposit left by Lake Iroquois when it was at its maximum extent. As well, several lower beach deposits can be found below the maximum extent of the Lake Iroquois shoreline. These deposits were formed by the post-Iroquois lake stages, with the beaches from the Frontenac and Sydney stages being the most conspicuous. Generally, these lower beaches are fragmented and poorly developed because the post-Iroquois lake stages were short lived. The extent of these stages can be difficult to determine because the beach formations have been somewhat obscured in places by erosional and depositional processes (Mirynech 1963).

4.2.4 Drumlinized Till Plain

Above the shoreline cliffs on the crest of the Murray Hills is a drumlinized till plain that is part of the Peterborough Drumlin Field (Mirynech 1963). The drumlins are composed of a highly calcareous silt and gravel till, with some associated sand, rubble and boulders (which are of Precambrian origin and can be up to 1 m in diameter). The depth of this till is quite variable. The orientation of the drumlins in the Mayhew Creek watershed is from northeast to southwest at an angle of 20° to 30° west of south, reflecting the angle of ice movement during the last glaciation

(Chapman and Putnam 1984). The crest of the Murray Hills is actually composed of a number of drumlins that have coalesced into a single irregularly shaped upland area (Mirynech 1963).

4.2.5 Clay Plain

In the northeast corner of the watershed, a relatively low lying clay dominated plain can be found. This landform was created by a long, narrow embayment of Lake Iroquois that extended up the Trent River valley as far inland as the present day City of Peterborough. The feature is composed of lacustrine deposits of silt, clay and stones which have been reworked by the water and wave action of Lake Iroquois (ERM 1970; Chapman and Putnam 1984) to form a level till plain (Hoffman and Acton 1974). The well water records for Northumberland County (MOE 1975, 1999) indicate that overburden depth in this small area of the watershed ranges from 1.0 m to 10.0 m with an average depth of approximately 5.8 m.

4.3 SOIL DESCRIPTIONS

Due to variations in surficial deposits, topography and the accumulation of organic materials, a range of soil types have developed within the Mayhew Creek watershed. Map 4 shows the distribution of these soil types. The association between soil characteristics and the pattern of surficial deposits is described in Table 1. Characteristics such as soil texture, permeability, and soil depth affect the drainage of the land, runoff rates, and groundwater recharge (Dunne and Leopold 1978) and consequently the suitability of the land for particular land uses (Hoffman and Acton 1974).

The Brighton sandy loam soil complex is the predominant soil type in the Mayhew Creek watershed. It is common within all of the surficial landform classes except the clay plain that is located in the northeast corner of the watershed. The Brighton Series is derived from a parent material of calcareous sands, which generally have fine and medium textures. Due to the open matrix structure of sand dominated soils, this series is well drained. Consequently, the water holding capacity and natural fertility of these soils can be low, although productivity can be greatly increased with commercial fertilizers. Lands covered with this soil type support upland forest communities with mesic to xeric tree species and are generally considered suitable for development (although biological or hydrological site features may reduce suitability).

4.3.1 *Soils of the Trenton Kame Moraine*

The Trenton kame moraine, located in the southern portion of the watershed (north of County Road 2), is covered by the well drained soils of the Bookton and Pontypool Series. Both of these soil types are formed from a parent material of medium grained sands and the Pontypool Series may have some till mixed in the parent material. Thus, some small stones are generally associated with the Pontypool soils. This soil type is generally not know for its agricultural productivity and erosion may be a significant problem in some areas (especially on steeper slopes). Often, the

MAP 4: MAYHEW CREEK WATERSHED SOIL CLASSIFICATION

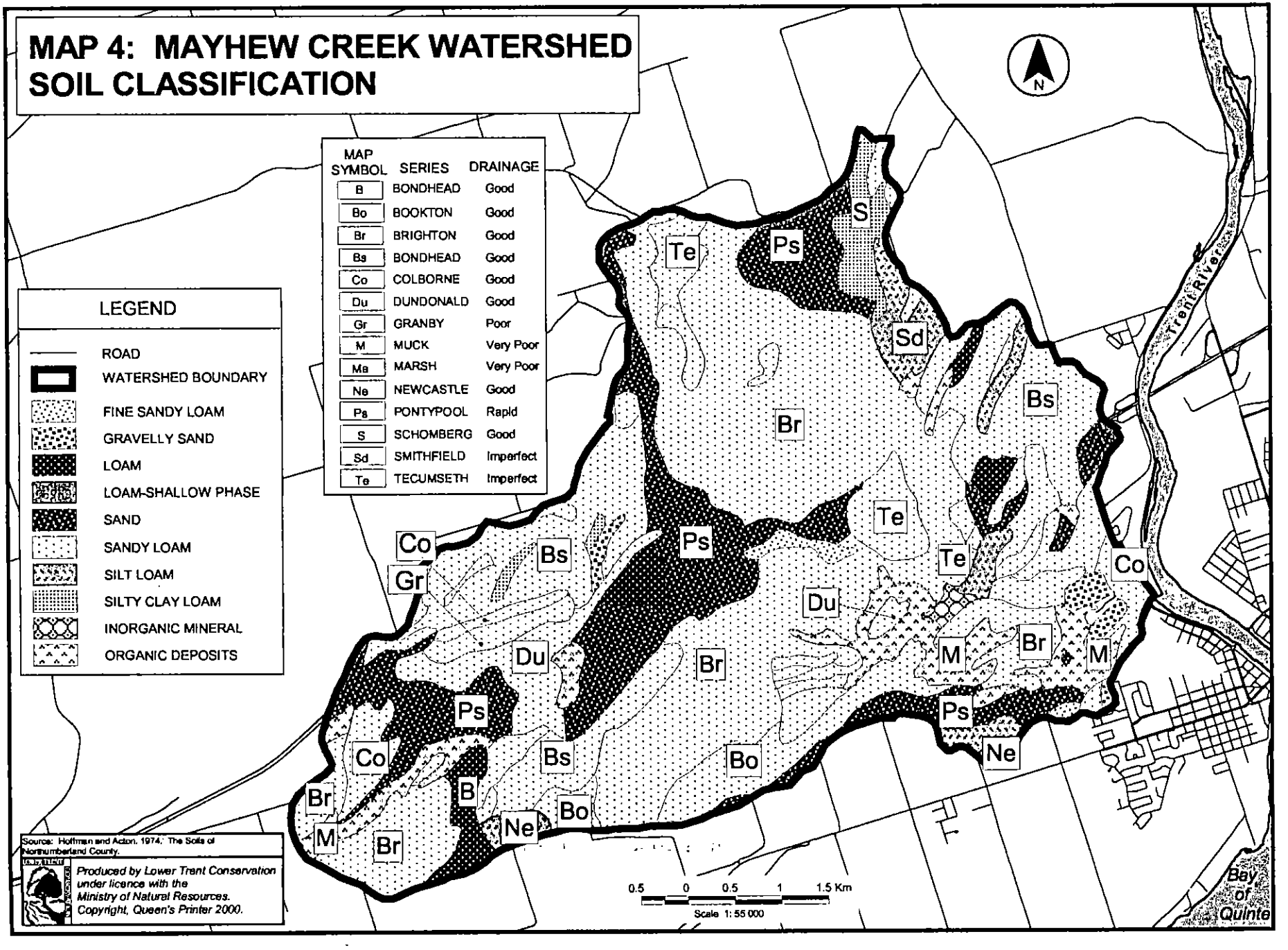


Table 1. Soil characteristics and the association with the pattern of glacial deposits in the Mayhew Creek watershed.

Surface Feature[1]	Location	Common Soil Textures[2]	Common Soil Series[2]	Soil Drainage[2*]	Overburden Depth (m)[3]
Kame Moraine	Southern portion of watershed; north of Hwy. 2	Sandy loam	Bookton**	Good	13-15 m
			Brighton	Good	
		Sand	Pontypool**	Rapid	
		Silt loam	Newcastle	Good	
Sand Plain	Central watershed; both sides of Telephone Rd. and east of Wooler Rd.	Sandy loam	Bondhead	Good	12 - 28 m
			Brighton**	Good	
			Dundonald	Good	
			Tecumseth	Imperfect	
		Sand	Pontypool	Rapid	
	East of Tremur L.	Marsh		Poor	
	Outlet/headwaters	Muck		Poor	
Beach and Shoreline Cliffs	Slope and base of Murray Hills	Sandy loam	Brighton**	Good	Variable
			Colborne	Good	
			Dundonald**	Good	
			Granby	Poor	
		Sand	Pontypool**	Rapid	
Drumlinized Till Plain	Crest and upper slope of Murray Hills	Sandy loam	Bondhead**	Good	> 25 m
			Brighton**	Good	
			Colborne	Good	
			Dundonald	Good	
		Sand	Pontypool**	Rapid	
Clay Plain	Northeast portion of watershed	Sandy loam	Bondhead	Good	Generally < 10 m
		Silty clay loam	Schomberg	Good	
		Silt loam	Smithfield	Imperfect	

1. Chapman and Putnam (1984).
2. Hoffman and Acton (1974).
3. Estimated base on well water records (MOE 1975).

* Drainage characteristics are described by Hoffman and Acton (1974).
poor - soil saturated for 9 to 11 months of the year
imperfect - soil saturated for 6 to 8 months of the year
good - soil saturated for less than 6 months of the year.

** Dominant soil series.

Pontypool soils are good candidates for reforestation projects. Conversely, the Bookton soils are less erodible and are moderately productive as agricultural soils. Less abundant soil types, including the Brighton sandy loam and the Newcastle silt loam, are also found associated with the kame moraine.

4.3.2 Soils of the Sand Plain

Most of the Mayhew Creek watershed, including the lands surrounding much of the main branch, is located on the sand plain landform. The dominant soil type in this area is Brighton sandy loam, a soil series previously discussed. Other, less common soils overlying this landform include the Bondhead, Dundonald and Tecumseth sandy loams, the Pontypool sand, as well as lowland soils that are classified as either muck or marsh.

Muck consists of thick layers of partially decayed organic deposits that have accumulated in shallow lakes or wet, undrained depressions. In contrast, soils classified as marsh are composed primarily of inorganic mineral soils that are formed in areas flooded by shallow water where there is little decay of organic matter. The Soils of Northumberland County map (Hoffman and Acton 1974) indicates three main areas where muck occurs in the watershed. Generally, these hydric soils are found adjacent to the lower reaches of Mayhew Creek, at the headwaters of the main branch of the creek, and at the headwaters of a couple of the smaller tributaries (generally within the sand plain landform). According to Hoffman and Acton (1974), the only location in the Mayhew Creek watershed where marsh soils are found is a small area on the main branch just east of Wooler Road, under the Old Mill Pond/Wetland. Although not indicated on the soils map, marsh and muck soil types may be located in other small, isolated wetland pockets or in association with small ponds throughout the watershed.

4.2.3 Soils of the Beach and Shoreline Cliffs

Although the beach and shoreline cliffs only occupy a small areal portion of the watershed, these are considered the most distinctive landform features in the region. The Brighton and Dundonald sandy loams, as well as the Pontypool sand, are the most common soils found associated with these landforms. The Dundonald series is formed from the sandy outwash material that is found at the base of the Lake Iroquois beach. Generally, it is considered to have a moderately high productivity, but the topography of the land may be limiting to agriculture at the base of the beach and shore cliffs. The Granby and Colborne soil series are also represented in this area.

4.2.4 Soils of the Drumlinized Till Plain

The Bondhead and Brighton sandy loams, and the Pontypool sand are the major soil types found on the drumlinized till plain located on the crest of the Murray Hills. The Bondhead sandy loams are well drained as water readily percolates through the loose matrix of this coarse textured soil. With this soil series, terrain slope is generally the major limitation affecting land use. In areas where the slope is gentle, this soil is considered ideal for a variety of crops and pasturing

livestock. Due to the soil's well drained nature, it is also suitable for development (Hoffman and Acton 1974). Other soil series associated with the drumlinized till plain include the Colborne and Dundonald series.

4.3.5 Soils of the Clay Plain

As would be expected, finer textured soils become more prevalent in association with the clay plain landform feature. Although, the Bondhead sandy loam series is found along the clay plain's western edge, including a small portion of the eastern Mayhew Creek watershed. The other dominant soil types are the Schomberg silty clay loam and the Smithfield silt loam series. The Schomberg series is formed from deep deposits of stratified clay and silt loam layers. Due to the gentle topography associated with the clay plain landform and the well drained nature of these soils, much of the land overlain by the Schomberg series has been cleared for agriculture. Crop yield on this series is considered to be moderate to high, and mixed farming operations are common. Erosion can be a problem on the Schomberg series, and thus conservation tillage practices should be used in this area. The Smithfield silt loam is derived from the same parent material as the Schomberg series, but is more often found in the low lying areas surrounding streams. There is little problem with the erosion of these soils, and they are considered to be of high quality for agriculture, although they are less suitable for housing developments and landfilling due to their imperfect drainage (Hoffman and Acton 1974).

4.4 SOIL CAPABILITIES FOR AGRICULTURE

Soil capabilities for agricultural production in the Mayhew Creek watershed vary widely (Map 5). Some areas in the Trent River valley are considered to have excellent soils for agriculture and many of the soils associated with the sand plain landform support highly productive orchards and specialty crops. In other locations, capabilities of otherwise productive soils are limited by stoniness or adverse topographic conditions. While soils designated as muck can be very productive when the environment is manipulated and altered (e.g. the Holland Marsh area north of Bradford, Ontario), these organic soils have not been included in the land capability mapping. Organic soils are generally associated with wetlands, and the degradation and clearing of these vital land-water interfaces should be avoided. Descriptions of the various land classes located in the study area are given in Table 2.

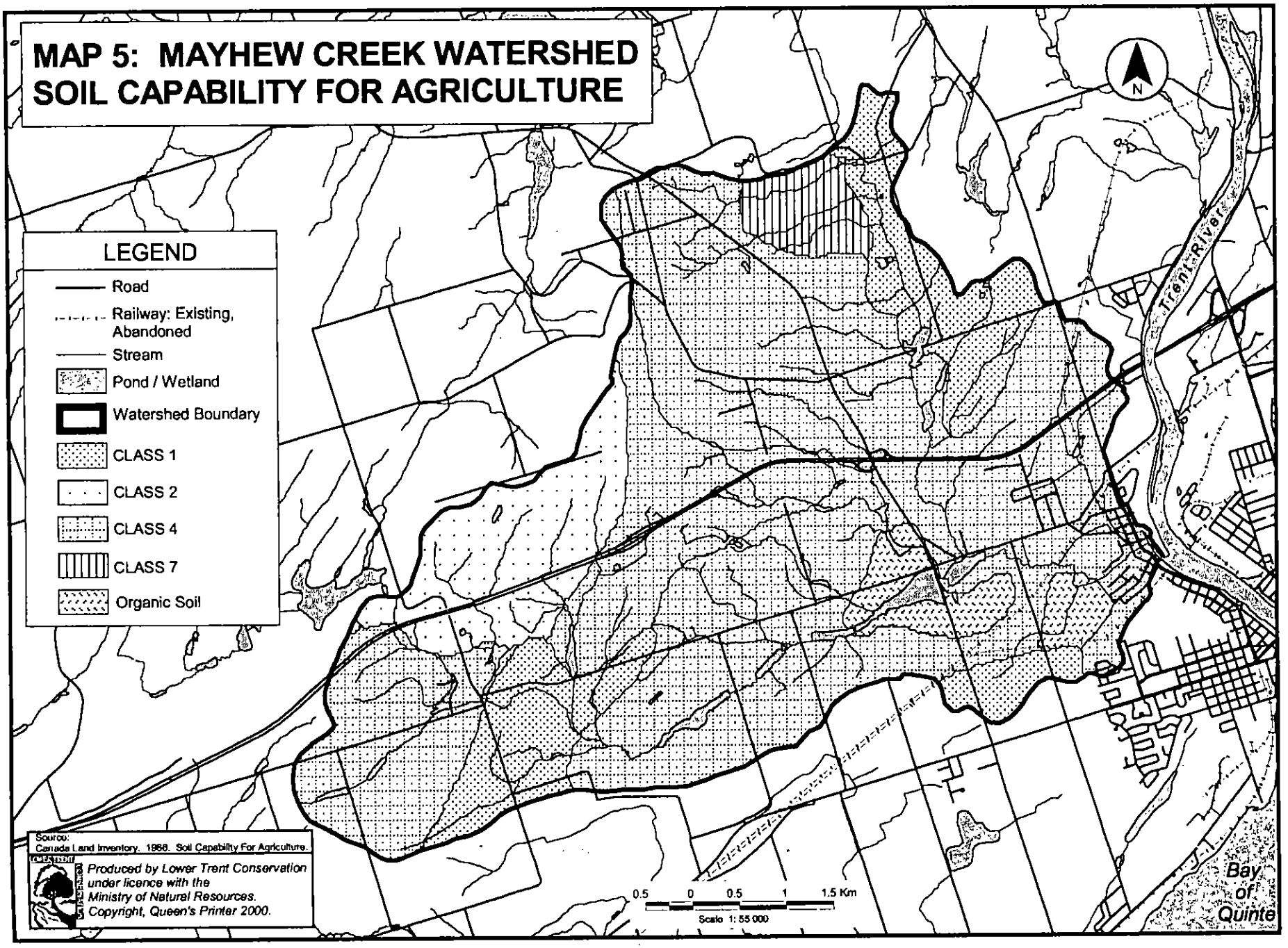

MAP 5: MAYHEW CREEK WATERSHED
SOIL CAPABILITY FOR AGRICULTURE
LEGEND
Road
Railway: Existing, Abandoned
Stream
Pond / Wetland
Watershed Boundary
CLASS 1
CLASS 2
CLASS 4
CLASS 7
Organic Soil
N
Trent River
Bay of Quinte
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Source:
Canada Land Inventory. 1966. Soil Capability For Agriculture.
Produced by Lower Trent Conservation under licence with the Ministry of Natural Resources.
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Table 2. Soil capability for agricultural production classification system a described by the Canada Land Inventory (1966).

Soil Classes:	
Class 1:	Soils in this class have no significant limitations in use for crops. The soils are deep, are well to imperfectly drained, hold moisture well, and in the virgin state were well supplied with plant nutrients. Management and crops can be attained without difficulty. Moderately high to high productivity can be achieved for a wide range of field crops under good management.
Class 2:	Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. The soils are deep and hold moisture well. Moderate limitations exist and soil management and cropping can be done with little difficulty. Under good management they are moderately high to high in productivity for a fairly wide range of crops.
Class 3:	Soils in this class have moderately severe limitations that restrict the range of crops that may be grown or the soils require special conservation practices. The limitations are more severe than for Class 2 soils. They affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. Under good management they are fair to moderately high in productivity for a fair range of crops.
Class 4:	Soils in this class have severe limitations that restrict the range of crops, require special conservation practices, or both. The limitations seriously affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. The soils are low to fair in productivity for a fair range of crops but may have high productivity for a specially adapted crop.
Class 5:	Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, although improvement practices are feasible. Limitations are so severe that the soils are not capable of use for sustained production of annual crops. Soils are capable of producing native or tame species of perennial forage plants. The potential of these soils may be improved through the use of farm machinery and improvement practises.
Class 6:	Soils in this class are capable only of producing perennial forage crops, and improvement practices are not feasible. The soils provide some sustained grazing for farm animals, but the limitations are so severe that improvement by use of farm machinery is impractical. The terrain may be unsuitable for use of farm machinery, or the soils may not respond to improvement, or the grazing season may be very short.
Class 7:	Soils in this class have no capability for arable agriculture or permanent pasture. This class also includes rockland, other non-soil areas, and bodies of water too small to show on the maps.
O	Organic soils (Not placed in capability classes).

Subclasses	
P	Stoniness - Stones interfere with tillage, planting, and harvesting.
R	Shallowness to solid bedrock - Solid bedrock is less than three feet from the surface.
S	Soil limitations - Limitations include one or more of the following: undesirable structure, low permeability, a restricted rooting zone due to soil characteristics, low natural fertility, low moisture-holding capacity, salinity.
T	Adverse topography - Either steepness or the pattern of slopes limits agricultural use.

High quality agricultural lands are an important resource in the Mayhew Creek watershed and the surrounding areas. Soils that have been designated as Class 1 and 2 by the Canada Land Inventory are recognized as capable of producing all common field crops with no or moderate conservation practices (Canada Land Inventory 1966). These lands provide economic benefits in terms of wages and commodities, while supporting a distinctive rural style and quality of life. Once degraded by development or other incompatible land uses, the resource will be lost and there is little opportunity for mitigation or rehabilitation.

AVAILABLE INFORMATION
Canada Land Inventory 1966. *Soil Capability for Agriculture.*
Chapman and Putnam 1984. *The Physiography of Southern Ontario.*
Dunne and Leopold 1978. *Water in Environmental Planning.*
Hoffman and Acton 1974. *The Soils of Northumberland County.*
Mirynech 1963. *Pleistocene Geology of the Trenton-Campbellford Map Area, Ontario*
MOE 1975. *Water Well Records for Ontario - Counties of Durham, Northumberland, Victoria 1946-1969.*
Proctor & Redfern and Gartner Lee 1975. *Geological Inventory - Mineral Aggregate Study for Part of the Eastern Ontario Region.*
Totten Sims Hubicki Associates 1995. *South Sidney Watershed Plan.*
White 1996. *Dead Creek State of the Watershed Report.*

5.0 Hydrology

The hydrologic cycle involves the natural movement of water in the biosphere. It includes numerous physical processes such as precipitation, infiltration and runoff. Various types of land use can greatly impact the hydrologic cycle of a watershed. For example, urban development can increase the proportion of impervious surfaces within the watershed (e.g. parking lots), thereby increasing surface runoff volumes and pollutants entering watercourses (MOE 1991). The characteristics of surface water and groundwater can affect the suitability of an area for development.

5.1 SURFACE WATER

5.1.1 Watercourses

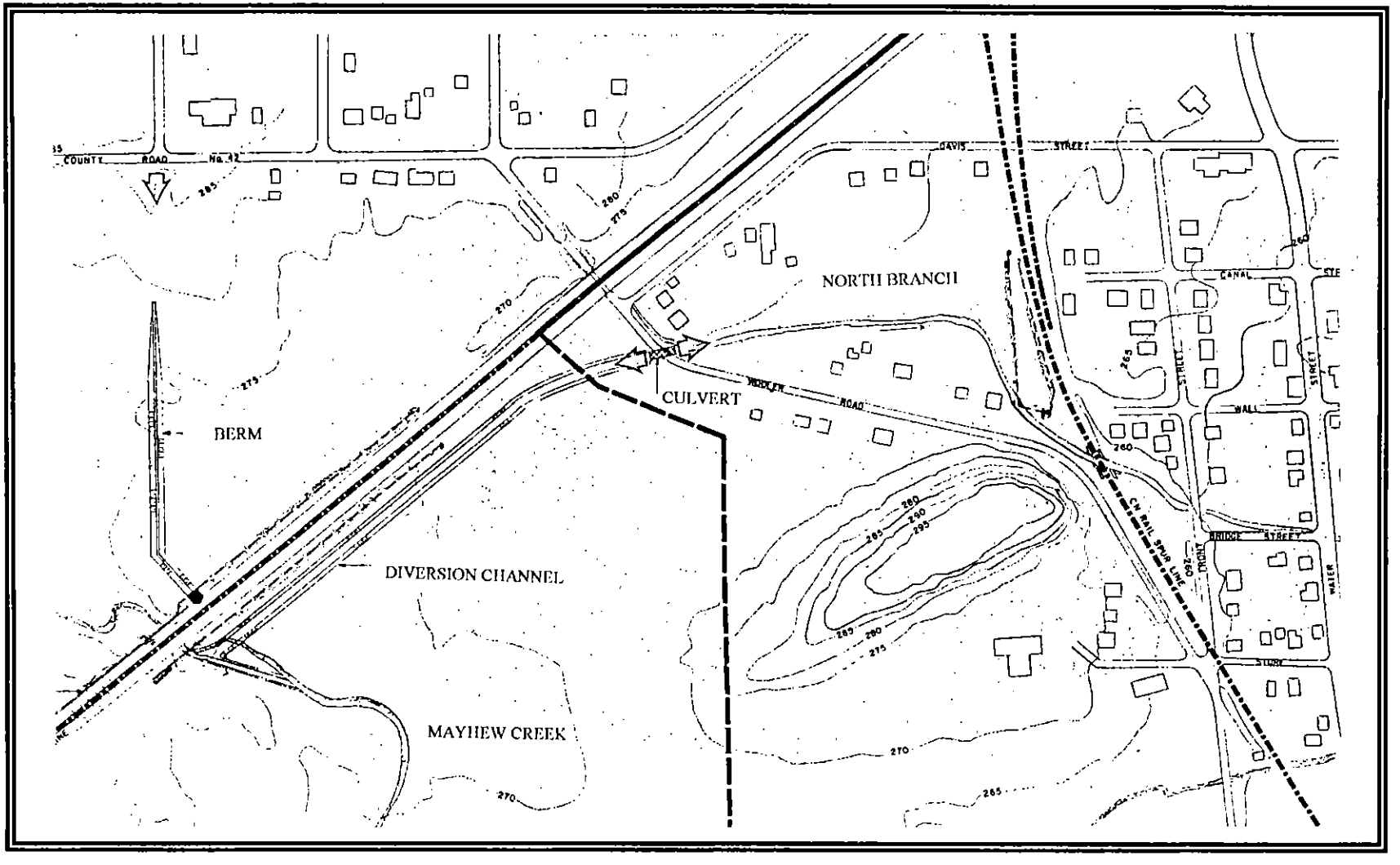
Mayhew Creek

The main branch of Mayhew Creek is approximately 10.8 km long with an average gradient of 7.5 m/km (Cumming-Cockburn & Associates 1981). A number of groundwater discharge areas are located in the headwaters of the main branch, as well as the unnamed smaller tributaries that begin in the Murray Hills and flow south to the main branch and Tremur Lake. These discharge aquifers are associated with the coarse particle soils of the Lake Iroquois shoreline cliffs and the associated beach deposits. Most of the headwater areas are found within the two significant natural areas (the Mayhew Creek Headwaters Area and the Murray Hills Headwaters Area) inventoried by Brownell and Blaney (1995, 1996), where the forest cover of the land is largely intact.

In its upper reaches, Mayhew Creek is a coldwater stream with a high capacity for buffering warm summer temperatures. The high gradient slopes of the headwaters also mean that the water in these reaches remains well oxygenated. The well oxygenated waters and low summer temperatures make the stream ideal for coldwater fish species, such as brook trout. As the stream continues through the watershed in a west to east direction, the surrounding lands become increasingly deforested, and summer water temperatures begin to increase. Further warming occurs as the stream flows through a number of online ponds in the agricultural and rural residential portions of the lower watershed, with Tremur Lake being the largest of these. Stream conditions in this area favour aquatic communities composed of organisms that are adapted to warmer summer temperatures. Isolated groundwater upwellings in downstream areas may provide localized thermal refugia in the summer months for coldwater species.

Below Tremur Lake, the stream continues to flow in roughly an easterly direction towards the urban centre of Trenton. Just outside the former city limits, there is a flood reduction bypass channel maintained by Lower Trent Conservation (the Conservation Authority has an easement for access to these lands). The bypass splits from the main channel at a location immediately east of the Canadian National Railway tracks (Map 6). From this location, it runs in a northeast

Map 6: Location of Mayhew Creek Flood Reduction Bypass Channel



direction parallel to the tracks to the Old Wooler Road crossing, where it swings to the east. From there, the artificial channel joins a small tributary before crossing Front Street and continuing along its course to the Trent River. Although the flood control channel is dry for much of the year, during spring runoff and storms it helps attenuate flood waters in the urban area of Trenton for events up to and including the 100 year storm.

A number of storm sewer outfalls discharge directly into Mayhew Creek. All of these discharge sites are located on the lower reaches of the stream in the urbanized area of Trenton. Storm water is removed from rural properties in the watershed by open roadside ditches. These ditches also eventually discharge to the stream or to small wetland pockets, although some of the nutrient load in the storm water may be removed if the ditches are well vegetated.

Tremur Lake

Created in 1967, Tremur Lake is located to the west of Wooler Road and is a major source of municipal water for the urban area of Trenton. The Quinte West Public Utilities Commission (PUC) withdraws between 4.5 and 6.8 million litres of water per day from the lake. There are no other permits for water withdrawals from the lake (Steve McDonald, Quinte West PUC, personal communication). While the total storage capacity of the reservoir is approximately 369 000 m^3 (Reeves 1979), this water level must be maintained by a dam at Wooler Road. Use of the lake for activities such as swimming, canoeing and angling is prohibited by the PUC, although they have traditionally permitted the harvest of bait fish (using minnow traps) and ice skating in the winter (Steve McDonald, Quinte West PUC, personal communication).

Immediately east of Tremur Lake, on the opposite side of Wooler Road, there is a wetland, locally referred to as the Old Mill Pond. This ecosystem has not been evaluated under the MNR wetland evaluation system. The major vegetation community types present include a cattail marsh with tall grasses around the fringe, and an open water pond with a dense mat of submerged macrophytes. The water level of the pond is maintained by the Old Mill dam that is located approximately half way between Wooler Road and 2nd Dug Hill Road, just south of Telephone Road. Wetlands located on Mayhew Creek and its tributaries are extremely important in maintaining the health of the stream. Wetland functions include flood attenuation, water storage and discharge, the removal of excess nutrients, and the provision of wildlife habitat. For example, due to the abundance of open water and the habitat provided by the adjacent cattail marsh, the Old Mill Pond may provide one of the few breeding and/or staging areas for waterfowl in the watershed. This marsh area and other wetland pockets along Mayhew Creek may warrant consideration for assessment under the provincial wetland evaluation system.

Trent River

Mayhew Creek discharges to a short man-made channel that was originally intended to be part of the Trent Canal. Construction of the channel commenced in 1837 and was abandoned in 1839 when government financial constraints, stemming from the rebellion in Upper Canada, resulted in the cessation of payments to labourers (Daw and Rutledge 1978). Although this channel is a man-made extension of the Trent River, it has been included as part of the watershed because

Mayhew Creek water must flow through this channel before joining the Trent River proper, at a location adjacent to the Lower Trent Conservation administrative offices.

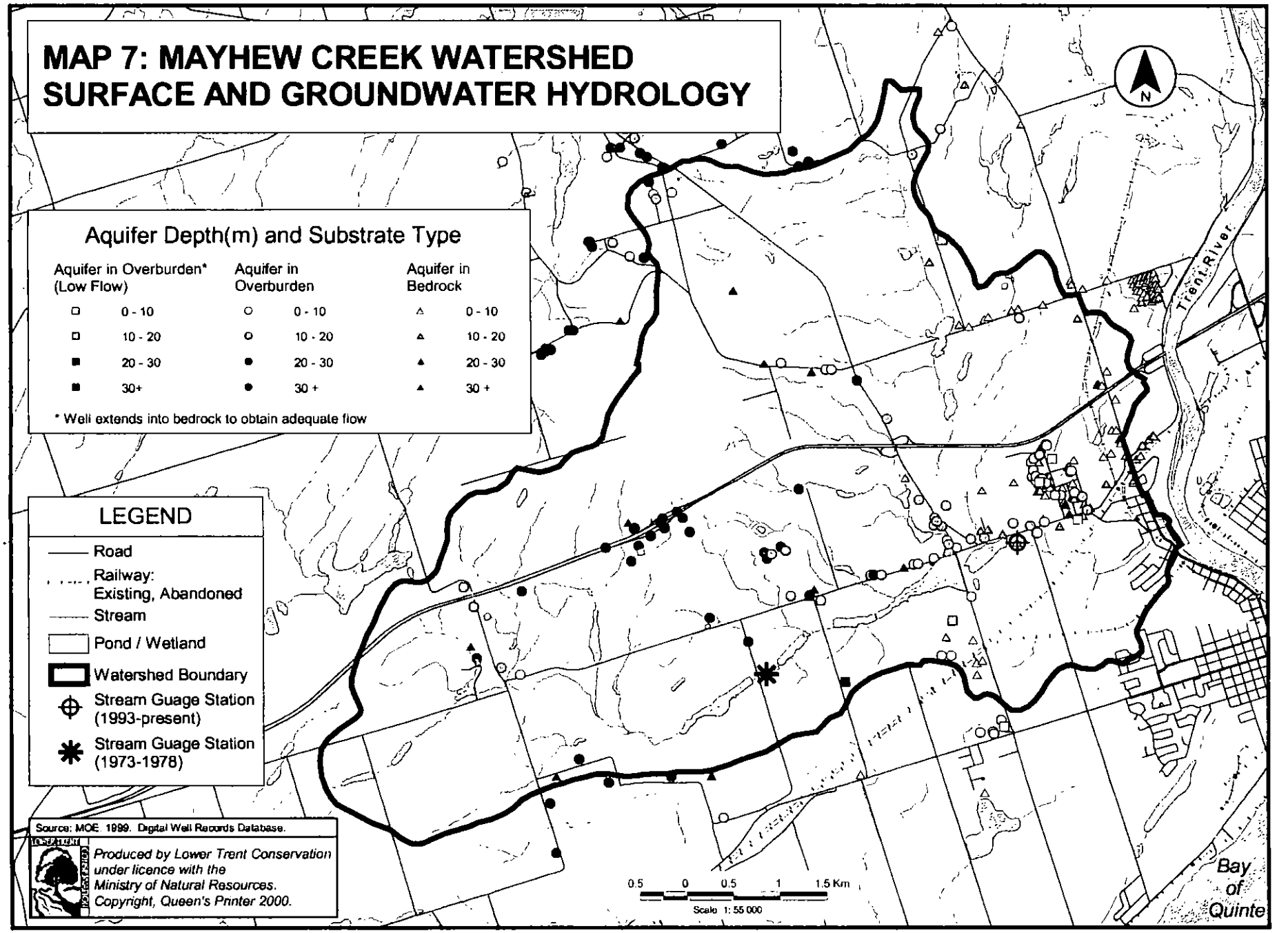
The confluence of Mayhew Creek and the Trent River is approximately 2 km north of the mouth of the Trent River, where it discharges to the Bay of Quinte. Discharge from the Trent River is much greater than from Mayhew Creek, and the water quality of the Trent River is heavily impacted by the upstream land use and pollution point sources. Despite this, each tributary of the Trent River has the capacity to affect both the water quality and quantity of the larger river, and subsequently the Bay of Quinte. In many locations, where the Trent Canal shares a channel with the Trent River, the banks of the river have been modified and armoured. As a result, erosion is not a significant problem in areas adjacent to the mouth of Mayhew Creek.

5.1.2 Surface Water Quantity

Flow in the stream and its tributaries can be quite variable depending on the season, and the frequency and magnitude of recent precipitation events. During the 1970's, a stream flow gauge was maintained on Mayhew Creek, at Fraser Road, by the Ministry of the Environment in the summer and fall months (see Map 7 for location). The data collected from this gauge were used to calculate the summer base flow of the creek, which was determined to be approximately 0.028 m^3/s (1 c.f.s.) by Reeves (1979). Summer base flow in the creek does not seem to be dependent on recent precipitation events, but is instead maintained by groundwater inputs. In turn, the state of the aquifers is dependent upon the climatic conditions of at least the previous year, and likely a much longer period of time, as the depletion and recharge of major aquifers is a slow process (Reeves 1979).

The base flow value calculated by Reeves (1979) seems quite reasonable when his data set from the 1970's is examined. Discharge values of less than the calculated base flow value were seldom recorded during the summer months during the study period (the minimum discharge recorded was 0.0085 m^3/s - recorded September 16, 1973 during a prolonged drought). In most years, the actual recorded flow was greater than or equal to the calculated base flow value. For example, precipitation in the summer of 1976 appears to be relatively moderate. In this summer, there was an average discharge of 0.086 m^3/s with a maximum of 0.26 m^3/s (October 10) and a minimum of 0.037 m^3/s (August 26 and September 14).

More recently, a gauge station has been established on Mayhew Creek downstream of the Fraser Road Station to the west of 2nd Dug Hill Road (shown on Map 7). Based on these data, recorded continuously from 1993 to the present (monthly averages are presented in Table 3), it appears that conditions in the watershed have changed, and the base flow value calculated by Reeves (1979) is no longer accurate. In the summers of 1995 through 1999, discharge values less than 0.028 m^3/s were frequently recorded. This was particularly true for the summers of 1995 and 1999. In 1995, discharge was less than the calculated base flow value for much of July and August (with a low value of 0.015 m^3/s), while discharge was generally less than 0.028 m^3/s from mid-July to the end of September in 1999 (with a low of 0.011 m^3/s recorded on July 28). Reduced flow during these


MAP 7: MAYHEW CREEK WATERSHED
SURFACE AND GROUNDWATER HYDROLOGY
Aquifer Depth(m) and Substrate Type
Aquifer in Overburden* (Low Flow)
0 - 10
10 - 20
20 - 30
30+
Aquifer in Overburden
0 - 10
10 - 20
20 - 30
30 +
Aquifer in Bedrock
0 - 10
10 - 20
20 - 30
30 +
* Well extends into bedrock to obtain adequate flow
LEGEND
Road
Railway: Existing, Abandoned
Stream
Pond / Wetland
Watershed Boundary
Stream Guage Station (1993-present)
Stream Guage Station (1973-1978)
Source: MOE 1999. Digital Well Records Database.
Produced by Lower Trent Conservation under licence with the Ministry of Natural Resources.
Copyright, Queen's Printer 2000.
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
N
Trent River
Bay of Quinte

periods may reflect changes in ground water quantity due to a number of unusually dry years in the mid to late-1990's.

Table 3. Monthly average discharge values (m^3/s) at 2nd Dug Hill Road for the years 1993 to 1999.

Month	1993	1994	1995	1996	1997	1998	1999
January	0.981	0.226	0.751	0.838	0.649	0.752	0.252
February	0.296	0.315	0.227	0.960	0.772	0.568	0.350
March	0.825	0.775	0.550	0.499	1.351	1.329	0.813
April	1.460	0.954	0.345	0.832	1.026	0.582	0.559
May	0.360	0.533	0.305	0.826	0.667	0.272	0.184
June	0.353	0.197	0.105	0.296	0.403	0.311	0.079
July	0.111	0.118	0.032	0.086	0.131	0.134	0.097
August	0.063	0.062	0.043	0.047	0.111	0.086	0.023
Sept.	0.110	0.042	0.073	0.365	0.167	0.058	0.032
October	0.285	0.056	0.594	0.300	0.164	0.077	0.076
Nov.	0.419	0.244	0.968	0.550	0.325	0.131	0.311
Dec.	0.407	0.313	0.390	0.849	0.263	0.144	0.259

Peak flows for Mayhew Creek have been calculated by both Kilborn Engineering Ltd. (1975) and Cumming-Cockburn & Associates (1981). The Kilborn study only reported flow rates for the regional storm, whereas the Cumming-Cockburn study calculated flow rates for the 100 year storm in addition to the regional storm. As well, the latter study also considered potential storage in Tremur Lake and in the wetland above the Old Mill Dam. The maximum flow rates reported here are from the Cumming-Cockburn & Associates (1981) study.

At the outlet of Mayhew Creek (to the Trent River), the maximum discharge that would occur during the regional storm event would be 132.9 m^3/s. The regional storm (which is the regulatory storm for the Lower Trent region) is defined as a storm of similar magnitude to the one that occurred in the Timmins area in 1961, where 173 mm of precipitation were received over a 12 hour period. Maximum discharge rates were also calculated for other storm events, including the 100 year event. A summary of the precipitation accumulations and peak discharge rates associated with each storm event is included in Table 4. It should be noted that these values are calculated, and that the largest storm events have not necessarily been recorded in the Mayhew Creek watershed.

Table 4. Depth of precipitation accumulations and peak discharge rates for given storm events.

Return Period of Storm (years)	Precipitation (mm)	Peak Discharge (m^3/s)
Timmins (unknown return period)	193.0[1]	132.9
100	76.20[2]	12.8
50	69.09[2]	9.1
25	62.48[2]	5.7
10	52.58[2]	2.6
5	44.96[2]	1.2

Source: Cumming-Cockburn & Associates (1981)

1. Based on a 12 hour storm event.
2. Based on a 6 hour storm event.

Twice during the period 1993 to 1999 discharge at 2nd Dug Hill Road exceeded the peak discharge calculated for the 25 year storm event. On January 5, 1993 a discharge of 7.96 m^3/s was recorded, and a discharge of 6.80 m^3/s was recorded on January 19, 1996. These values may not necessarily represent flows resulting from a storm event as intense as the 25 year storm (in terms of precipitation amounts). These values were likely recorded following the breach of an upstream ice dam that was created after a rainstorm and/or mid-winter thaw. Only once during the ice free season (May through October) did the recorded discharge exceed the 10 year storm calculated discharge. On May 12, 1996 a discharge value of 2.81 m^3/s was recorded. This peak discharge event may have been caused by a large storm event (relatively substantial rainfall events were recorded for May 10, 11, and 12), but other factors may have been involved as well, such as the breach of a beaver dam.

5.1.3 Areas of Seasonal Flooding

Certain areas of the watershed that experience seasonal flooding were identified through the landowner survey (Appendix 3) and by Lower Trent Conservation staff. Landowners reported a number of areas immediately adjacent to the stream (i.e. in the flood plain) that flooded in the spring of 1980. Another significant flood event occurred just west of Trenton following the spring breakup in 1984. The occurrence of flood events, up to and including the 100 year event, within the urban area of Trenton has been effectively mitigated through the construction of the flood reduction channel by Lower Trent Conservation.

5.1.4 Flood Plain Mapping

The flood plain is the low lying area adjacent to a stream channel which can be periodically inundated by floodwaters following the spring melt or after a storm event. The purpose of flood plain mapping is to delineate the area affected by a flood of a specific magnitude, so that development can be restricted in these hazard areas. Flood plain mapping in the lower Trent region is based on the regional event (Timmins storm). The 100 year flood event is also mapped

for some areas where a two-zone approach to flood plain mapping has been considered. In the Mayhew Creek watershed, flood plain mapping is only available for the reaches of the stream below Tremur Lake (Cumming-Cockburn & Associates 1981). This portion of the flood plain was mapped because of the high flood potential in the urbanizing area.

The planning documents for Trenton allow for a two-zone approach to flood plain management in a portion of the Mayhew Creek Watershed near the mouth of the creek. This more permissive approach allows for development to occur in the flood fringe, provided floodproofing measures are taken. The two-zone approach is relatively common in areas where there is a historical precedence for urban development. For example, other urban areas in the lower Trent region, including Brighton, Campbellford and Frankford, also use a two-zone approach to flood plain management.

The flood plain mapping for Mayhew Creek is now outdated, as conditions in the lower portions of the watershed have been extensively altered in recent years. For example, construction of the flood reduction channel in Trenton was not initiated until after the flood plain mapping was completed. Thus, updating the flood plain mapping for areas below Tremur Lake is considered a priority by Lower Trent Conservation. With continued development in the watershed, flooding problems associated with rural residential properties have increased in frequency. As a result, additional flood plain mapping should be prepared for the portion of the watershed upstream of Tremur Lake.

5.1.5 Surface Water Quality

Tributary loadings of phosphorus, bacteriological and toxic contaminants associated with urban stormwater, agriculture and industrial activities were identified by the Bay of Quinte RAP as factors contributing to major water quality concerns in the Bay of Quinte (QRAP 1993a). Any assessment of water quality is dependant upon the purpose of the analysis and the parameters of interest. Acceptable levels of various parameters can differ greatly depending upon whether the water quality objectives are measured for human health concerns or for those related to aquatic ecosystem health. The MOE has attempted to integrate these concerns and has developed Provincial Water Quality Objectives and Guidelines (PWQOGs) for human health and the suitability of waters for aquatic life.

Water quality data were collected by the MOE as part of the Bay of Quinte RAP program for 19 stations in the Bay of Quinte watershed during the period 1991 to 1996. This included one station on Mayhew Creek, which is located on the west side of 2nd Dug Hill Road where the creek crosses under the road.

Phosphorus

In most aquatic ecosystems, phosphorus is the nutrient that is capable of promoting excessive amounts of algae growth. The overabundance of algae can result in the reduction of available oxygen for fish and other forms of aquatic life. As well, waterbodies containing an excessively

high algal biomass are aesthetically unpleasing, and decaying algae can produce foul odours and certain species can be toxic to other aquatic organisms (Horne and Goldman 1994). The process by which phosphorus stimulates excessive algae and aquatic weed growth resulting in the loss of dissolved oxygen and the impairment of waters is know as eutrophication. This has been identified as a major problem in the Bay of Quinte ecosystem (QRAP 1990).

Of the 19 tributaries monitored by the MOE, Mayhew Creek ranked ninth in Total Phosphorus (TP) loading, and eleventh in TP loading per drainage basin area (QRAP 1993a). Between the years 1991 and 1995, the annual average concentration of TP in the creek ranged from 0.022 to 0.036 mg/L. These values are similar to those recorded for other streams in the lower Trent region, including Cold Creek, Rawdon Creek and the Trent River. Compared to other Bay of Quinte tributaries, Mayhew Creek phosphorus concentrations were fairly moderate, with some tributaries (e.g. Meyer's Creek) having much higher values. TP concentrations in the other major rivers (the Moira and Salmon Rivers) were somewhat lower. Similar to the pattern observed in most area streams, TP concentrations in Mayhew Creek are generally higher in the summer months. In the period 1991 to 1995, average summer values ranged from 0.020 to 0.067 mg/L (QRAP 1997). Thus, concentrations in the creek often exceeded the PWQOGs of 0.03 mg/L for unimpaired use of streams.

Nitrogen

In some situations, when phosphorus is extremely plentiful in a body of water, nitrogen may be the nutrient that is limiting to algae and aquatic plant growth. Although large quantities of biologically available nitrogen are required by plants for growth (the ratio of nitrogen to phosphorus required by plants is approximately 10:1), nitrogen is able to pass from the land to watercourses very quickly in the form of nitrate which is readily converted to the biologically available form (ammonia) by bacteria (Horne and Goldman 1994).

The MOE measured Total Kjeldahl Nitrogen (TKN), a measure of total filtered reactive and ammonia nitrogen, as part of the water quality monitoring for the Bay of Quinte RAP program. The annual average concentration of TKN in Mayhew Creek between 1991 and 1995 ranged from 0.44 to 0.55 mg/L. These values are lower than the concentrations recorded in many of the other small tributaries of the Bay of Quinte. The large rivers in the Bay's watershed (the Moira, Salmon and Trent Rivers), as well as Cold Creek, had annual TKN concentrations similar to Mayhew Creek (QRAP 1997).

Other Water Quality Parameters

Although the data has not been published, a number of other parameters were measured for the Bay of Quinte RAP water quality monitoring program. These include chloride concentrations, conductivity, pH and suspended solids. Chloride concentrations and conductivity can fluctuate widely in rural and urbanized watersheds due to the salting of roads in the winter. Most aquatic flora and fauna have an upper tolerance for water salinity that they can withstand, and excessive transports of road salts to the stream can have detrimental effects. The concentration of suspended solids in the water is representative of the sediment load of the stream. The suspended

sediments are an important vehicle for transporting adsorbed particulate phosphorus, which may be chemically released as a biologically available form in the Bay.

It is recommended that water quality data be collected at regular intervals in the future to examine potential areas of concern, and to compare gathered information with provincial and national water quality objectives for supporting human well-being and healthy ecosystems. Through the landowner survey, water quality issues were identified as the most pressing concern of watershed residents.

Benthic Invertebrates

Benthic invertebrate samples from the Mayhew Creek watershed have not been collected in the past. Due to the ecological diversity of these organisms and their habitat preferences, benthic invertebrates are generally considered to be a good indicator of habitat conditions and ecosystem health in the stream (Totten Sims Hubicki 1995).

One of the most commonly used indices for relating benthic invertebrate data to stream health is the BioMAP system (Griffiths 1993, 1996). This system has commonly been used in southern Ontario by a number of agencies: including Conservation Authorities, the Ministry of Municipal Affairs and Housing, and the Ministry of Natural Resources. Recently, the accuracy of indices such as BioMAP have been criticized, and even the underlying assumptions on which the models are based have been questioned. Barton and Kilgour (1999) argue that it is unclear exactly what the BioMAP index does indicate. Although the index is based on stream size and the expected distribution of species based on that stream size, the scores generated by BioMAP for a group of relatively pristine streams were largely unrelated to the size of the streams. As well, these authors demonstrated that BioMAP scores were highly correlated with maximum water temperature and substrate type, two parameters that are not considered by the model. Thus, quantitative assessment methods using benthic invertebrates, such as BioMAP, may not be a reliable method of assessing water quality.

Despite criticisms of quantitative methods of evaluating water quality using benthic organisms, the collection of benthic invertebrates can be useful if community data is evaluated in a qualitative fashion. Although it is difficult to assign a 'score' to a stream reach in the sense of BioMAP, knowing the community structure of these organisms and the environmental tolerances of the individual species is useful. A great deal of information pertaining to the quality of habitat and the degree of impairment in a stream can be determined from an analysis of benthic community structure. For example, the presence of stonefly larvae indicates a high quality coolwater stream, while it could be inferred that a community dominated by Oligochaetes (aquatic worms) indicates a highly eutrophic warmwater system with low levels of dissolved oxygen.

As well, the collection of benthic invertebrates is a good method of establishing base line data for detecting the effects of changing water quality on biota. Due to their lack of mobility, changes in the composition of the benthic organism community is often detectable over much shorter periods of time than, for example, shifts in the fish community. Thus, multiple samples could be collected

for a site over a short period of time (i.e. 1 to 2 years between samples), and the effects of land use changes on the biota of the steam could be assessed. The other benefit of using benthic invertebrates is that they can be preserved for several years and analyzed when resources permit, or when management issues dictate.

5.2 GROUNDWATER

Water contained in aquifers below the surface of the earth play an important role in the hydrology of Mayhew Creek. The majority of rural residences in the watershed rely on wells as a source of water for drinking, domestic and agricultural uses. As well, groundwater inputs are vital for maintaining summer base flow in the creek and maintaining water levels in wetland ecosystems.

Land use planning plays an important role in the protection of groundwater resources. Decisions that consider areas of rapid surface water infiltration, groundwater movement, or the ground's capacity to adsorb contaminants (Driscoll 1986) are very important in maintaining the quality and supply of the resource. Activities that negatively affect the quality or quantity of groundwater generally create long term problems, since the residence time of the water and the recharge of most aquifers is a slow process. Therefore, Ministry of the Environment policies related to the management of this resource focus on the prevention of groundwater degradation, rather than the rehabilitation of previously degraded sites.

The depth of the water table is quite variable across the Mayhew Creek watershed. The depth of the aquifer and the type of substrate in which it is contained (Map 7) was determined using the Digital Well Records obtained by the City of Quinte West from the Ministry of the Environment (MOE 1999). The depths included in Map 7 represent the depth at which groundwater was first encountered when the well was excavated. Many of the wells extend beyond this depth, as adequate flows were not always available at the top of the aquifer. In the eastern portion of the study area (the Trent River valley), where the land is lower, the water table is generally located less than 20 m below the surface. On the higher lands located to the west of Wooler Road, the water table is often greater than 30 m deep.

Many of the newer wells in the watershed have not been included on Map 7. Although drilling records do exist for these wells, the precise location (UTM coordinates) for many of the wells was not contained in the database obtained from the City. The location of these wells should be determined prior to the completion of the *Mayhew Creek Watershed Plan*, so that sound planning decisions can be made.

5.2.1 Groundwater Movement

Groundwater in the vicinity of the Mayhew Creek watershed is believed to flow southward and eventually discharge into the Bay of Quinte (White 1996). The bedrock formation underlying the watershed is known to slope gently to the south-southwest with a grade of approximately 4

m/km. As a result, groundwater contained in subsurface aquifers would likely move in this direction at a relatively slow rate (Mirynech 1963).

Layers of permeable sand and gravel associated with the beach deposits of Glacial Lake Iroquois may permit the rapid infiltration of surface waters in the headwaters of the watershed (Hoffman and Acton 1974; Brownell and Blaney 1995, 1996). As well, there are a number of groundwater discharge areas that are found among the various beach deposits and former shoreline cliffs. Some of these discharge areas form the source of Mayhew Creek.

5.2.2 Bedrock Aquifer

Limestone bedrock provides the main source of groundwater for many domestic wells in the watershed. Generally, wells that draw water from bedrock aquifers (indicated on Map 7 by triangles) are found in the eastern portion of the watershed where overburden depths are quite shallow. This includes areas that are adjacent to the urban area of Trenton, along County Road 33, in the Barry Heights Subdivision, and in the northeast portion of the watershed in the vicinity of Stockdale and Miron Roads. In other areas of the watershed, wells that extend to the bedrock do exist, but they are more rare.

5.2.3 Overburden Aquifer

Overburden well yields are generally considered quite low in the Lake Ontario drainage basin by Ostry et al. (1972). Within the Mayhew Creek watershed, the potential yield of overburden aquifers is typically less than 0.2 litres per second, although there is a small area in the headwaters where potential yields are slightly greater (between 0.2 and 1.6 litres per second).

However, a number of domestic wells, located in the headwaters west of Wooler Road and in the Murray Hills, obtain groundwater from the overburden above the bedrock (indicated by circles on Map 7). In these areas, a deep layer of glacial till covers the underlying bedrock. Well water records (MOE 1999) indicate that most of the overburden groundwater is contained in a layer of gravel and sand that is located directly above the bedrock. Squares on Map 7 indicate that the water table was first encountered in the overburden, but flows were insufficient to maintain the well, until the bedrock aquifer was tapped.

5.2.4 Well Water Quantity and Quality

Concerns of well water quantity were recorded sporadically throughout the watershed, possibly the result of irregular fractures in the bedrock (Driscoll 1986; Totten Sims Hubicki 1995). Despite this, well water quality and supply was generally considered good for most of the year by surveyed landowners/residents (Appendix 3). However, a few residents did identify problems. It is known that water quantity problems exist for some area wells during the late summer months of drier years. Also, one landowner reported high levels of sulphur and iron in their water, while another reported calcium, iron and bacteria problems. The unacceptable bacteria levels may be

attributed to improper management of livestock on or adjacent to the property, or to the proximity of adjacent septic tanks.

5.3 IMPACTS OF CLIMATE CHANGE ON THE HYDROLOGIC REGIME

Changes in the global climate regime, brought about by human activities during the last century, will impact water resources and all of our natural systems. Clean, abundant water is essential for a healthy environment. In the years ahead, maintaining the health of our water systems will become an increasing challenge.

Climate change is happening now and will continue to impact us into the foreseeable future. Weather extremes, be they drought or flood, are happening more frequently. These events can have widespread effects on many facets of the environment. Not only are water quality and quantity affected, but so are fish and wildlife habitats, public safety, property damage, economic productivity of communities, and the health and enjoyment of our communities. In preparing the *Mayhew Creek Watershed Plan,* the changes occurring in our local climate should be considered and recommendations made, where possible, to help minimize impacts on the hydrologic regime and, in turn, on natural ecosystems and human health and activities.

AVAILABLE INFORMATION
Cumming-Cockburn & Associates 1981. *Flood Control Study of Mayhew Creek, Trenton.*
Driscoll 1986. *Groundwater and Wells, second edition.*
MOE 1999. *Digital Well Records Database.*
Ostry et al. 1972. *Overburden Well Yields - Lake Ontario Drainage Basin (map).*
QRAP 1993a. *Stage 2 Report, Time to Act.*
QRAP 1997. *The Big Cleanup, Project Quinte Annual Report 1995.*
Reeves 1979. *Mayhew Creek - A Water Management Discussion Paper.*
CONTACTS
Barry Jones, QRAP Habitat Coordinator, Lower Trent Conservation.
Mike Lovejoy, Water Resources Technician. Lower Trent Conservation.
Steve McDonald, Quinte West Public Utilities Commission.

6.0 Biotic Communities

6.1 NATURAL AREAS

Due to a lack of knowledge related to the biological communities in the lower Trent region, Lower Trent Conservation initiated a study of the natural areas within its watershed. The initial landscape analysis was completed by Reid and Grand (1994), followed by inventories conducted by Vivian Brownell and Sean Blaney (1995, 1996). Prior to this, with the exception of a study of Northumberland County (Hall and Jones, 1976), most of the natural heritage research and inventories for this area concentrated on Presqu'ile Provincial Park. Little was known about the other vital natural areas.

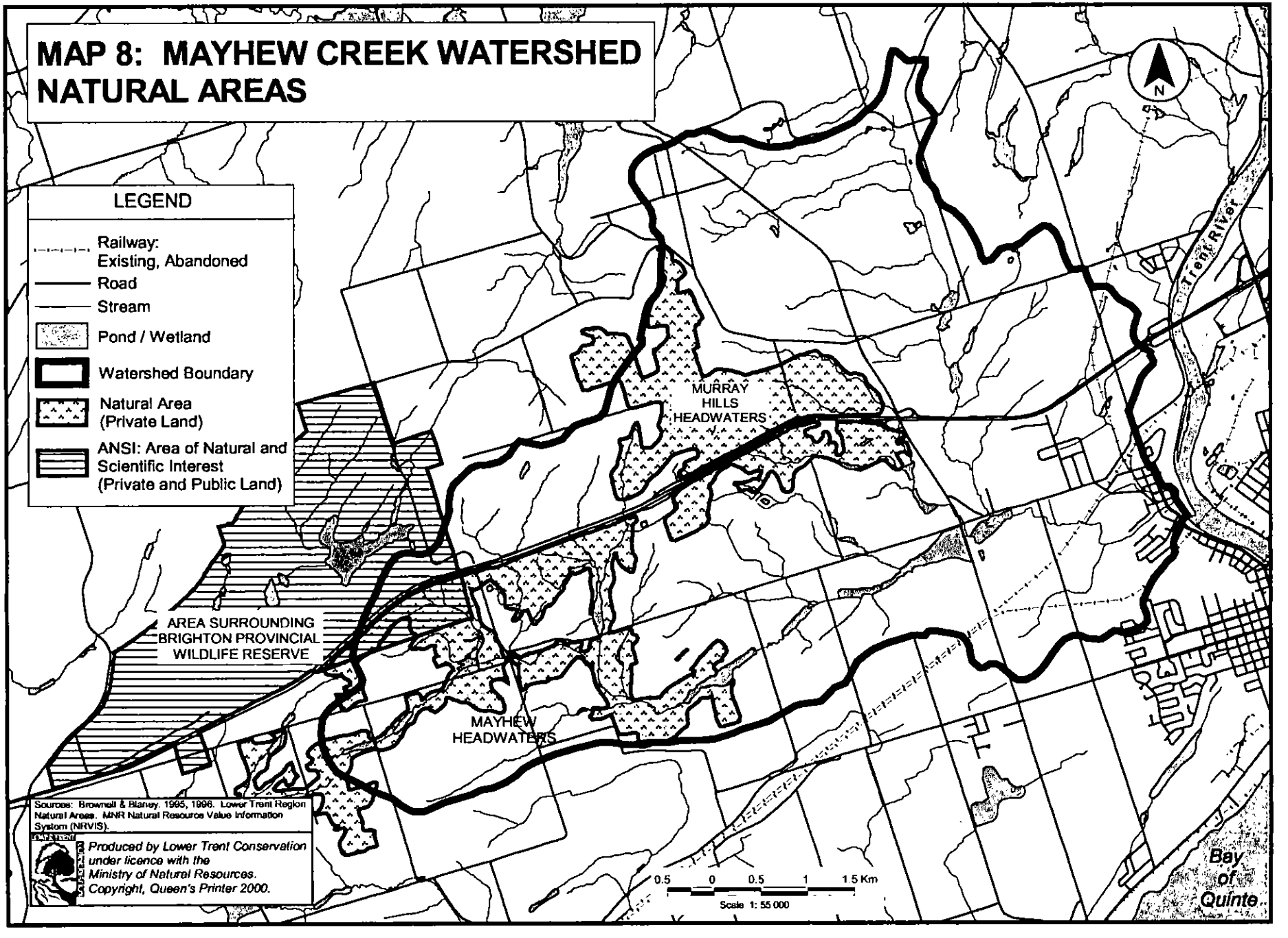
As part of the Lower Trent Conservation study, areas to be inventoried and evaluated were identified by Reid and Grand (1994). Potentially significant areas were evaluated by Brownell and Blaney (1995, 1996) based on 10 criteria, including significant geologic, geographic, hydrologic and biological features. See Brownell and Blaney (1995, 1996) for a detailed description of the criteria.

Two significant natural areas were identified in the Mayhew Creek watershed by Brownell and Blaney (1995, 1996). The areas identified are the Mayhew Creek Headwaters and the Murray Hills Headwaters Natural Areas (Map 8). The southeast corner of one additional natural area, the Brighton Provincial Wildlife Area, is within the watershed boundary of Mayhew Creek. The Provincial Wildlife Area, which is managed by the Ontario Ministry of Natural Resources, was not included in the Significant Natural Areas study of Brownell and Blaney (1995, 1996). The significant natural heritage features of this property have been identified by other sources (see Gordanier 1999).

6.1.1 Mayhew Creek Headwaters

The Mayhew Creek Headwaters Significant Natural Area is located approximately 3 km northwest of Trenton and just south of Hwy. 401, at the base of shoreline cliffs left by glacial Lake Iroquois. Much of this natural area is also located on the sand plain that extends to the south of the shoreline cliffs. After the Murray Hills Headwaters Area (Brownell and Blaney 1996), this site represents the best example of remnant Lake Iroquois shoreline cliffs. Thus, the rarity of this landform is considered to be a significant feature of the Mayhew Creek Headwaters.

The diversity of plant species and the number of vegetation communities in the Mayhew Creek Headwaters is considered to be high, while the diversity of breeding birds is considered to be average for the lower Trent area. A number of the forest types represented are considered to be rare in Ontario. The rare community types are highlighted by an old growth hemlock ravine that is one of the oldest and most extensive examples of this community type in southern Ontario. Generally, the upland forest communities in the headwaters are considered to be in good to


MAP 8: MAYHEW CREEK WATERSHED
NATURAL AREAS
LEGEND
Railway: Existing, Abandoned
Road
Stream
Pond / Wetland
Watershed Boundary
Natural Area (Private Land)
ANSI: Area of Natural and Scientific Interest (Private and Public Land)
MURRAY HILLS HEADWATERS
AREA SURROUNDING BRIGHTON PROVINCIAL WILDLIFE RESERVE
MAYHEW HEADWATERS
Trent River
Bay of Quinte
N
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Sources: Brownell & Blaney, 1995, 1996. Lower Trent Region Natural Areas. MNR Natural Resource Value Information System (NRVIS).
Produced by Lower Trent Conservation under licence with the Ministry of Natural Resources.
Copyright, Queen's Printer 2000.

excellent condition with relatively little interior human disturbance (Brownell and Blaney 1996). Based on the list developed by Oldham (1996), there are three plant species that are considered to be rare in Ontario, and two of these species were previously undocumented in eastern Ontario. One provincially significant bird species, the red-shouldered hawk, was observed and documented as a possible breeder in this natural area (Brownell and Blaney 1996). The red-shouldered hawk is listed as a rare species both in Ontario and in Canada by Cadman et al. (1987), and as vulnerable in Ontario and Canada by the Natural Heritage Information Centre (NHIC 1999).

The hydrological features of the Mayhew Creek Headwaters also contribute to its significance as a natural area. The area is an important groundwater recharge zone and several areas with coldwater springs (discharge areas) are recognized as the source of Mayhew Creek. The habitats provided in this area are in close proximity to the large tracts of relatively undisturbed habitat contained within the other two significant natural areas identified in this report (the Murray Hills Headwaters and the Brighton Provincial Wildlife Area). Unfortunately, the Hwy. 401 corridor disrupts the continuity of these three natural areas and eliminates natural corridors to and from the Mayhew Creek Headwaters (Brownell and Blaney 1996).

6.1.2 Murray Hills Headwaters

Immediately to the northeast of the Mayhew Creek Headwaters is another large tract of natural forests known as the Murray Hills Headwaters Natural Area. Although the most noticeable feature of this area is the steeply terraced, remnant shoreline cliffs of glacial Lake Iroquois, the natural area also extends to the mature forests located south of Hwy. 401. Of the natural areas in the lower Trent region, the Murray Hills are considered to be the best example of Lake Iroquois shoreline cliffs landform.

Compared to the other natural areas studied by Brownell and Blaney (1995), the Murray Hills Headwaters is considered to have the highest quality, undisturbed upland forests. There are a number of rare vegetation communities within this area, including a remnant dry prairie habitat and a rare spicebush ravine. Although the remnant prairie habitat is small in area, its species diversity is high and it is considered unique in eastern Ontario (Catling and Catling 1993). Typically, spicebush is found associated with the Carolinian forest regions of southern Ontario, and the Trenton-Belleville area is considered to be the northeastern limit of this species' range (Brownell and Blaney 1995). Additionally, there are four plant species in the Murray Hills Headwaters that are provincially rare (Oldham 1994), two of which have not previously been observed in eastern Ontario. The total number of native vascular plant species (379) is considered to be very high for the size of the natural area. In fact, Brownell and Blaney (1995) note that this diversity is quite remarkable considering the area is primarily upland forest with very little wetland habitat. As well, one provincially significant bird species, the Louisiana waterthrush, was reported as a probable breeder by Brownell and Blaney (1995). This species is considered rare to uncommon in Ontario (Sutherland 1994) and is considered vulnerable by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

This site also serves a significant hydrologic function. The deep deposits of sand and gravel serve as an important regional groundwater recharge zone, and a number of springs and seeps in the area contribute to the headwaters of Mayhew Creek. As well, there are several soil types within the Murray Hills that are considered rare in Northumberland County. The continuity of this Significant Natural Area is compromised by the Hwy. 401 corridor, which bisects the site, although passage to the Brighton Provincial Wildlife Area to the west is relatively unobstructed (except by a secondary rural road). The Mayhew Creek Headwaters are located to the southwest, across Hwy. 401 from the main forested areas of the Murray Hills Natural Area.

6.1.3 Brighton Provincial Wildlife Area

The Brighton Provincial Wildlife Area (BPWA) is comprised of a relatively large tract (392 ha) of forested land to the north of Hwy. 401. This is one of 24 Provincial Wildlife Areas that are managed by the Ministry of Natural Resources for a variety of recreational opportunities. Following the restructuring of the Ministry of Natural Resources in 1992, the Ministry began developing a co-management agreement with a number of interested stakeholders to manage the BPWA more efficiently. The Ministry of Natural Resources reports that current management partners include: the Brighton Wildlife Area Citizens Advisory Committee, the Township of Brighton, the Presqu'ile-Brighton Field Naturalists, the Quinte Wild Turkey Chapter, the Pine Ridge Retriever Club and two local residents (Gordanier 1999).

Due to the diversity of geographical features present within the boundaries of the BPWA, the area has been designated as a provincially significant Earth Science Area of Natural and Scientific Interest (ANSI). The significant natural features include several Late Wisconsinan Port Bruce wave cut drumlins, Interstadial Lake Iroquois boulder to gravel sized lag deposits, a baymouth bar, an infilled lagoon, and a series of remnant beaches associated with the recession of Glacial Lake Iroquois (NHIC 1999b). The presence of glacial till deposits has made this area attractive for aggregate extraction industries. Although there have been a number of gravel pits located on this land in the past, extractions in the foreseeable future are unlikely due to the designation of the BPWA as an Earth Science ANSI (Gordanier 1999).

The dominant land cover type in the BPWA is forest, although there are also large areas of open fields, wetlands and open water ponds. As a result of this landscape diversity, the area supports a diverse wildlife community, although existing biological inventories for the area are considered incomplete (Gordanier 1999). Some of the coniferous forests in the Wildlife Area are considered to be suitable white-tailed deer wintering habitat, and there is an area of potentially high quality wintering habitat on the adjacent Murray Hills (MNR, unpublished data). Conservation organizations have completed a number of habitat improvement initiatives to increase the abundance and diversity of wildlife in the area. For example, Ducks Unlimited Canada has installed a number of water control structures in the wetland areas to increase waterfowl nesting opportunities.

Like other Provincial Wildlife Areas, the BPWA is managed for a variety of recreational uses, as well as for the natural communities that exist on the land. Some of the year round recreational opportunities that exist include: hunting, wildlife viewing, nature education, hiking, dog training, target shooting, riding of recreational vehicles and mountain biking. To facilitate many of these activities, a number of low impact trails have been maintained within the Wildlife Area.

Hunting has been a popular activity in the BPWA since it was opened to this activity in the early 1970's. As such, a number of game species have been actively managed in the area by the Ministry of Natural Resources. The first program initiated in this area was the release of ring-tailed pheasants in the early 1970's to supplement the hunting of wild populations. This program was discontinued in 1984 due to increasing costs. Between 1994 and 1997, wild turkeys were reintroduced to an area just north of the BPWA, in the former Murray Township (Bellamy and Malhiot 1999). Since this time, naturally reproducing populations have become well established in the Wildlife Area and hunting of this species is permitted within the appropriate season. Projects such as those of Ducks Unlimited Canada have increased waterfowl hunting opportunities in recent years (Gordanier 1999).

The BPWA is part of a large, relatively continuous corridor of natural areas that includes the two other natural areas discussed previously. The major barrier to the migration of terrestrial species in a southerly direction (to the Mayhew Creek Headwaters Natural Area) is the Hwy. 401 corridor (Brownell and Blaney 1995). Movement of species to the north and east is less of a problem as sufficient linkage corridors connect this area to the Murray Hills Headwaters Natural Area, located approximately 1 km to the east, and the Cold Creek Wetland Complex, located approximately 5 km to the northeast. Although, the corridor to the Cold Creek Wetland has become greatly reduced and increasingly disturbed in recent years, passage is still possible for species that do not require interior forest habitat.

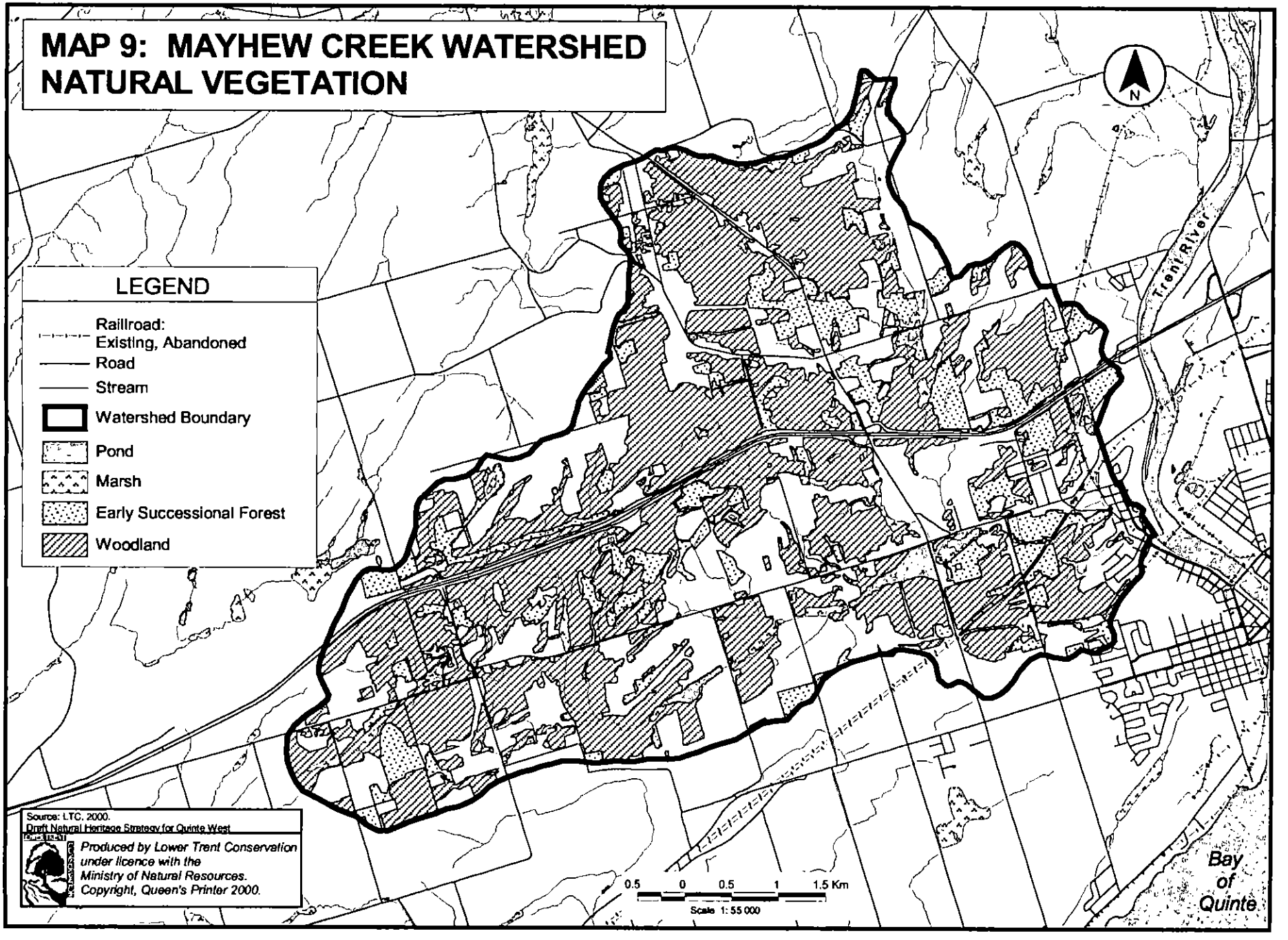
6.2 VEGETATION COMMUNITIES

The wide variety of environmental conditions existing in the Mayhew Creek watershed are able to support a diverse range of vegetation communities. Two factors, moisture and soil depth, are particularly important in determining the distribution of plant communities across small geographic areas (Hosie 1969). Slope is another important factor in a number of areas in the region, particularly those on or adjacent to the Murray Hills. Map 9 shows the distribution of vegetation communities in the watershed.

6.2.1 Wetlands

Wetlands are defined as lands that are "seasonally or permanently covered by shallow water including adjacent areas where the water table is close to the surface. They have water saturated soils and are dominated by hydrophytic or water tolerant plants" (MNR 1993). Wetlands provide a number of vital functions in nature, including (but not limited to): the provision of habitats for

MAP 9: MAYHEW CREEK WATERSHED NATURAL VEGETATION



terrestrial and aquatic wildlife, groundwater recharge and discharge, and water storage and flood attenuation. Wetlands also contribute to landscape diversity and aesthetics.

Although there are no evaluated wetlands in the watershed, a number of small, unevaluated wetlands are scattered throughout the watershed (Map 10). They can be described as marsh, wooded swamp, and swamp thicket. In the headwaters of the Mayhew Creek watershed, there are a number of small marsh and cedar swamp pockets that are sources of groundwater discharge. These wetland discharge areas help maintain base flow in the creek and buffer water temperatures in the summer months. Several small wetland pockets were identified by Brownell and Blaney (1995, 1996) in both the Mayhew Creek Headwaters and Murray Hills Headwaters Natural Areas. Also, a relatively large marsh area exists below Tremur Lake (to the east of Wooler Road). This area provides additional storage capacity for the stream at times of high flow and helps attenuate flood events downstream.

A number of the wetlands in the watershed should be considered for evaluation under the MNR system. Although it is unlikely that any of these wetlands are provincially significant, it is important to ensure that these ecosystems are precisely mapped, and that an inventory of their natural features be maintained. This is particularly important for areas that are adjacent to existing, proposed, or anticipated developments.

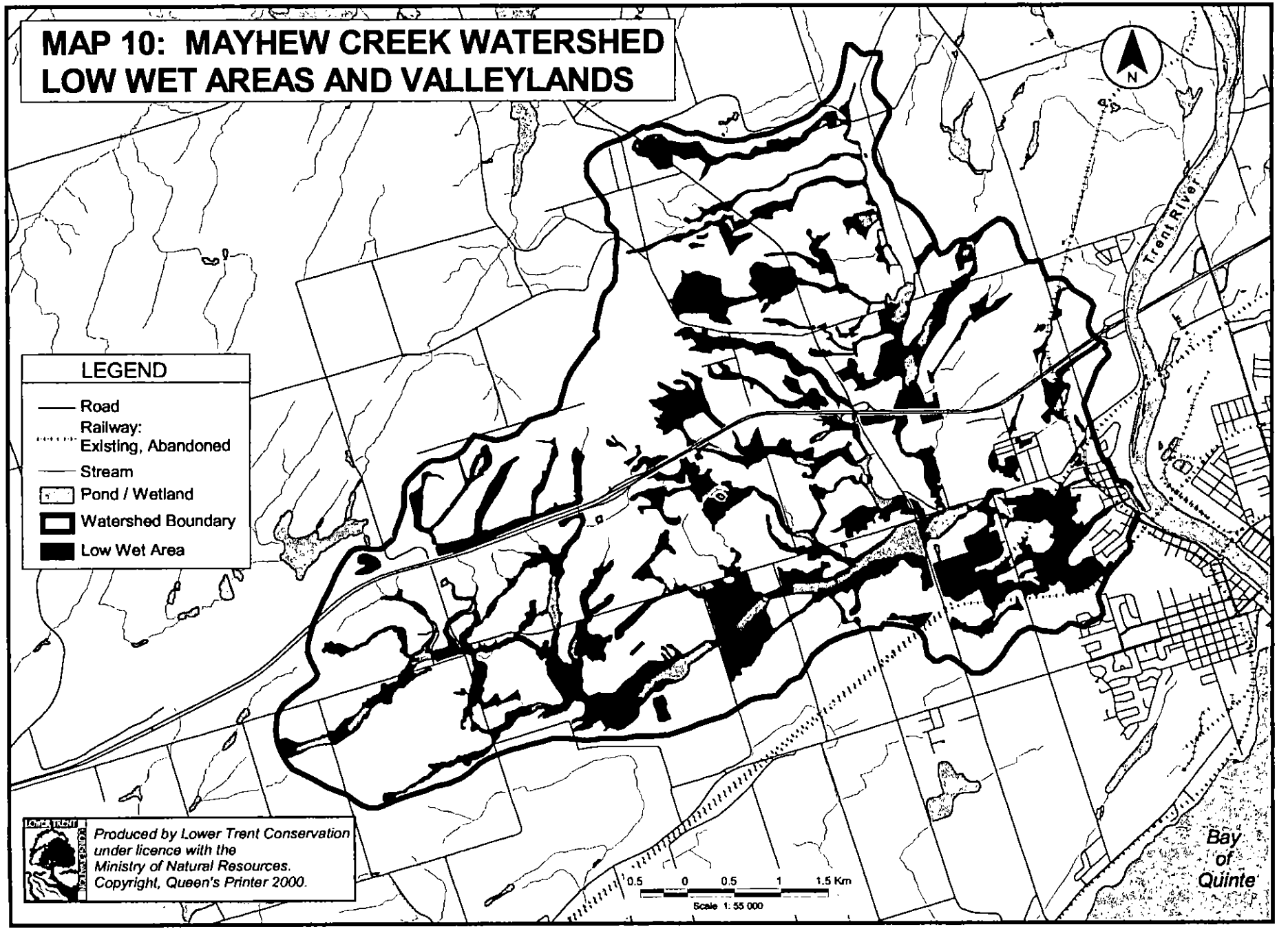
6.2.2 Ravines and Valley Lands

Ravines and valley lands were delineated from aerial photographs of the Lower Trent watershed. These landform features have been combined with wetlands on Map 10. Wetland habitats are often found in the low areas at the bottoms of ravines and valleys.

Ravines and valley lands are common in the headwater areas of the watershed, and are particularly abundant in association with the Murray Hills. These features offer a unique type of environment where the biota is protected from the natural elements by the topography of the landscape. At the same time, ravines and valleys are particularly vulnerable to damage from land use activities. The high gradient slopes of the valley walls makes the land especially prone to erosion. In turn, streams in ravine and valley bottoms are vulnerable to excessive sedimentation and other related water quality problems. Thus, efforts should be made to retain the forest cover at the top and on the sides of valleys, minimize encroaching developments, and maintain naturally vegetated riparian zones adjacent to valley streams.

6.2.3 Forests

The woodlands of the northern Lake Ontario shoreline are considered part of the Great Lakes - St. Lawrence Forest Region. In this region, forests are comprised of a mix of deciduous and coniferous trees, with the deciduous species often being more dominant in the south. Given the northern temperate climate of the area, the species and community diversity is considered to be relatively high. Many of the species that are found on the north shore of Lake Ontario are at, or


MAP 10: MAYHEW CREEK WATERSHED
LOW WET AREAS AND VALLEYLANDS
N
Trent River
LEGEND
Road
Railway:
Existing, Abandoned
Stream
Pond / Wetland
Watershed Boundary
Low Wet Area
Produced by Lower Trent Conservation
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Ministry of Natural Resources.
Copyright, Queen's Printer 2000.
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Bay
of
Quinte

near, the northern limit of their range. Species such as bitternut hickory, ironwood (blue-beech), butternut, eastern cottonwood and black cherry are found in the region, but are more widely distributed in the United States than in Canada (Hosie 1969).

Historically, the forest cover of the Mayhew Creek watershed was composed of mixed hardwood forests that were dominated by white pine - oak communities. These large expanses of mature trees (particularly white pine) were cut for the British ship building industry following the arrival of Europeans to the area. Although some high quality white pine - oak communities do still exist in the watershed (Brownell and Blaney 1995, 1996), this community type has become quite rare (ERM 1970). Today, the re-establishment of white pine communities is being aided by a number of private plantations of this species. If managed properly, a number of more shade tolerant hardwood species will develop into an understorey after the pines have become established. This will serve to increase the diversity of the stands, produce a more stable forest community type, and create habitat for wildlife. Selective logging of the monoculture pine forest can hasten this process by providing a window of opportunity for the understorey species to gain co-dominance.

Currently, almost half (48.6%) of the land in the Mayhew Creek watershed is forested. Due to the diversity of physical habitat types in the watershed, a wide range of forest types are able to thrive. Lowland deciduous, upland deciduous, lowland coniferous, upland coniferous and upland mixed forests are all readily apparent community types. Other common natural species assemblages (beyond the white pine - oak remnant previously mentioned) include aspen - white elm, poplar - oak, beech - sugar maple, sugar maple - basswood (ERM 1970) and sugar maple - ironwood (Gordanier 1999).

Like most areas of southern Ontario, old growth forests in the Mayhew Creek watershed are uncommon. For the purpose of this study, potential old growth forest is defined as in Brownell and Blaney (1995). An old growth community must contain trees that are at least 100 to 120 years old with a minimum size of 2 ha to provide interior habitat that is relatively free of edge effects. Only one area in the watershed has been identified as having old growth forest. There is a 10.7 ha old growth hemlock swamp and ravine slope located just south of Telephone Road in the Mayhew Creek Headwaters Significant Natural Area. In this area there is a relative abundance of trees that are between 120 and 150 years old, and 3% of the trees are approximately 250 years old. Other species associated with the hemlock are sugar maple, white ash, white birch, ironwood, bitternut hickory and beech (Brownell and Blaney 1996).

Other forested areas in the watershed are the result of secondary growth. Lands are often left relatively bare following disturbances such as forestry or the abandonment of unproductive agricultural fields. The process of disturbed lands returning to their natural state is known as secondary succession. In the first stage, light and drought tolerant early successional species move onto the vacant land and develop into a scrubland community. In the lower Trent region, eastern red cedar is often one of the first pioneer species to move into an area. Other common pioneer species include eastern white cedar, poplars and white birch. These tree species are often found in combination with a number of shrubs, such as hawthorn, sumac, European buckthorn,

red osier dogwood and mountain maple. As the ecosystem matures, the tree species (poplars and birch) will begin to form an open canopy woodlot in which there is ample space between individual trees.

In upland areas, the composition of species that form the later successional stages is primarily determined by the density of trees, and thus, the amount of sunlight received by the understorey. In a young forest, where the canopy is partially open, a mid-tolerant association of species will develop. In this type of a forest community, a wide variety of species will become established, with species such as sugar maple, beech, red oak, white ash, white birch, basswood, ironwood and white pine becoming the most prevalent.

Gradually, the canopy of the forest will become more developed and dense, and shade tolerant species will begin to dominate the community. As the canopy becomes more closed and less light reaches the forest floor, the shade tolerant species are able to flourish in the understorey and eventually enter the canopy becoming the dominant species. These shade tolerant climax communities are typically dominated by sugar maple with beech, yellow birch and eastern hemlock. A variety of other species are generally present in limited numbers, with the exact composition depending on a number of factors. These factors include, but are not limited to: past land use and land management practices, the soil type, the moisture regime of the soil, exposure to wind and edge effects, and the angle and orientation of the slope. Eventually, the mature community will develop into an old growth forest with a diversity of species and habitats for wildlife.

Inventoried Areas

Two wooded areas were inventoried as part of the Lower Trent Region Natural Areas Inventory and Evaluation (Brownell and Blaney 1995, 1996). Both the Mayhew Creek Headwaters and the Murray Hills Headwaters Natural Areas are described in Section 6.1 above. An inventory of the Brighton Provincial Wildlife Area is also available (Gordanier 1999). Again, details of this wooded area are provided in Section 6.1.

6.2.4 Old Field and Meadow Community

Aerial photographs from 1953 show that many of the existing old field and meadow communities in the watershed were actively cultivated at that time. As these fields are abandoned, the areas begin the process of secondary succession, detailed above. For the purposes of this study, old field and meadow communities are defined as former agricultural areas that have been left to regenerate, but have not proceeded past the pioneer community stage, where the community is dominated by shrubs and small trees. In some locations, the remnants of old orchards that have been left unattended have also been included as old field communities.

Old orchards may be found on both sides of Wooler Road just north of Miron Road, and on the west side of Stockdale Road north of Hwy. 401 (labelled as early successional forest on Map 9). Old field and meadow communities are most common in the areas surrounding the Canadian

National and Canadian Pacific Railway tracks just to the west of the urban area of Trenton, and in an area immediately north of Hwy. 401 and east of Wooler Road. Typical species in these communities include native grasses, goldenrod, milkweed, aster, eastern red cedar, and eastern white cedar. Old field and meadow communities provide essential habitat for numerous bird and mammal species that require open spaces and forest edges. For example, many birds of prey visually hunt for small mammals in fields, but will roost and nest in large trees along the edge of the forest. Open areas such as these are also particularly prone to invasive species, such as purple loosestrife, apple trees (in areas adjacent to orchards) and common buckthorn (Hosie 1969).

6.2.5 Fence and Hedge Rows

Treed fence and hedge rows have been maintained between many agricultural fields in the Mayhew Creek watershed. Along their base, vegetated fence and hedge rows form a barrier which slows the wind and reduces soil erosion. In addition, they provide food and cover for wildlife and insects, and diversify the landscape for wildlife viewing and aesthetics.

The abundance and diversity of insect communities are known to be greater in agricultural fields that are bordered by fence and hedge rows (Peng et al. 1993). Thus, the fence rows may not only increase the amount of available habitat for wildlife, but the increased abundance of insects may also lead to an increase in the populations or community diversity of insectivorous birds and mammals. While an increase in certain types of insects within or adjacent to agricultural fields would not be viewed favourably, it has been reported that in the presence of fence and hedge rows, the number of predatory insects increases (Sotherton 1984, 1985), whereas the abundance of pest insects decreases (Peng et al. 1993). Thus, the maintenance of vegetated fence and hedge rows actually promotes the biological control of pest insects.

6.2.6 Other Vegetation Communities

A number of other significant vegetation communities are located in the study area. As mentioned previously, there is a wet spicebush ravine community located in the Murray Hills (Brownell and Blaney 1995). This community type is considered to be imperiled in Ontario and in the Carolinian Forest Zone (Kavanagh and McKay-Kuja 1992). Also located in the Murray Hills is a remnant dry prairie community consisting of tall bluestem and Indian grass (also see Catling and Catling (1993) for a description of other remnant dry prairie communities found in the Lower Trent region), a white oak - red oak savanna that is in excellent condition, and a black oak savanna. This savanna community is considered to be rather small and young, and large portions of the area have been disturbed by the use of off-road vehicles. Despite this, all three communities are deemed to be significant in the area (Brownell and Blaney 1995).

6.2.7 Natural Heritage Strategy

In 1999, Lower Trent Conservation, in cooperation with its Bay of Quinte Remedial Action Plan (QRAP) partners, initiated work on a Natural Heritage Strategy for the Municipality of

Campbellford/Seymour, Township of Percy, Village of Hastings, and City of Quinte West (LTC 2000). The municipalities, Quinte Conservation and the Ministry of Natural Resources are working together with Lower Trent Conservation to complete this project.

Criteria for significance will be developed as part of the Natural Heritage Strategy for woodlands, significant wildlife habitat and valleylands. These areas, along with already identified significant natural areas, will be identified on digital mapping and a series of recommendations aimed at protecting and enhancing the natural heritage system will be developed. the recommendations will be focussed in three main areas: municipal planning, stewardship and restoration projects. In addition to core areas, wildlife corridors and linkages will be identified. This strategy will be completed prior to the *Mayhew Creek Watershed Plan*, providing an opportunity to incorporate the mapping and recommendations into the plan.

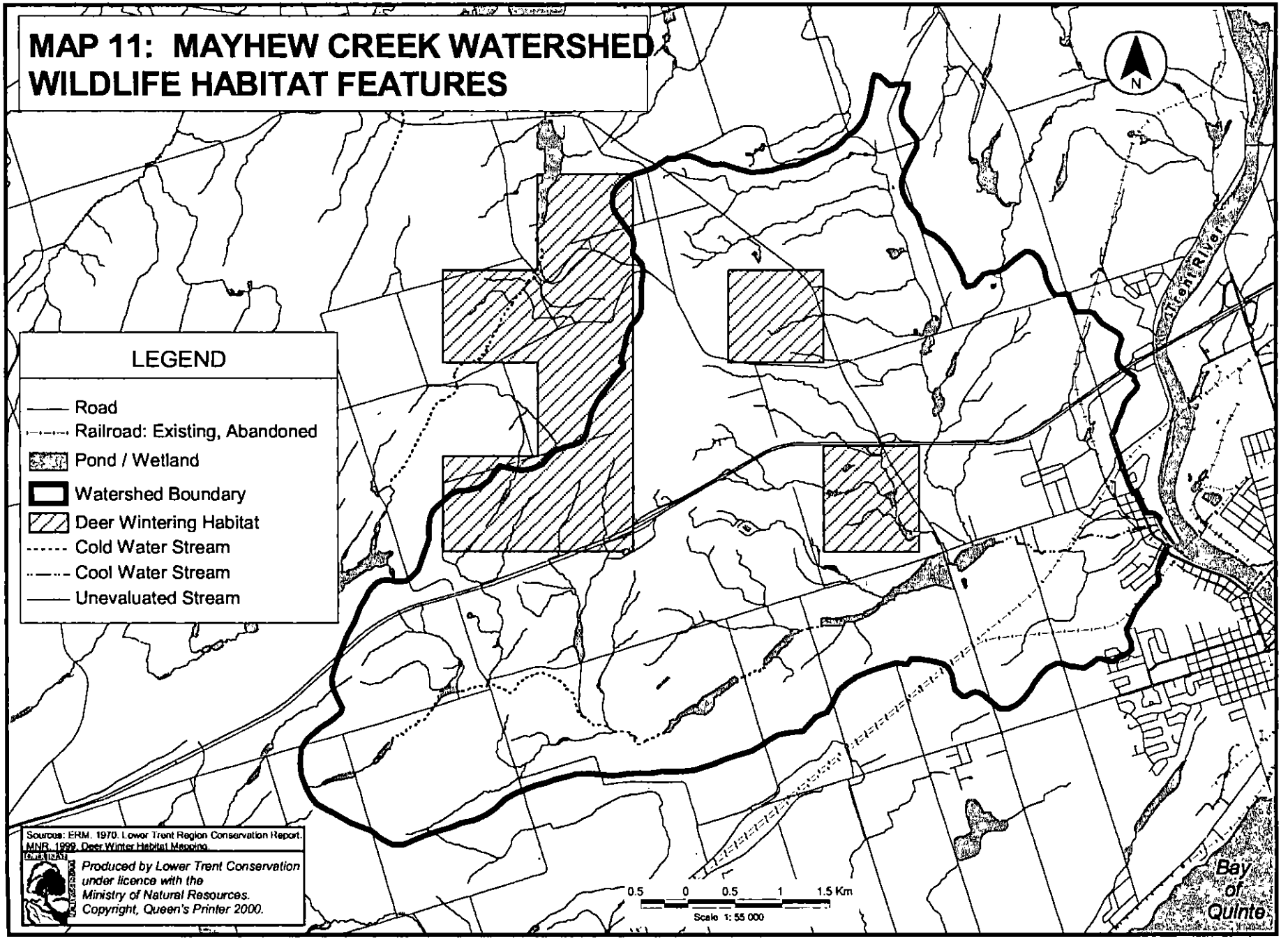
6.3 FISHERIES

A formal survey of the fish community of Mayhew Creek has not been completed since the 1970's. Thus, the exact community composition and the distribution of the various species at the present time are largely unknown. Antidotal information is available for the presence of many of the game species, some of which are discussed below. See Appendix 4 for a complete list of species documented in the creek. An updated survey of aquatic habitats, the fish community and the distribution of species in the creek should be considered a priority.

Upstream of Tate Road, Mayhew Creek is considered a valuable coldwater stream (Map 11) that supports a number of sensitive fish species, such as brook trout. This species is considered to be a good indicator of the health of a coldwater stream, as brook trout require cool (generally less than 20°C), well-oxygenated waters. For spawning, this species requires a clean gravel substrate and flows of a moderate velocity. Thus, spawning often occurs in high gradient headwater streams (Scott and Crossman 1973). As well, brook trout streams are usually well vegetated to buffer the effects of warm summer air temperatures.

Data from the 1970's indicate that brook trout inhabited all portions of the creek upstream of Tate Road, although their range may have been restricted in recent years as development in the watershed has increased. During the warmest summer months, the range of this species can be reduced to a number of refugia where there are abundant groundwater upwellings. Once stream temperatures begin to drop in the fall, the trout will again expand their range to other areas of the stream. Other coolwater species found in association with brook trout include brown trout, blacknose dace, pearl dace and brook stickleback.

The brown trout is a species that was introduced to North America from Europe in the late-1800's due to its value as a sport fish. The first recorded introduction of this species in Ontario was in 1913 (MacCrimmon and Marshall 1968). Unfortunately, like many introductions of exotic species, brown trout have had a detrimental effect on populations of native species. Brown trout


MAP 11: MAYHEW CREEK WATERSHED
WILDLIFE HABITAT FEATURES
LEGEND
Road
Railroad: Existing, Abandoned
Pond / Wetland
Watershed Boundary
Deer Wintering Habitat
Cold Water Stream
Cool Water Stream
Unevaluated Stream
N
Trent River
Bay of Quinte
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Sources: ERM, 1970. Lower Trent Region Conservation Report.
MNR, 1999. Deer Winter Habitat Mapping.
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occupy habitats that are similar to those occupied by native brook trout, as both species require cool, well-oxygenated waters with gravel substrate for spawning. Although the two species are often found to co-exist, brown trout generally suppress the abundance of native brook trout, because brown trout are longer lived, attain larger size, and large individuals are known to prey on juvenile brook trout (as well as some of their own young). Also, brown trout are able to tolerate a wider range of temperatures than brook trout, and have an optimal temperature range of 18-24°C, whereas brook trout prefer temperatures below 20°C (Scott and Crossman 1973).

Other introduced salmonid species reported in Mayhew Creek include rainbow trout, coho salmon and chinook salmon. Rainbow trout are likely able to occupy most reaches of the creek, as they are considered a coolwater species and are able to tolerate warmer water temperatures than brook trout (Stoneman and Jones 1996). It is unknown if any of the rainbow trout in Mayhew Creek are in fact permanent residents of the stream, or if they are lake residents that return to their natal stream to spawn. The distribution of rainbow trout in the upper portions of the creek may be restricted by a number of dams along the length of the stream, especially if the fish are primarily migrant lake residents. Coho salmon, introduced to the Great Lakes, are known to have formed naturally reproducing populations in some locations, and may have used Mayhew Creek for such purposes in the past. The results of various introductions of chinook salmon have met with less success. Natural reproduction of chinooks in the Great Lakes basin is considered to be negligible (Scott and Crossman 1973), although some fish are still reported long after stocking efforts were discontinued, and therefore some reproduction must be occurring.

Downstream of Tremur Lake, the fish community of Mayhew Creek is dominated by warmwater species. Bluegill, pumpkinseed, rock bass, largemouth bass, yellow perch, brown bullhead, white sucker and various species of cyprinids (minnows) are typically found in this stream reach. The community structure of Tremur Lake is similar to the lower reaches of the creek, although the diversity of the cyprinid family is reduced in the lake. Again, the fish communities of Mayhew Creek and Tremur Lake have not been surveyed since the 1970's, and should be updated.

The stream reach between Tremur Lake and the Trent River is also a known spawning area for parasitic sea lamprey. Sea lamprey are native to the Lake Ontario basin (they are only considered to be an invasive species in the upper Great Lakes), but nevertheless are considered to be problematic by fisheries managers. Numerous valuable sport fish species become hosts for parasitic lamprey adults. Common hosts include lake trout, lake whitefish, yellow perch, rainbow trout, burbot, channel catfish, northern pike, carp and walleye (Scott and Crossman 1973). The lower reaches of Mayhew Creek have been treated with the lampricide TMF (3-trifluoromethyl-4-nitrophenol) since the early 1970's by the Department of Fisheries and Oceans Canada. This lampricide targets lamprey in the ammocoete (juvenile) life stage and is considered to be relatively non-toxic to other freshwater species. Treatments were applied in 1990, 1992, 1996, and most recently in the late summer of 2000 (Barry Scotland, DFO, personal communication). Lampricide treatments are not necessary every year because sea lamprey remain in the ammocoete stage for four to seven years (Scott and Crossman 1973).

6.4 WILDLIFE

Surveys and studies of wildlife populations and community structure in the Mayhew Creek watershed are virtually non-existent. Through extensive research, some data was obtained from the Ministry of Natural Resources, consultant reports and local naturalist groups, although these data sets are largely incomplete or need to be updated. This lack of information is identified as a serious data deficiency, and updated inventories of birds, mammals, reptiles and amphibians (as well as fish) should be undertaken as part of the *Mayhew Creek Watershed Plan.*

6.4.1 Birds

In recent years, declines in a number of southern Ontario forest song birds have been noted and primarily attributed to habitat loss (Mumford 1999). The fragmentation of forests results in the loss of interior habitat and an increase in the relative amount of marginal edge habitats. Due to the proximity of the Mayhew Creek watershed to Presqu'ile Provincial Park (a vital stopover for many migratory bird species), and the presence of several areas of continuous forest in the watershed, the preservation and enhancement of these remaining forest habitats may be essential for maintaining the diversity of birds in the lower Trent region.

During the 1990's, Quinte RAP and the Canadian Wildlife Service have been involved with a Black Tern Breeding Enhancement Study. In the past, Black Terns have been observed nesting in various areas within the City of Quinte West (Richardson 1994), although data were not collected in the current study area.

According to the Canada Land Inventory (1966a), most of the land in the watershed has little capability for the production of waterfowl, due to the lack of permanent open water. Areas near the mouth of the river were classified as having limited capabilities for the production of waterfowl, although these areas may be an important stopover area for migratory waterfowl (Canada Land Inventory 1966a). The marsh area adjacent to the Old Mill Pond, to the east of Tremur Lake (between Wooler Road and 2nd Dug Hill Road), may offer breeding opportunities for waterfowl as well as other bird species. This wetland is a small cattail marsh which has an appropriate proportion and pattern of open water for supporting a diverse range of wildlife habitats (MNR 1993). As well, Ducks Unlimited has created additional nesting opportunities through wetland creation programs in the Brighton Provincial Wildlife Area.

A list of the bird species occurring in the Mayhew Creek watershed is included as part of Appendix 5. This list has been compiled from the Atlas of Breeding Birds of Ontario (Cadman et al. 1987), the Mayhew Creek Headwaters Significant Natural Area Report (Brownell and Blaney 1996), reports by local naturalist groups and landowners, and observations by LTC staff. A further list of breeding birds for all of Northumberland County is available (Roy 1976), but data from this report were not included in Appendix 5 because it is outdated, and the atlas data better represents the extent of the study area. Undertaking a thorough inventory of bird species inhabiting the watershed may be an interesting project for a naturalist group.

6.4.2 Mammals

Complete mammal surveys for the study area are not available. The sporadic information that is available is summarized below. A list of all of the mammals presumed to inhabit the watershed is included in Appendix 6. Records included are based on the distribution of mammals given in the *Atlas of the Mammals of Ontario* (Dobbyn 1994). The majority of the Mayhew Creek watershed is covered by parts of UTM squares 18 TD 88 and 18 TD 98, although small portions of the watershed are also located in squares 18 TD 89 and 18 TD 99. Unless otherwise noted, Appendix 6 only includes those species that are located in squares 18 TD 88 and 18 TD 98. Some species from adjacent squares were included on this list because they are known to be common in the Mayhew Creek watershed area. Other species reported in the *Brighton Provincial Wildlife Area Management Plan* (Gordanier 1999) have also been included.

Although the gray wolf was included on the list of mammals provided by Gordanier (1999), this species has not been included for the purposes of the current study. The distribution of the gray wolf in Ontario is limited to areas with continuous heavy forest cover that are relatively unpopulated by humans (Dobbyn 1994). These conditions do not exist in the vicinity of the Mayhew Creek watershed, and there have been no confirmed records of the gray wolf in the lower Trent region (or other areas on the Lake Ontario shoreline) since the 1960's (Dobbyn 1994). It is likely that the gray wolf observation reported by Gordanier (1999), is either a very old record (the date of the observation was not reported), or it is based on an incorrectly identified coyote or coyote-dog hybrid. Coyotes are much more adaptable than wolves, are better able to co-exist with humans, and are known to be relatively common in the lower Trent region. Differentiating wolves and coyotes can be further complicated because the two species often hybridize in areas where their ranges overlap, which includes areas immediately south of the Canadian Shield in central Ontario. It is generally believed that a pure stock of gray wolves no longer exists in the southern part of their range in Ontario. As well, recent studies indicate that the wolves in central Ontario are not actually gray wolves, but are instead a separate species (the Algonquin wolf); which genetically, is more closely related to the coyote and the red wolf of the southern United States (Brad White, Trent University, personal communication).

Many wooded areas in the watershed provide habitat for deer. Although information on annual deer harvests was not available, some landowners have indicated that deer occur on their property. Natural food sources such as red osier dogwood, white cedar, maple, and beech (Dobbyn 1994) are common in the watershed. Although there are not any provincially significant deer yards (as identified by the Ministry of Natural Resources) in the study area, winter aerial surveys of deer indicate that there are several locations that are regularly used by deer in the winter months. The quantity of suitable winter habitat is considered to be the limiting factor in the production of all central Ontario deer populations (Dobbyn 1994). In the winter months, white-tailed deer require dense coniferous vegetation for shelter and to provide adequate browse. Dense stands of eastern white cedar often provide high quality winter habitat for deer in Ontario. According to the Canada Land Inventory (1966b), most of the land area in the Mayhew Creek watershed has few limitations for the production of ungulates.

A portion of the Murray Hills Headwaters Natural Area and an area north of Tremur Lake (adjacent to Wooler Road, south of Hwy. 401) have been identified as being used regularly by deer in the winter of 1998/99 (Map 11). Based on that winter's aerial deer track survey, deer track densities were classified as level 2. A level 2 classification is defined as having "more than a few track aggregates and/or a few trails, but much of the [square] kilometre of forest had little or no deer activity". Furthermore, the results of the 1998/99 winter survey are considered to underestimate deer densities, because there had been a recent snowfall event prior to flying the aerial survey. This likely covered many tracks and trails, which resulted in lower than expected classifications for many areas (Karen Belamy, MNR, personal communication). The winter deer survey was scheduled to be flown again in the winter of 1999-2000, but the unusually warm winter did not provide the conditions necessary to undertake the study. Hopefully, another survey will be completed in the near future to determine if any areas of significant deer wintering habitat exist in the lower Trent region.

Other noteworthy mammal species in the study area include a number of furbearers and three introduced exotic species. Furbearers are identified by the Ministry of Natural Resources (MNR 1993) and include the following species which may be found in the watershed: beaver, coyote, mink, muskrat, raccoon, red fox, red squirrel and striped skunk. Although the economic importance of furbearers in Ontario is greatly reduced compared to the past, these species are still recognized as having an additional value (MNR 1993) as there are a number of licensed trappers in the area.

Species introduced from Europe that are found in the watershed include the Norway rat, house mouse and European hare. The Norway rat and house mouse are generally associated with human settlements and are both considered pests as they tend to inhabit buildings. Of the two, the Norway rat is a much more costly pest due to its destructive nature, whereas the house mouse is relatively uncommon in Ontario. Although the house mouse does primarily inhabit buildings, white-footed and deer mice are more commonly found in the homes and cottages of Ontario. In 1912, the European hare was purposely introduced to Ontario for hunting from a stock of German animals. It has subsequently spread throughout much of southern Ontario, and is considered a popular small game species with many people (Dobbyn 1994). The eastern cottontail has naturally expanded its range from the United States into Ontario, and is now found throughout most of the southern and central portions of the province.

6.4.3 Herptofauna

Inventories of amphibians and reptiles have not been completed for the Mayhew Creek watershed. The lack of information about the distribution of these species is likely due to the shy, cryptic nature of many of these animals, and the lack of skilled biologists that are able to correctly identify them. A list of amphibians and reptiles that are thought to occur in the watershed can be found in Appendix 7. These species are known to occur in nearby Presqu'ile Provincial Park (ERM 1970a), and this data set represents the best available approximation of the herptofaunal community. Despite recent evidence of amphibian population declines in Ontario, none of the

amphibian or reptile species reported in this area are considered rare, threatened or endangered (NHIC 1999a, 1999b).

Several of the amphibian and reptile species found in the Mayhew Creek watershed are discussed in more detail below. These species were selected because of interesting aspects of their ecology or their relation to humans.

The eastern milk snake, which is quite common in the lower Trent region, is often found near farm buildings or in fields. This species is often mistakenly identified as a rattlesnake and killed because of its colouration and its tendency to mimic the rattlesnake by vibrating its tail when approached (although the tail of this species does not produce the characteristic rattling sound). Eastern milk snakes are harmless and may actually be beneficial to rural residents because they feed on the young of other species of snakes, mice and other small rodent pests. Other small snakes, such as the northern red-bellied and northern brown snakes are also beneficial to man. Both of these species feed on the slugs and grubs that are known by many to damage lawns, as well as flower and vegetable gardens (Johnson 1989).

Although fairly common in the lower Trent region, snapping turtles are considered uncommon in many parts of Ontario. This species can be found in slow moving streams and ponds in the study area. Most land observations of snapping turtles are in the early summer when females head onshore in search of sunny areas of sand to dig a nest and lay their eggs. Other sitings may occur when turtles are basking on rocks and logs adjacent to the water in the spring and early summer. Despite its aggressive behaviour on land, where this species is quite prone, it is a common misconception that snapping turtles are equally aggressive in the water. In fact, when in the water, the turtles are quiet shy and will dive to deeper water when disturbed.

The blue-spotted salamander (which is listed in Appendix 7) is often confused for the Provincially Significant Jefferson salamander. These closely related species are almost identical in appearance and must be distinguished from one another by genetic analysis (MNR 1993). To further complicate the identification of the two species, they are known to interbreed, producing two hybrid types that exist only as females (see Johnson 1989 for more details). The Jefferson salamander has not been recorded in the lower Trent region. This amphibian has only been identified in Peel, Halton and Waterloo Counties, and it is unlikely to be found in the Mayhew Creek watershed.

AVAILABLE INFORMATION
Brownell and Blaney 1995. *Lower Trent Region Natural Areas - Volume 1: 20 Natural Areas in the Lower Trent Region.*
Brownell and Blaney 1996. *Lower Trent Region Natural Areas - Volume III: 23 Natural Areas in the Lower Trent Region.*
Dobbyn 1994. *Atlas of the Mammals of Ontario.*
ERM 1970. *Lower Trent Region Conservation Report, Volume I and II.*
Gordanier 1999. *Brighton Provincial Wildlife Area Management Plan.*
Hall and Jones 1976. *Northumberland County Environmentally Sensitive Areas Study.*
Hosie 1969. *Native Trees of Canada.*
MNR 1993. *Ontario Wetland Evaluation System, Southern Manual.*
CONTACTS
Karen Belamy, Area Biologist. (MNR, Peterborough District).
Leslie Claridge, Presqu'ile-Brighton Naturalists.
Barry Jones, QRAP Habitat Coordinator, Lower Trent Conservation.

7.0 Land Use

7.1 EXISTING LAND USE

Logging and agriculture were the first activities in the area to significantly alter the landscape of the lower Trent region (ERM 1970). Today, agriculture and residential developments are the primary human land uses within the watershed. Such development can impact surface water runoff characteristics, water quality and the extent and quality of natural habitats (QRAP 1993). Aerial photographs, the City of Quinte West parcel mapping, the landowner questionnaire, and field observations were used to provide information on current and historical land use in the Mayhew Creek watershed.

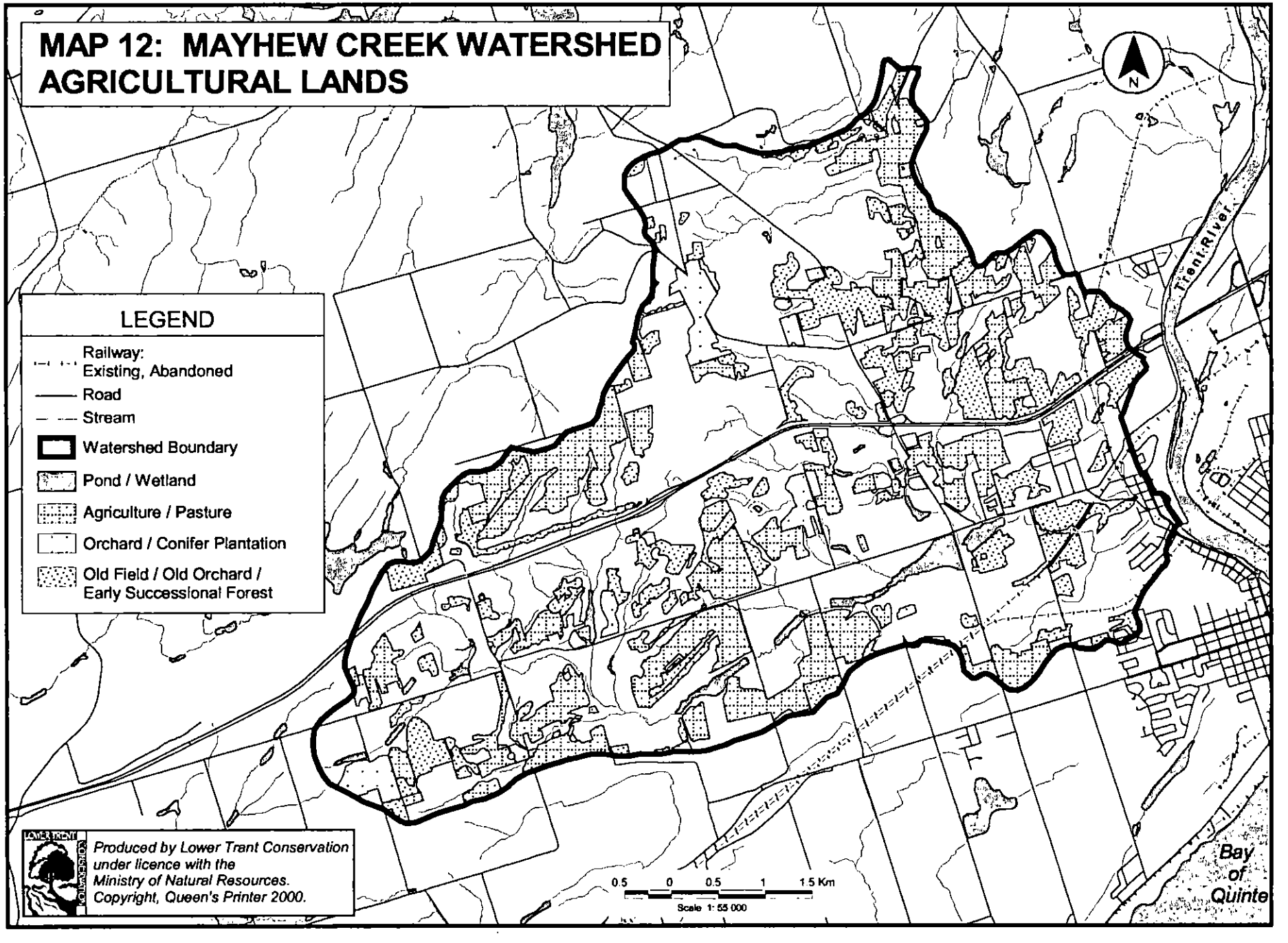
7.1.1 Agriculture

The most productive agricultural lands are located around the periphery of the watershed (see Map 5). The largest area of productive agricultural land extends from north of the Murray Hills Headwaters and the Mayhew Creek Headwaters Natural Areas, south to the community of Smithfield. Other smaller areas of highly productive soils are found to the south of the Mount Zion Crossroads, and north of the Trenton Escarpment on the kame moraine landform. Much of the land in the centre of the watershed has severe limitations for agricultural productivity according to the Canada Land Inventory (1966). These lands may be moderately productive for certain types of crops and often require the use of special conservation practices.

The distribution of active agricultural lands is included on Map 12 and areas designated as agricultural lands in the municipal official plans are included on Map 13. Abandoned agricultural fields are most common in the eastern part of the watershed.

A comparison of 1953 and 1999 aerial photographs indicates that the amount of cultivated land has decreased. Urbanization, most notably in the Barry Heights and the Brett Park (Nicholas Road) subdivisions, has occurred on land that was previously used for agriculture. In addition, fields surrounding the Canadian National and the Canadian Pacific Rail lines, and those adjacent to Tremur Lake, have been abandoned and allowed to naturally regenerate.

It is known that livestock have access to portions of Mayhew Creek (personal observation). One recommendation made by the QRAP to overcome tributary bacterial contamination involves eliminating livestock access to watercourses by providing alternative on-land watering facilities. Assistance for alternative watering facilities and fencing off watercourses is currently available through the Rural Water Quality Program administered by Lower Trent Conservation through the Bay of Quinte RAP program. As well, chemical discharges to the stream from some farm operations have been documented in the past (MNR, unpublished reports). These types of incidents have not been reported in recent years, and it appears that area farmers are interested in operating in a more conservation oriented manner.


MAP 12: MAYHEW CREEK WATERSHED
AGRICULTURAL LANDS
LEGEND
Railway:
Existing, Abandoned
Road
Stream
Watershed Boundary
Pond / Wetland
Agriculture / Pasture
Orchard / Conifer Plantation
Old Field / Old Orchard /
Early Successional Forest
N
Trent River
Bay
of
Quinte
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
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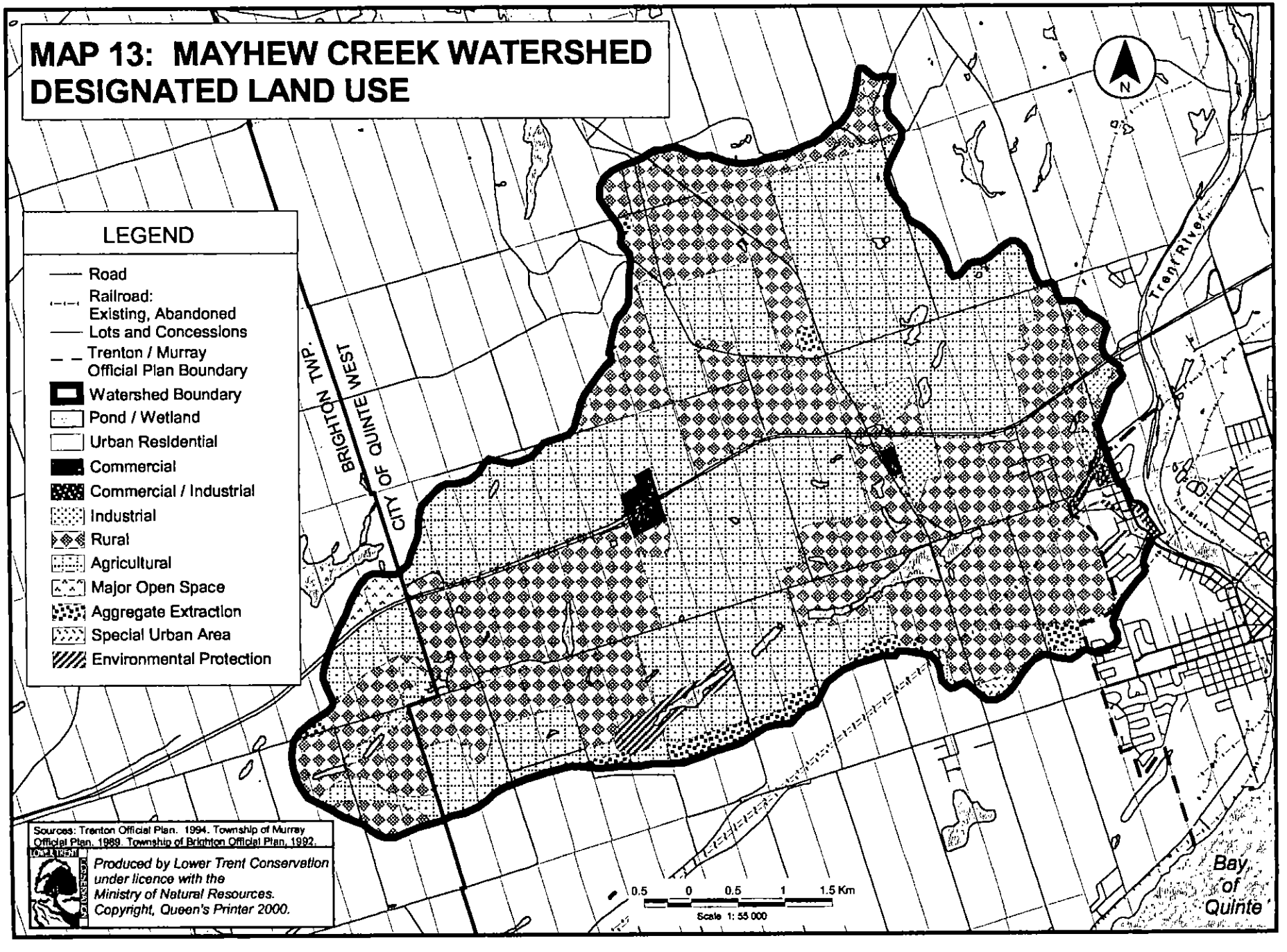
MAP 13: MAYHEW CREEK WATERSHED
DESIGNATED LAND USE
LEGEND
Road
Railroad: Existing, Abandoned
Lots and Concessions
Trenton / Murray Official Plan Boundary
Watershed Boundary
Pond / Wetland
Urban Residential
Commercial
Commercial / Industrial
Industrial
Rural
Agricultural
Major Open Space
Aggregate Extraction
Special Urban Area
Environmental Protection
BRIGHTON TWP.
CITY OF QUINTE WEST
Trent River
Bay of Quinte
N
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Sources: Trenton Official Plan. 1994. Township of Murray Official Plan. 1989. Township of Brighton Official Plan. 1992.
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A number of area farmers have adopted specific conservation practices, such as conservation tillage and no-till farming, as well as the restoration of stream buffers. Other common practices in the watershed include maintaining cover crops between trees in an orchard, providing vegetated fence rows among crops, and the rotation of crops to maintain viable agricultural soils.

7.1.2 Forestry

Although there are no large scale forestry operations in the watershed, a number of private landowners do have timber harvested from woodlots on their property. In Murray Ward (City of Quinte West), 28 private stands covering 262 ha were identified by the Northumberland Stewardship Council. Only 21% of this area is considered to be high quality, unharvested forest. Of the municipalities in Northumberland County, Murray Ward has the greatest percentage of previously harvested forests, with half of the forested area being disturbed in the past.

A survey of landowners with woodlots on their property was completed by the Northumberland Stewardship Council in February, 2000 (Hallworth 2000). Of the 182 Northumberland County landowners that were surveyed, 45% indicated that their woodlot had been harvested in the past, although only 18% responded that they derived part of their income from timber harvests (others were likely using the harvested trees for personal firewood, or the harvesting had occurred many years ago). Only 21% of landowners had some sort of a management plan for their woodlot, yet 69% responded that they would be interested in learning more about the sustainable management of their forests.

7.1.3 Residential

There are several types of residential land use within the Mayhew Creek watershed. The most obvious distinction is between the urban residential developments in and adjacent to Trenton Ward, and the rural areas of Murray Ward and the Township of Brighton. Residential developments in the urban areas can generally be described as concentrated residential lots with urban services. Outside the urban area, residential developments can be further subdivided into concentrated privately serviced lots and low density privately serviced lots.

Concentrated residential development with urban services

The residential area within Trenton Ward, near the mouth of the creek, consists of concentrated lots with urban services. This area is subject to a two-zone approach to flood plain management, as discussed in Section 5.1.3 of this report. Surface water that runs off roofs, roads and parking areas is conveyed to natural watercourses via a storm sewer system. To the north of the intersection of County Road 2 and 2nd Dug Hill Road (across from and north of Walmart), there is parcel of land that has been designated as a Special Urban Area in the Township of Murray Official Plan. Only the northern most portion of this parcel is within the Mayhew Creek watershed. Although this land could be used for residential or commercial developments in the future, it is currently an agricultural field.

Privately serviced, concentrated residential development
A subdivision just outside of the Trenton Ward limits, known as Barry Heights, consists of privately serviced, concentrated lots. An adjacent development that is currently underway, Crestview Heights, would also fall into this classification. This type of residential development has the potential for negative impacts on water quality where soils are unsuitable for private waste disposal systems and/or when such systems are located too close together (Driscoll 1986). Groundwater contamination from neighbouring septic bed leachate is often a concern with residents in these types of developments. The depletion of shallow aquifers may also be an issue.

Privately serviced, low density residential development
This type of development is associated with rural and agricultural areas, and often exists as scattered developments along road corridors. Scattered rural developments have the potential to fragment natural areas, impact farm operations, and increase the cost of services for a municipality.

7.1.4 Commercial
Commercial developments occur in several locations throughout the watershed. These include the two service stations on Hwy. 401, and an area of land along Wooler Road, south of the highway. An additional area in the urbanized portion of the watershed, along Trenton Street and Telephone Road, is classified as Commercial/Industrial in the Trenton Official Plan and is currently occupied by a number of commercial businesses. Increased surface runoff volume and parking lot contaminants may be associated with these types of developments (Totten Sims Hubicki 1995).

7.1.5 Industrial
Several light industrial sites exist in the eastern portion of the watershed, in the urban area of Trenton and along Wooler Road at Hwy. 401. Light industry currently exists southeast of this intersection, whereas the area to the northeast has been designated as industrial, but remains vacant. The potential for surface and groundwater contamination is always a concern with industrial developments, especially when companies require the use of toxic chemicals. As with commercial developments, the quantity and quality of storm water runoff can be problematic if there are extensive paved areas associated with the operation.

7.1.6 Aggregate Extraction
The extraction of sand and gravel for concrete and asphalt occurs in a number of locations in the watershed (see Map 13). Several active pits are located at the southern boundary of the watershed on the Trenton kame moraine. These can be found just to the north of County Road 2 along the boundary between the Mayhew Creek watershed and the watersheds of Dead and York Creeks. Several smaller aggregate operations can be found further north along the beach deposits and shoreline cliffs left by glacial Lake Iroquois.

Significant deposits of unexploited aggregate resources have also been mapped by the Ministry of Natural Resources and the mapping is available at the Peterborough District Office. The areas with the highest potential for future aggregate extraction are generally found adjacent to the active pits mentioned above (i.e. associated with the Trenton kame moraine, and the remnant beach and shorecliffs landform features). As well, areas with low potential as a source of aggregate materials were delineated. A large area on the top of the Murray Hills is considered to have little potential for the extraction of aggregates. This land was formerly an island in glacial Lake Iroquois, and does not contain the rich sand and gravel deposits that are found at the base of the shorecliffs. Other areas that are considered unsuitable for aggregate extractions are located adjacent to the Mayhew Creek stream channel. These lands contain thick deposits of organic soils produced by wetland areas associated with the stream and its flood plain.

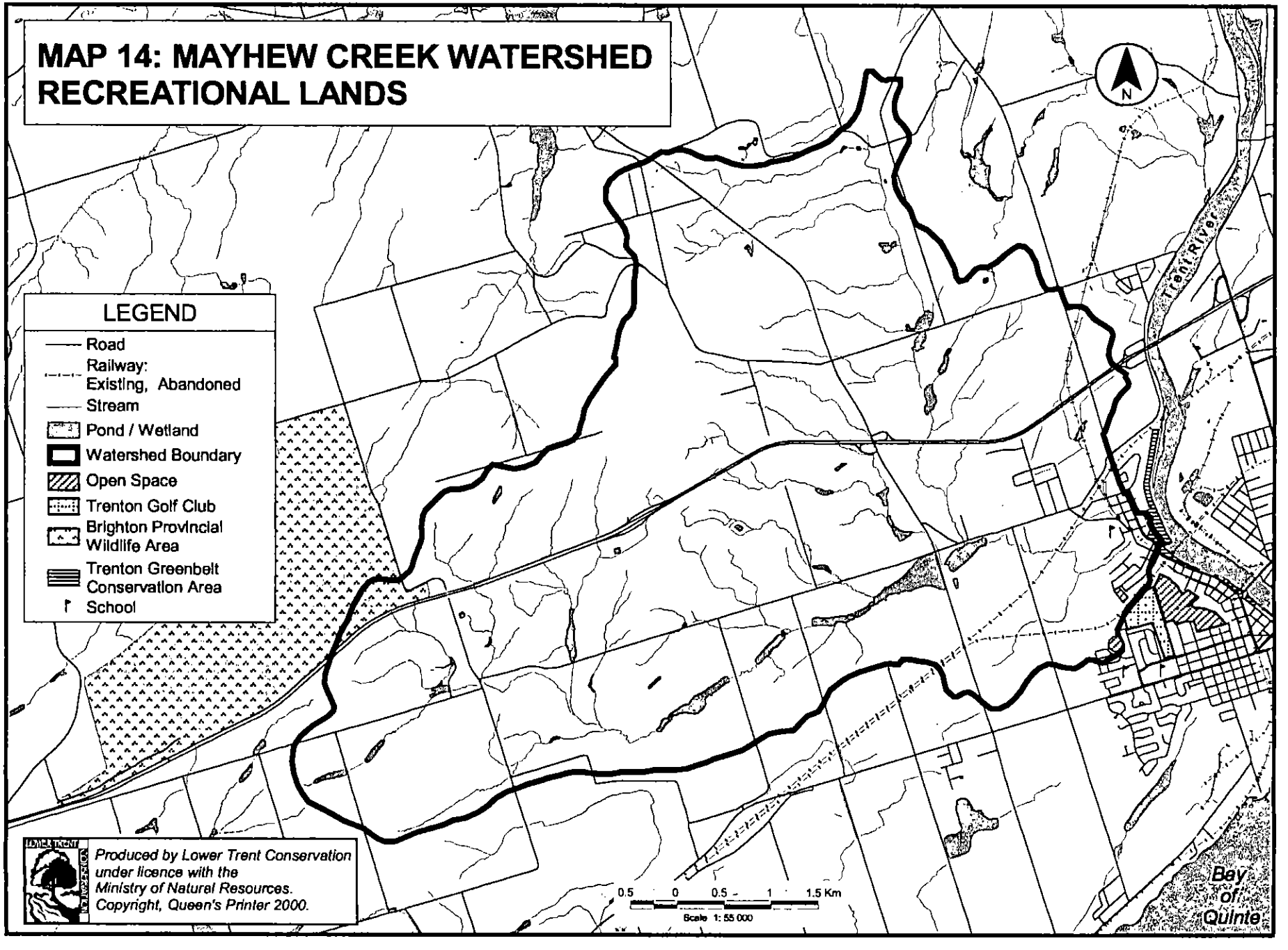
7.1.7 Recreational Opportunities

Recreational opportunities, especially related to the creek itself, are somewhat limited in the Mayhew Creek watershed. Many of the natural features and most reaches of the creek are located on private lands. However, there are some areas that are available for public use (Map 14). These lands may have an economic benefit to the surrounding community.

The Trenton Greenbelt Conservation Area and Jack Lange Memorial Walkway are located on the west bank of the Trent River, and include the lands surrounding the mouth of Mayhew Creek. The walkway extends from Lock 1 on the Trent Canal southward beyond the Lower Trent Conservation administrative office. The park land itself extends south to the McDonald bridge. Although not a part of the watershed, the Trent-Severn Waterway provides many recreational opportunities for boaters and anglers. The waterway connects the Bay of Quinte to Georgian Bay via Lake Simcoe.

A number of low impact trails are maintained in the Brighton Provincial Wildlife Area to facilitate a variety of recreational activities. Some of the year round activities that exist include hunting, wildlife viewing, nature education, hiking, dog training, target shooting, riding recreational vehicles and mountain biking. The natural features and the hunting opportunities available in the Wildlife Area are discussed in more detail in Section 6.1.3 of this report. Other hiking opportunities are available on the abandoned Canadian National rail bed, both north of Hwy. 401 and on the former north-south line in the urban area of Trenton.

There is a privately owned, commercial trout fishing pond located on Christiani Road just north of Hwy. 401. Common winter activities include cross-country skiing, skating on Tremur Lake and the Old Mill Pond, and snowmobiling.


MAP 14: MAYHEW CREEK WATERSHED RECREATIONAL LANDS
LEGEND
Road
Railway: Existing, Abandoned
Stream
Pond / Wetland
Watershed Boundary
Open Space
Trenton Golf Club
Brighton Provincial Wildlife Area
Trenton Greenbelt Conservation Area
School
N
Trent River
Bay of Quinte
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
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7.2 FUTURE LAND USE - PROJECTED DEVELOPMENT

The City of Quinte West anticipates that there are a number of areas surrounding Trenton that will experience development pressures over the next 20-25 years (Ed Woods, personal communication). These areas are indicated on Map 15. The parcel of land located north of County Road 2 and east of 2nd Dug Hill Road has been designated as a Special Urban Area in the Township of Murray Official Plan. Only a small portion at the extreme north end of the parcel is within the current study boundary. In accordance with the Official Plan, this area is designated to become a low density residential development (Art McKay, personal communication). Other areas indicated for future development include proposed residential areas south of the Canadian Pacific Rail line (east of 2nd Dug Hill Road) and immediately south of the Mill Pond (between 2nd Dug Hill Road and Wooler Road). Proposed industrial lands include the Webb Industrial Park (east of Wooler Road and south of Highway 401), the Miron Industrial Lands (on Wooler Road north of Highway 401), and the property owned by Fraser Glenburnie Ltd. (on Telephone Road between Tate and Fraser Roads).

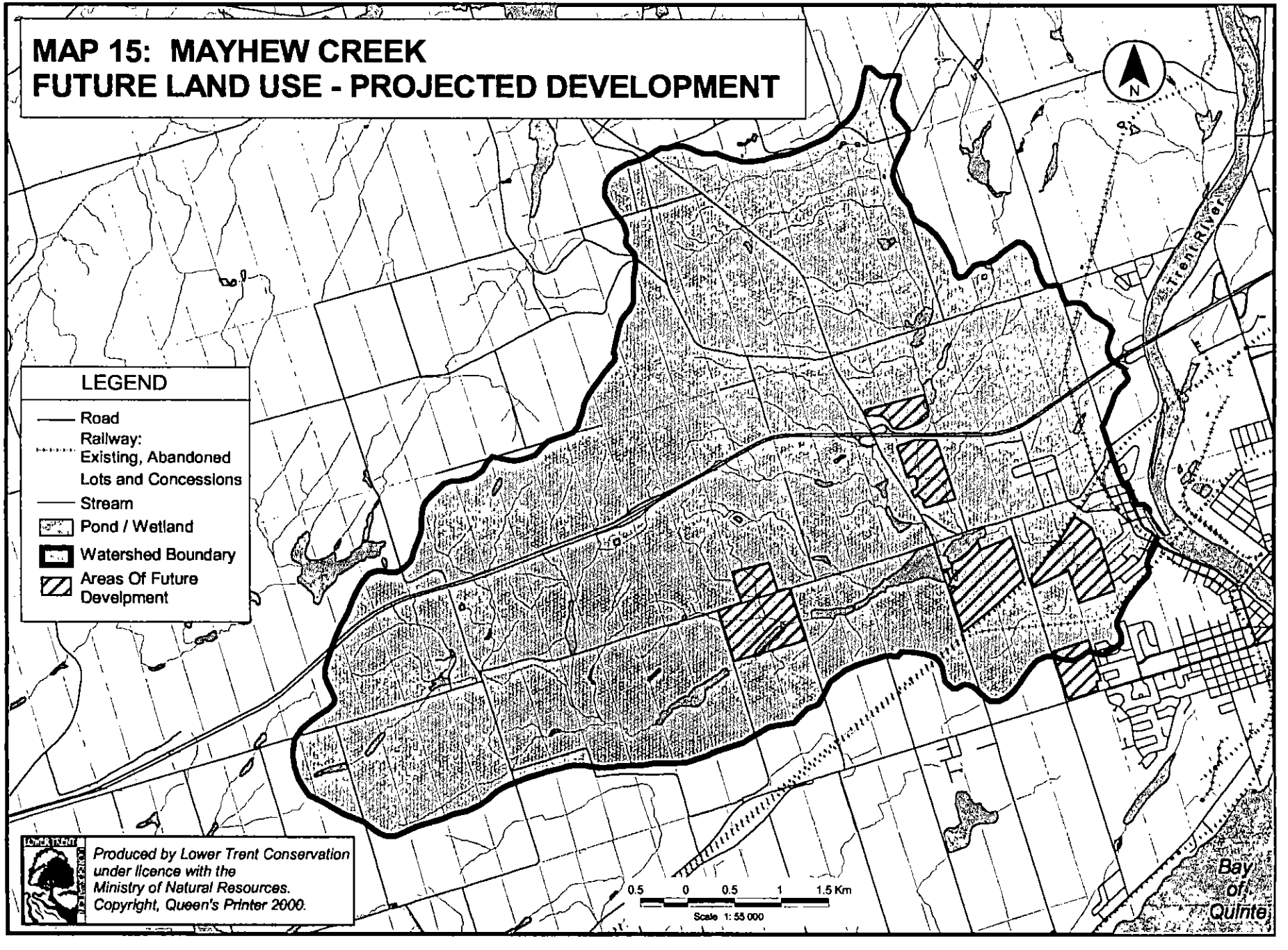
As well, it is likely that other low density residential developments will occur adjacent to the urban area of Trenton, and in scattered locations throughout the rural portion of the watershed. This type of development would include new estate subdivisions, such as Crestview Heights which is currently under construction to the west of Barry Heights subdivision. Rural residential development will likely occur as larger land parcels are severed and sold. As well, other small commercial and light industrial developments may occur along the major road corridors in the watershed.

7.3 LAND USE PLANNING POLICIES

Land use planning involves decisions regarding the use or preservation of land areas, and must consider known and expected circumstances, as well as given aims and criteria. Informed planning is particularly important because many land use changes are either permanent or extremely costly to revert. Collectively, federal and provincial legislation and policies, as well as local policies and by-laws, set forth the basic framework for land use planning in Ontario. The following sections place this planning framework within the context of the Mayhew Creek watershed.

7.3.1 Provincial Policy Statement (PPS)

Bill 20, the Land Use Planning and Protection Act, was first presented to the Ontario Legislature on November 16, 1995. The purpose of this Bill was to amend the Planning Act, and create a planning system that is faster and less bureaucratic than the one created by Bill 163. Following the Royal Assent of Bill 20, the Provincial Policy Statement (PPS) was issued on May 22, 1996, under Section 3 of the Planning Act, to replace the Comprehensive Set of Policy Statements (CSPS). Prior to this date, the amendments to the Planning Act as introduced in Bill 163, including the CSPS, were still in effect. The PPS applies to all planning applications which were commenced on or after March 28, 1995 for which no decision had been made as of May 22,


MAP 15: MAYHEW CREEK
FUTURE LAND USE - PROJECTED DEVELOPMENT
LEGEND
Road
Railway: Existing, Abandoned
Lots and Concessions
Stream
Pond / Wetland
Watershed Boundary
Areas Of Future Develpment
N
Trent River
Bay of Quinte
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
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1996, and for all new planning applications. Further minor amendments were made to the PPS in February 1997.

The policies contained within the PPS that are most relevant to the *Mayhew Creek Watershed Plan* are contained in Section 2 "Resources" and Section 3 "Public Health and Safety." Section 2 contains specific policies regarding agricultural lands, mineral resources, natural heritage features, water quality and quantity, and cultural heritage and archaeological resources. Section 3 contains policies that deal with natural and human-made hazards. A detailed review of the site specific applicability of the resources, features and hazards defined in the PPS should be included as part of the watershed planning process.

The overall intent of the watershed plan is to identify development opportunities and constraints within the study area. Once the natural resource and hazard issues have been addressed, the watershed plan can recommend appropriate locations for future development. This will also assist the municipalities in ensuring that they have fulfilled Section 1 of the PPS, which requires "Efficient, Cost-effective Development and Land Use Patterns." The policies of Section 1 address issues such as developing strong communities, housing, and the efficient provision of services and infrastructure. In the case of the Mayhew Creek watershed, the watershed planning process will provide an opportunity to resolve cross boundary concerns and provide a framework for environmentally sustainable land use planning.

7.3.2 Quinte RAP Recommendations

In 1985, the Bay of Quinte was identified by the International Joint Commission (IJC) as one of 43 areas of concern around the Great Lakes Basin where water uses were impaired. For each of these areas, strategies have been developed that identify remedial actions to overcome the environmental problems and restore the naturally functioning ecosystem of the Great Lakes. These strategies are called Remedial Action Plans (RAPs). The Bay of Quinte RAP released a Stage 2 Report (QRAP 1993) which made 80 recommendations concerning such issues as nutrient enrichment, loss of aquatic habitat, bacteriological contamination and persistent toxic chemicals.

In developing a watershed plan for the Mayhew Creek watershed, the following recommendations from the Stage 2 Report should be considered. These recommendations are considered important from a land use planning perspective.

#2. The ecosystem approach, which includes concepts such as sustainable development, should be integrated into future land use and economic planning processes within the Bay of Quinte watershed.

#8. Official Plans in the Bay of Quinte drainage basin should be amended at the time of their next cyclical review to include a strategy to prevent increased phosphorus loading to the bay associated with each jurisdiction's planned growth and development.

#9. Tributary loadings of phosphorus delivered to the bay from agricultural diffuse sources should be reduced by a further 12 500 kg per year.

#34. The province of Ontario's Subwatershed Planning Process should be adopted and employed by Quinte area municipalities to provide direction for the preparation of Secondary Official Plans for areas slated for new urban development.

#35. Livestock access to the bay and its tributaries for watering purposes should be minimized and alternative on-land watering facilities provided.

#36. Farmers throughout the watershed should develop and implement farm conservation plans to reduce the potential of surface water contamination associated with (1) their manure management and milk house wastewater disposal systems, (2) their practices concerning nutrient application, and (3) other farm sources and activities.

#64. MNR, MMAH (Ministry of Municipal Affairs and Housing), the Mohawks of the Bay of Quinte, the local Conservation Authorities, Quinte municipalities, local industries, Non-Government Organizations (NGOs), the private sector and individuals should cooperatively prevent any further loss of the integrity of the basin's remaining wetland ecosystems.

#67. Quinte watershed municipalities should provide protection of the shoreline and streambanks within their jurisdiction by designating in their Official Plans a buffer strip setback of 15 metres or greater to be maintained undisturbed as a natural protection zone.

#68. Municipalities in the Quinte basin, the MNR and MMAH should work cooperatively to maintain existing natural wildlife corridors and explore opportunities to create additional corridors, especially those that would link to coastal wetlands and public shorelines.

Other opportunities for ecosystem enhancement should also be considered through RAP, government, Conservation Authority and other grass roots environmental programs.

7.3.3 Status of Municipal Planning Documents

The land use planning documents of a municipality are intended to guide the physical development of a community with proper regard for the natural, social and economic environments. Although the time frame of these documents varies among communities, it is generally between 10 to 25 years. Land use in the Mayhew Creek watershed, based on the designations outlined in the Official Plans of the City of Trenton, the Township of Murray and the Township of Brighton, is included as Map 13.

Currently, the City of Quinte West is in the process of developing its Official Plan. A draft plan was circulated for public and agency review in June, 2000. The municipality will review the comments provided, and revisions will follow. It is anticipated that the final draft will be

completed by the end of 2000. Once approved, the new plan will replace the Official Plans of the former municipalities. Meanwhile, the old Official Plans for Trenton and Murray will continue to apply for land use decisions in the Mayhew Creek watershed.

The Township of Brighton is also currently updating their Official Plan. As well, the Township and the Town of Brighton will be amalgamating in January 2001, and it is anticipated that the amalgamated Brightons will then produce a single Official Plan.

Township of Murray

Official Plan:

The Township of Murray Official Plan was approved by the Minister of Municipal Affairs on April 6, 1993. There are a number of land use designations which are applicable within the Mayhew Creek watershed.

Much of the watershed is designated as either "Agricultural" or "Rural" lands. The Agricultural designation predominantly permits agricultural uses and the construction of buildings associated with standard agricultural practices. The predominant land use permitted by the Rural designation is also agriculture. However, other uses permitted by this designation include limited residential, recreational, conservation, and rural commercial and industrial uses related to the maintenance of a rural economy.

The "Special Urban" designation found north of County Road 2 and east of 2nd Dug Hill Road identifies areas where significant concentrations of urban uses have developed in the past and/or where future concentrated urban development is proposed during the period of the Official Plan. The area south of the watershed boundary has already been partially developed, with the Walmart store in place on the northwest corner of the intersection. Areas within the Mayhew Creek watershed are likely to be used for future urban residential developments.

There are two types of industrial land designations in the watershed. "General Industrial" refers to industrial uses which are not considered to be offensive because of heat, smoke, noise, dust or transportation facilities. These same restrictions apply to the "Prestige Industrial" designation. In addition, developments with this designation must not have an adverse effect on the adjoining agricultural and rural lands. Industries within the latter designation should also benefit from the increased visual prominence of being located on a major highway corridor or should enhance the visual appeal of the Township, hence the term "Prestige."

A large pond and wetland area west of Fraser Road is designated as "Environmental Protection." This designation does not permit development and these lands are intended for the conservation and preservation of the natural environment. Other permitted uses under this designation include agriculture, nurseries and market gardening, forestry, recreation, wildlife management areas, and parks.

Comprehensive Zoning By-law:
The Township of Murray Comprehensive Zoning By-law was passed by Council on June 29, 1978. There are a number of zone classifications which are applicable in the Mayhew Creek watershed.

The predominant zones in the watershed are the "General Rural (A2)" and "Restricted Rural (A1)" zones. These zones permit a number of rural land use types, such as agriculture, conservation and public uses. Barry Heights subdivision is currently zoned "Special General Residential" (R2 and R3). This zone permits single family detached (R2) or semi-detached (R3) dwellings.

Other land use zones in the study area include Highway Commercial, Light Industrial, and General Industrial. There are no "Environmental Protection" (EP) zones in the Mayhew Creek watershed. The watershed plan presents an opportunity to identify areas that should be placed in the EP zone.

City of Trenton
Official Plan:
The City of Trenton Official Plan was approved by the Minister of Municipal Affairs on August 8, 1972. A number of major updates and comprehensive amendments have been undertaken since that time, with the most recent major amendment occurring in 1996.

In terms of land use policies, in addition to general policies, this Official Plan divides the City into a number of planning districts, with each district having policies that are more applicable to that specific area. The portion of the Mayhew Creek watershed that is located within the City of Trenton is covered by Planning District 3A, 3B and 4. According to the Official Plan, the predominant designated land use within District 3A is low and medium density residential uses, whereas District 3B represents the major commercial and industrial area in the northwest section of Trenton. The predominant land use intended in District 4 is low density residential with some commercial use.

Comprehensive Zoning By-law:
The City of Trenton Comprehensive Zoning By-law was passed by Council in 1977. Since that time, there have been a number of updates and consolidations. There are a number of zones which are applicable in the Mayhew Creek watershed.

Lands located in Planning District 3B are primarily zoned as "Commercial" with some "Industrial" areas. Those portions of land located within Planning District 3A and 4 are predominantly zoned "Residential" with varying allowable densities. The lands immediately adjacent to the creek are zoned "Environmental Protection." This zone does not permit development, except for structures that are necessary for the preservation and conservation of the land.

Township of Brighton

Official Plan:

The Official Plan of the Township of Brighton was enacted and passed by Council on July 18, 1985, and has been amended several times. The most recent amendment was in 1992.

Most of the watershed area in the Township of Brighton is classified as either "Agricultural" or "Rural." The definitions for these classifications are similar to those contained in the Murray Official Plan and were described previously. There are a few interspersed areas that are designated as "Estate Residential", which means that the primary intended land use is for large single detached homes on large lots. Agriculture is also permitted on these lands, with the exception of intensive animal operations.

The area north of Hwy. 401 is designated as "Major Open Space." Permitted use under this designation includes public parks, conservation areas or wildlife management areas, and the buildings or structures associated with these uses. This particular area is the Brighton Provincial Wildlife Area.

Comprehensive Zoning By-law:

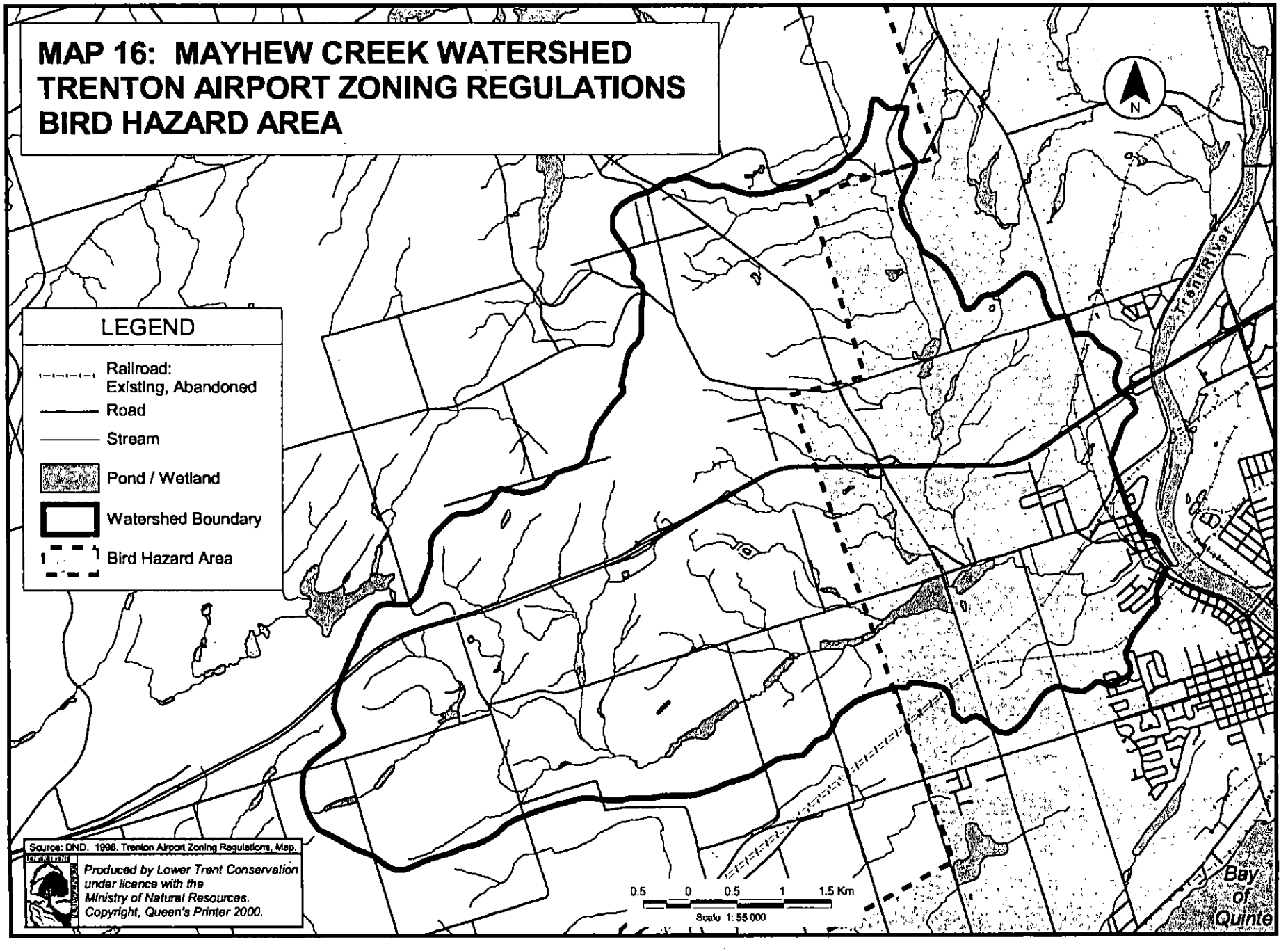
The zoning by-law of the Township of Brighton was completed in 1987. Lands within the study area have been zoned as "Rural," "Rural Residential," "Estate Residential," or "Open Space" according to the by-law. These zones closely follow the definitions outlined in the Official Plan.

Relevance to the Watershed Planning Process

For the purposes of the watershed plan, a review of all designations and zoning will be required to determine their accuracy and suitability. As the area adjacent to Trenton Ward urbanizes, it may be necessary to develop a secondary plan which would be based on the results of the watershed plan.

7.3.4 Trenton Airport Zoning Regulations

In order to minimize the hazard that birds present to the operation of the air strip at CFB Trenton, regulations are in place to restrict the size of ponds within the area shown on Map 16. These regulations apply to portions of the Mayhew Creek watershed. Open water storage reservoirs may be permitted in the delineated zone, if the total surface area of the reservoir does not exceed 1 ha, or the reservoir is not used for water storage for a period in excess of 48 hours (DND 1998). This has implications in terms of stormwater management in the urbanized area of the watershed.


MAP 16: MAYHEW CREEK WATERSHED
TRENTON AIRPORT ZONING REGULATIONS
BIRD HAZARD AREA
LEGEND
Railroad: Existing, Abandoned
Road
Stream
Pond / Wetland
Watershed Boundary
Bird Hazard Area
N
Trent River
Bay of Quinte
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Source: DND. 1998. Trenton Airport Zoning Regulations, Map.
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AVAILABLE INFORMATION
Hallworth 2000. *Sustainable Forest Management Initiative for the County of Northumberland.*
MNR 1997. *Aggregate Resources Inventory (Map - Available at Peterborough District MNR).*
QRAP 1993. *Stage 2 Report, Time to Act.*
CONTACTS
Art McKay, Area Planner (City of Quinte West)
Gary McLaren, Aggregate Resources Specialist (MNR, Peterborough District)
Ed Woods, Manager of Planning Services (City of Quinte West)

8.0 Watershed Issues

In developing this report, issues and concerns have been identified through the review of available information, field investigations, and consultation with the public, the local municipality and other agencies. The issues, and recommendations on how these might be addressed, are listed below. In a number of instances, further studies supplementing the background data are required to address specific issues. In other cases, developing a series of recommendations based on existing information will help to address the issues. Developing and implementing stewardship and public education programs will help to address many of the issues identified. Adopting and enforcing appropriate environmental policies will also help protect the natural ecosystem of the watershed and protect landowners from flooding and erosion hazards.

8.1 ISSUES IDENTIFIED AND RECOMMENDED ACTIONS

The issues discussed below represent a complete list of the issues identified by this *State of the Watershed Report*. While it is recognized that not all of these issues can be addressed through the Watershed Plan, many can be addressed through other municipal, conservation or agency programs.

8.1.1 Flooding and Surface Water Quantity

A number of issues related to the flooding of property and surface water quantity have been identified in the preparation of this *State of the Watershed Report*. The existing flood plain mapping for the watershed is outdated, and does not extend to include areas upstream of the Mill Pond (located between Wooler Road and 2nd Dughill Road). The flooding of lands adjacent to watercourses, due to storm events and spring runoff, is a concern for many landowners. The potential for rapid fluctuations in stream flow exists in the watershed. Such events may occur due to a dam breach of a beaver or man-made pond. Resulting flood events can lead to the loss of property, and in extreme cases, the loss of life if proper precautions are not taken.

In urban areas, the infiltration of stormwater is often greatly reduced. This leads to more severe flooding in the spring and following storm events. As well, changes in the typical annual flow regime of Mayhew Creek may be occurring and have not been fully quantified.

- Update the flood plain mapping for the areas that are currently covered.
- Extend the flood plain mapping to cover areas upstream of the Mill Pond.
- Establish development setbacks adjacent to small tributaries that are not included in the flood plain mapping.
- Continue to monitor stream discharge for all seasons. Analysis of existing data and additional monitoring will provide accurate estimates of base flow, spring runoff, and the response to frequent low intensity storm events.

8.1.2 Surface Water Quality

It is unknown if the tributary water quality goals proposed by the QRAP are being met for Mayhew Creek. The fouling of waters with chemical pollutants from point and non-point sources impairs human use of the water, affects suitability for biota, and reduces the aesthetic appeal of the watershed.

- Re-establish and expand the water quality monitoring program that was formerly administered by the MOE and QRAP.

8.1.3 Groundwater Resources

The status of the groundwater resources in the study area is largely unknown. This includes both the quality and the quantity of groundwater that is available. Some land owners indicated that bacterial contamination of their well water was a major concern. The loss of recharge and discharge areas to development compromises the integrity of the area's groundwater resources.

- Initiate a study of groundwater quantity and quality for the watershed area.
- Identify all recharge and discharge areas.
- Determine the location of rural water wells that did not include UTM coordinates in the MOE database obtained from the City of Quinte West. This information is required before the above groundwater study can proceed.
- Incorporate stormwater management practices to meet the water quantity and quality criteria established by QRAP.

8.1.4 Stormwater Management Strategies

Due to the impervious nature of many urban areas, storm water often flows rapidly overland to the nearest watercourse. This means that large volumes of water and contaminants are quickly mobilized in the channel, and rain water is not able to replenish groundwater reserves through infiltration. Thus, a strategy is required to provide a stormwater management framework that will prevent the impairment of surface and groundwater resources of the developing areas in the watershed.

- The Watershed Plan should include a full Stormwater Management Strategy.
- The Stormwater Management Strategy must consider the Trenton Airport Zoning Regulation for much of the watershed.
- Stormwater management practices must meet the water quantity and quality criteria established by QRAP.

8.1.5 Natural Hazards

The erosion of stream banks causes the loss of private property, has negative impacts on water quality, disrupts aquatic habitats, and is aesthetically unpleasing. Erosion and sedimentation may

be exasperated on construction sites, as it is often necessary to remove much of the natural vegetation cover.

- Adopt and enforce appropriate environmental planning policies.
- Ensure that federal, provincial and local regulations are enforced.

8.1.6 Aquatic Habitats

Protecting the integrity of aquatic habitats is essential for maintaining healthy populations and communities of fish and other organisms. Dams and on-line ponds create a barrier to fish migration. Both on- and off-line ponds, without bottom draws, cause excessive increases in water temperature. Excessive instream sedimentation (often related to stream bank erosion - see Section 8.1.5) can cover vital habitat features, such as gravel substrate, which is important for fish spawning and many species of invertebrates. The introduction of exotic species often results in the displacement of valuable native species.

- The Watershed Plan should include an assessment of available aquatic habitats. This should include fish community sampling and a temperature profile for the stream.
- Ensure that federal, provincial and local regulations are enforced.
- Develop proactive private land and water stewardship programs.

8.1.7 Natural Heritage Protection

The Watershed Plan must recognize the importance of protecting and maintaining natural habitat areas, including forested lands and wetlands, for wildlife use and aesthetic purposes. The loss of forest species diversity (both plants and animals) has a negative impact on the natural function of the ecosystem. It will be necessary to reduce forest fragmentation and promote the maintenance of natural corridors for wildlife migration to reduce the loss of native species.

- Ensure that federal, provincial and local regulations are enforced.
- Inventory and evaluate any wetlands or natural areas that are identified as significant through the Natural Heritage Strategy, which is currently being developed for the City of Quinte West and neighbouring municipalities.
- Ensure that sensitive natural areas (Significant Natural Areas, ANSI's, wetlands, and deer wintering areas) are identified in planning documents along with policies to protect them.

8.1.8 Fish and Wildlife

The status of populations and the composition of communities of fish and wildlife in the watershed are largely unknown. Numbers of some species may be too low to maintain viable populations of these species in the future. Wildlife management, as well as the control of certain "pest" species, such as beaver, were identified as concerns of some of the landowners surveyed.

- Update the fish survey data that was last collected in the 1970's.
- Protect aquatic habitats (see Section 8.1.6) through planning and the enforcement of regulations.
- Complete surveys of the other wildlife present in the watershed (mammals, birds and herptofauna).
- Update wildlife habitat mapping for features such as deer wintering yards.
- Ensure that rare, vulnerable and endangered species are identified and policies are in place to protect these.

8.1.9 Agriculture

Activities related to livestock operations can contribute to bacterial and nutrient problems. Agricultural best management practices need to be followed to protect surface water and groundwater resources. Runoff and erosion from croplands leads to the loss of valuable agricultural soils and contributes to the nutrient enrichment of area streams.

- Develop/implement proactive private land/water stewardship and public education programs.

8.1.10 Aggregate Resources

Many land uses are incompatible with the extraction of aggregate resources, and may prevent future extraction. As well, many of the abandoned aggregate pits in the watershed have not been rehabilitated at the present time.

- Ensure that planning policies are in place to protect high quality aggregate deposits.
- Develop proactive private land and water stewardship, and education programs.

8.1.11 Recreation and Aesthetic Amenities

Recreational lands are an important consideration for the well-being of residents and visitors. Although there are recreational opportunities in the watershed, many of these are not well known or are not highly visible. A number of issues related to the maintenance and use of recreational lands need to be addressed. Excessive maintenance, and the use of herbicides and pesticides in parks and recreational areas can have a negative effect on water quality and other aspects of the natural environment. The integrity of natural areas may be compromised by certain types of recreational activities (e.g. hiking or mountain biking on fragile lands, the use of recreational vehicles). As well, litter is a common problem in areas that are used for human recreation.

- Identify new recreational opportunities in the watershed.
- Develop proactive public land stewardship and education programs for parkland/greenspace managers.
- Identify potential links among existing trails, proposed trails and the Waterfront Trail.

8.1.12 Provincial and Regional Environmental Policies and Strategies

The QRAP and the Provincial Policy Statement must be considered in developing the Mayhew Creek Watershed Plan.

- Continue to apply and implement the recommendations for tributary nutrient management and stormwater management contained in the QRAP Stage 2 Report.
- Apply all relevant portions of Section 2 (Resources) and Section 3 (Public Health and Safety) from the Provincial Policy Statement.
- Identify sections of the municipal Official Plans and Zoning By-laws that are incompatible with the watershed plan, and recommend appropriate modifications to the municipal documents.

8.2 ADDRESSING THE KEY ISSUES

In order to address the issues identified in this report, a Watershed Plan should be completed for Mayhew Creek. The watershed plan should be comprised of a set of recommendations to address the environmental issues, which were developed in consultation with the Municipality, agencies and watershed community. In some cases, further studies are required before recommendations can be proposed.

The Watershed Plan should include a series of recommendations to achieve environmental protection through:

Municipal Planning

The identification of those areas that are subject to the natural heritage and natural hazard policies of the Provincial Policy Statement and Lower Trent Conservation can be completed through the development of the watershed plan. Once the environmental features are identified, the watershed plan can provide recommendations for updating the municipal planning documents.

Land/Water Stewardship and Public Education

The watershed plan should include a number of recommendations emphasizing the importance of good private land/water stewardship practises and public education. In many cases, good stewardship practices and public education will have a profound effect in rectifying the issues and concerns identified in this report.

Recommended Inventories and Studies:

Flood plain Mapping

Updating the flood plain mapping for Mayhew Creek has been identified as the most pressing issue in developing the watershed plan. The current mapping is outdated, as the hydrology of the lower watershed has been altered extensively in recent years. As well, the original mapping did not include any areas upstream of the Mill Pond. Due to increased rural development and the

expansion of urban developments, some of these areas should be included in the revised flood plain mapping. Based on the future development scenario provided by the City of Quinte West, it appears that extending the flood plain mapping upstream to Fraser Road would be appropriate. Providing flood plain mapping for the tributary that flows into the Mill Pond from the north should also be considered due to development pressures on the east side of Wooler Road.

Fisheries and Fish Habitat Inventories

It is extremely unlikely that the fish community structure and the type of habitat available has remained unchanged since the last fish survey was conducted in the 1970's. An inventory of the fish community should be completed during the spring and early summer using a method that allows the standardization of sampling effort, such as electrofishing. A second survey of the fish community in the fall may be desirable to check for seasonal differences. Habitat reaches should be quantified using a standard method in the late summer or early fall.

Groundwater Resources Inventory

A thorough study and inventory of the groundwater resources in the watershed are needed. Some of the required data related to water quality and quantity are available from the City of Quinte West in the form of well water records. These data need to be analyzed and supplemented to provide a better understanding of this valuable resource. A preliminary study of the groundwater resource should be undertaken as part of the Watershed Plan.

Surface Water Quality Sampling

The MOE established a tributary water quality monitoring program as part of the Bay of Quinte Remedial Action Plan. Although the monitoring program was discontinued, other recommendations from the QRAP are continuing to be implemented by Lower Trent Conservation and other agencies. Without the water quality monitoring program, the effectiveness of these remedial actions is difficult to quantify. Thus, re-establishing the tributary monitoring program at one or more sites on Mayhew Creek would be a worthwhile endeavour. Also, collecting benthic invertebrates would allow the effects of water quality on the biology of the watershed to be assessed. Invertebrates could be collected by LTC staff and, if desired, preserved and analyzed (by a private lab/contractor) in the future when management issues dictate. A survey of benthic invertebrates is the best way to assess the effects of changes in water quality.

Stormwater Management Strategy

Stormwater management is an additional issue that requires further study. A strategy is needed for the developing areas to help address stormwater management in a comprehensive fashion, and in a manner that meets the water quality and quantity criteria set out by the QRAP. With an overall strategy in place, developers will be able to work together to make better use of their land and reduce the number facilities required. Based on the future development scenario provided by the City of Quinte West, it appears that there are six areas that are likely to experience development pressures in the near future. The Watershed Plan should include Stormwater Management Strategies for each of these six areas.

9.0 Scope of the Watershed Plan: Recommended Approach

This *State of the Watershed Report* is the first phase of the Watershed Plan. Existing information has been collected and summarized and the watershed issues identified. The scope of the watershed plan and recommended approach can now be outlined. This includes: a preliminary project outline, estimated costs, and roles and responsibilities of the various players.

The proposed work plan and costs should be reviewed by a steering committee, consisting of the major stakeholders, prior to commencing the project.

9.1 PRELIMINARY PROJECT OUTLINE FOR MAYHEW CREEK WATERSHED PLAN

9.1.1 Time-frame

To allow adequate time for data collection, a minimum of one year will be required to complete the Watershed Plan. An alternative is to complete the project over two years, spreading the project costs over a longer period. This would provide more time for data collection and consultation with the public.

9.1.2 Issues

The main issues to be addressed in this study relate directly to future development and its compatibility with the natural environment. Stormwater management and flood plain mapping are two of the key issues that will need to be addressed through engineering studies. Additional recommended studies include: fisheries and fish habitat assessments, groundwater resources inventory, and surface water quality sampling. These studies are imperative for determining the health of the watershed, not only for biota, but also for the people living in the area.

Appropriate recommendations will need to be developed to assist the municipality with interpretation and implementation of the Provincial Planning Policies as it applies to Natural Heritage, Natural Hazards and Water Quality and Quantity issues. Recommendations for the protection and enhancement of the natural heritage features through stewardship and education, and identification of recreation opportunities should be developed as part of the Watershed Plan. Reference should also be made, where appropriate, to the Quinte Remedial Action Plan Stage 2 Report, and applicable recommendations highlighted.

9.1.3 Objectives

The objectives of the Mayhew Creek Watershed Plan are:

- To ensure that development within the Mayhew Creek Watershed contributes to improving the health of the watershed and the Bay of Quinte.

- To help achieve a balance between ecosystem health and human land use patterns.

- To bring together all the players - interested citizens, developers, community groups, agencies and the municipality - to develop a consensus on what the Mayhew Creek watershed should look like in the future, and to identify the means of reaching that vision.

- To identify environmental objectives upfront: with a watershed plan in place, developers will know what criteria they will have to meet, which will help eliminate lengthy review periods and delays.

- To increase public awareness of watershed planning and the ecosystem approach. Individual landowners will have access to information that will help them manage their properties in a manner that respects and enhances the watershed ecosystem.

- To cut the costs of development. Compared with the *ad hoc* way of land use planning, watershed planning saves money. While the initial start up costs are high, implementation and maintenance costs are quite reasonable compared with the repetitive high costs of dealing with individual situations as they arise (numerous, small, unrelated environmental studies, law suites and remedial infrastructure).

- To provide the municipality with technical information that will help it "have regard to" the *Provincial Policy Statement*, issued under the Planning Act, when making land use planning decisions.

9.1.4 Data Collection and Studies

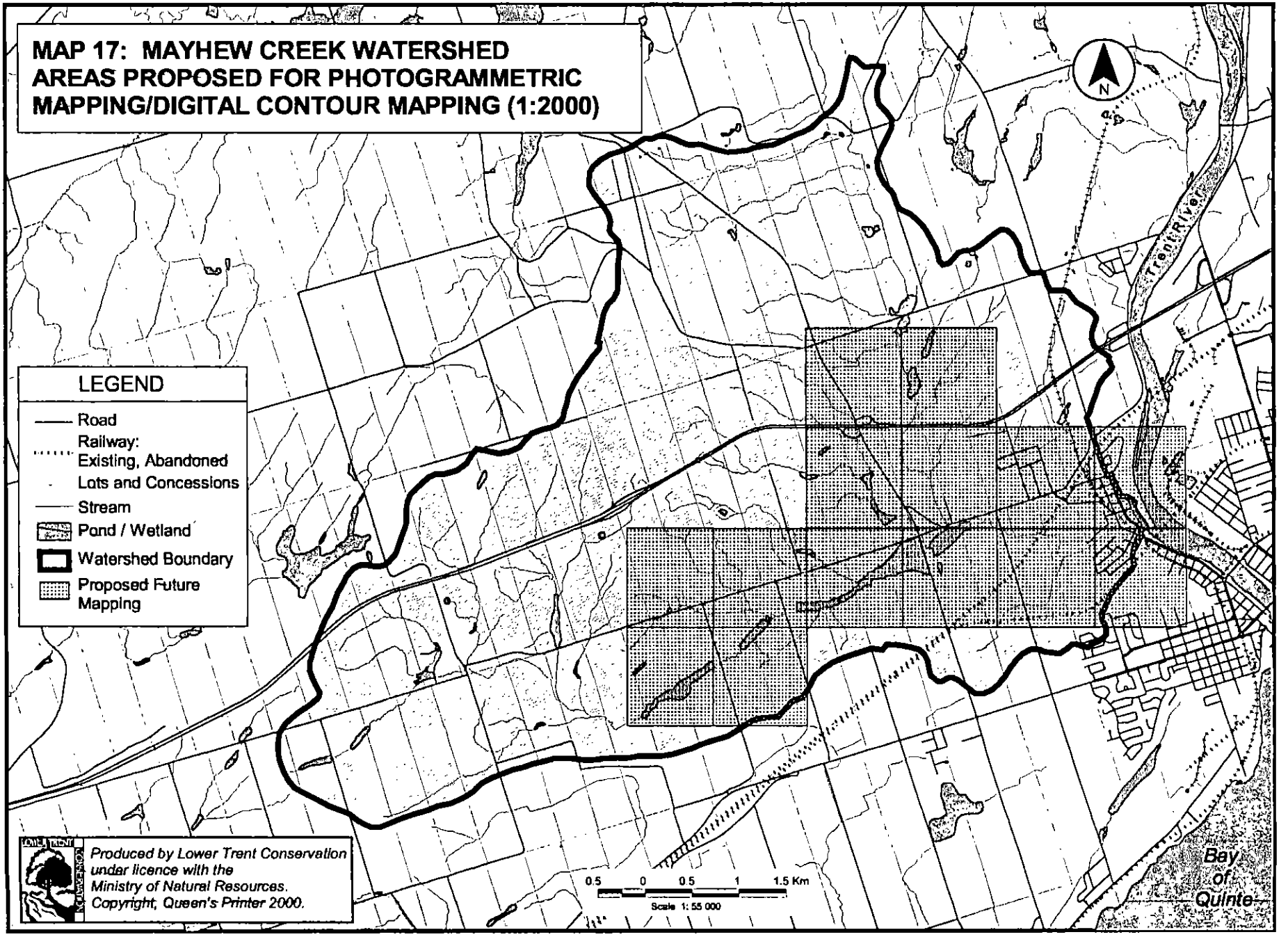
In developing the *State of the Watershed Report*, available information on the watershed was identified and collected. The following additional information and studies are needed to complete the Watershed Plan:

Contour Mapping

Contour mapping (at a scale of 1:2000) has been completed for the urban ward of Trenton, but is quite dated (1984). This mapping is not in digital format and does not cover all of the areas with potential for development. Contour mapping (at a scale of 1:2000) should be completed, in digital form, for the area between Trenton and Wooler Road where urban expansion is likely to occur, as well as the lands owned by Fraser Glenburnie Ltd. (Fraser Road at Telephone Road) that are proposed for industrial use. The area where digital contour mapping should be completed is indicated in Map 17. Consultants will be hired to undertake the mapping project. The mapping should be done at a scale of 1:2000, with 1 metre contour intervals to OBM/FDRP specifications.

Flood Plain Mapping

The flood plain mapping for Mayhew Creek needs to be updated and extended to include the developing areas mentioned previously. Based on the engineering studies, the flood plain would be plotted on the contour maps (identified above) to FDRP standards.


MAP 17: MAYHEW CREEK WATERSHED
AREAS PROPOSED FOR PHOTOGRAMMETRIC
MAPPING/DIGITAL CONTOUR MAPPING (1:2000)
N
Trent River
LEGEND
Road
Railway: Existing, Abandoned
Lots and Concessions
Stream
Pond / Wetland
Watershed Boundary
Proposed Future Mapping
Produced by Lower Trent Conservation
under licence with the
Ministry of Natural Resources.
Copyright, Queen's Printer 2000.
0.5 0 0.5 1 1.5 Km
Scale 1: 55 000
Bay of Quinte

Stormwater Management Strategy

The subwatersheds within the study area need to be assessed in terms of hydraulic parameters, to determine the rainfall/runoff response of the watercourses. Consultants will be hired to determine the hydrology of the various sub-basins for the six areas identified for development. The consultants will develop a stormwater management strategy that takes watershed considerations into account. The ability of natural areas to assimilate runoff and pollutants will need to be assessed. Maintenance of robust and viable natural areas will be encouraged in the overall stormwater control strategy to offset mechanical or man-made systems.

Stormwater management alternatives which satisfy the water quality and quantity criteria set out by the Bay of Quinte Remedial Action Plan will be identified by the consultant. Environmental and engineering studies will be undertaken to determine the preferred combination of stormwater management facilities, best management practices and use/preservation of natural areas.

The consultants will provide preliminary engineering for the works proposed in the preferred stormwater management alternative, including cost estimates, target flows, land requirements, grading requirements and structural works, in sufficient detail to allow the document to be used as guidelines for final design.

A stormwater strategy implementation plan will also be developed that includes phasing, cost-sharing, responsibilities, and post-development monitoring.

For those areas that are likely to remain rural beyond the life of the Watershed Plan, recommendations relating to stormwater and drainage will be general in nature, and will be based on the recommendations set out by the Bay of Quinte Remedial Action Plan.

Water Quality

A water quality sampling program for Mayhew Creek should be re-established to document background conditions and as a basis for monitoring change. Sampling can be done by LTC staff with analyses at a private lab. A survey of benthic invertebrates would provide a more complete picture of the effects of water quality on the biology of the watershed.

Fisheries and Fish Habitat Inventories

Since a fish survey has not been completed since the 1970's, this study should be undertaken to help establish criteria to minimize impacts of development. This study can be undertaken by LTC staff.

Groundwater Resources Inventory

The quality and quantity of groundwater is emerging as a major environmental issue because of the increased frequency of drought in the past few years, the potential future impacts of climate change, increased public awareness of water taking issues, and groundwater quality issues in other jurisdictions. Since many people in the watershed rely on private wells for their drinking supply, an inventory of the watersheds groundwater resources should be completed. The Groundwater

Resources Inventory would be completed by a consultant or through hiring of a short-term specialist in the field.

9.1.5 Watershed Plan Mapping

Mapping for the Watershed Plan will be completed in digital format (ArcView) by LTC staff.

9.1.6 Preparation of the Watershed Plan

Development of the Watershed Plan will require synthesis of all the available information, studies and reports. Recommendations for the plan will be made based on the information obtained. It will be necessary to identify:

- development opportunities and constraints
- water quality and quantity criteria for future development
- regulatory flood plains
- a stormwater management strategy
- preferred methods of protecting ecosystems
- remedial actions to restore and protect the Bay of Quinte
- recommendations for delineation of environmental protection designations and zones
- stewardship recommendations
- recreational opportunities
- an implementation plan
- a monitoring plan

9.2 ROLES AND RESPONSIBILITIES

9.2.1 Steering Committee

A Steering Committee, consisting of representatives from LTC, the City of Quinte West, and the QRAP will guide the development of the Watershed Plan. The Steering Committee will be responsible for making sure that the project is proceeding within the projected time lines and budget. They will also ensure that the views of other stakeholders (agencies, developers and the public) are given due consideration, and that the final plan makes recommendations that are locally acceptable. Special meetings may have to be scheduled at certain times during the development of the Watershed Plan to consult with key community groups and other agencies.

9.2.2 Lower Trent Conservation

Lower Trent Conservation is prepared to act as Project Manager for the Watershed Plan. As Project Manager, the LTC would be responsible for:

- overall coordination of the project (including technical and financial management)
- liaising with stakeholders (government agencies, interest groups, developers, public)
- development and implementation of a public consultation program
- establishment of a Steering Committee

- development of terms of references for consultant studies in consultation with the Steering Committee
- liaising with consultants
- formulating recommendations to address issues to present to the Steering Committee
- writing draft and final reports

Lower Trent Conservation would also:
- provide Geographic Information Services (GIS) to complete the mapping
- collect water quality samples and interpret the results
- conduct a fisheries assessment

9.2.3 Consultant Studies

LTC would be responsible for hiring specialists to complete specific technical studies, including:
- Contour Mapping
- Flood Plain Analysis/Mapping
- Stormwater Management Strategy
- Groundwater Resources Inventory

9.3 ESTIMATED COSTS

Table 5 includes items for the proposed work plan and an estimate of the costs for completing the Mayhew Creek Watershed Plan. LTC recommends that all of the identified components be included in the Watershed Plan. All components of the natural environment (this includes the physical, biological and the human elements of the environment) are interconnected and should be viewed as a whole. This approach will foster a more accurate understanding of the watershed level processes that affect downstream areas, and will provide a better basis for making planning decisions.

However, depending on the available budget and the priorities of the City of Quinte West, it may be possible to reduce costs by considering options such as those described below. The various studies needed to complete the Watershed Plan could be staggered over a period of several years to reduce the financial burden in any one fiscal year. Alternatively, the City may wish to concentrate on only a portion of the watershed, for example the area located downstream of either Wooler Road or 2nd Dug Hill Road. While this is not the ideal approach, it would reduce the costs associated with virtually all components of the Watershed Plan. Some upstream areas may need to be assessed, as upstream processes affect land use in downstream areas, but the studies could be focussed in the developing area. It is recommended that City and Conservation staff meet to discuss various options and timing of the project.

Table 5. Proposed work plan and estimated costs for the Mayhew Creek Watershed Plan.

PROJECT COMPONENT	TASKS	ESTIMATED COSTS
Project Management	• project coordination • administrative costs (preparation for meetings, agenda, minutes) • oversee consultant studies • data/file management • correspondence/reports	**$10 000**
Photogrammetric Mapping/Digital Contour Mapping (1:2000)	• area to be mapped (future development and downstream areas) covers 14 OBM sheets at 1:2000	**$30 800** (14 sheets x 100 ha/sheet x $22.00/ha + GST)
Flood Plain Analysis/ Mapping (hydrology/hydraulics)	• field surveys • hydrology and hydraulic investigations • flood and fill line delineation	**$30 000**
Stormwater Management Strategy	• proposed location of facilities • preliminary sizing of facilities • consultation with landowners • recommendations	**$30 000** ($6000 x 5 areas of future development)
Groundwater Resources Inventory	• preliminary assessment of the groundwater resource	**$10 000**
Water quality assessments (to determine background water quality data - parameters: general chemistry, selected dissolved metals & anions, bacteria)	**Sub-total:** • site selection • collection of samples (6 sites) • lab costs fro analysis of samples (private lab) • benthic invertebrates - collection (14 sites) - lab analysis (56 samples @ $75.00/sample) • compile & interpret data	**$26 800** $200 $2400 (8 hrs x 12 samples) $16 200 ($225/sample x 6 sites x 12 months) $2800 (2 people x 14 hrs x 2 reps x 2 samples) $4200 (private lab) $1000

Fish Habitat Assessments (14 sites)	**Sub-total:** • site selection • habitat assessments - methodology - field work (for 13 sites) • fish community assessment (electrofishing/seine - 14 sites) • interpretation of results	**$10 200** $200 $200 $2800 (2 people x 56 hrs) $6000 (3 people x 40 hrs x 2 samples) $1000
Public Consultation	• newsletters, questionnaires • media coverage/ads • open houses/public meetings • displays	**$3000**
Preparation of Final Plan	• draft report and final plan • mapping for report	**$9000**
Mileage, Equipment, Supplies	• mileage • postage • equipment rental • shipping costs (for water/benthic samples) • phone calls, office supplies	**$2000**
TOTAL PROJECT COSTS		**$161 800**
* LTC staff time @ $25.00/hour		

9.4 WORK PLAN

Phase 1

1. Establish Steering Committee: Representatives from the City of Quinte West, QRAP and LTC should form the Steering Committee.

2. Develop a *Terms of Reference* based on the project outline in this report and identify available funding.

3. Steering Committee review/revision of *Terms of Reference*.

4. Initiate water sampling/surface water monitoring programs (this should be done as soon as possible, once funding is available).

5. Initiate Public Consultation Program:

- Public Information bulletin/fact sheet
- Public Meeting/Open House

6. Initiate consultant/in-house studies
   - fisheries assessments*
   - groundwater inventories
   - contour mapping
   - flood plain mapping
   - stormwater management strategy

*once funding is confirmed, the fisheries assessment should be initiated to allow for a fall and spring field season.

Phase 2

1. Continue consultation with the public

2. Complete consultant/in-house studies

3. Initiate GIS mapping

4. Identify recommendations for:
   - updating municipal planning documents
   - enhancing natural areas
   - recreation opportunities
   - implementing the Remedial Action Plan
   - implementing the stormwater/drainage plan

5. Identify roles and responsibilities of various players

6. Develop an implementation and monitoring plan

7. Complete the final plan/mapping

9.4 PROJECT INITIATION

Upon completion of this report, a meeting should be held between the City and Conservation Authority to identify potential funding and determine when the Watershed Plan should be initiated. A *Terms of Reference*, along with a project budget, should be developed at this meeting based on the recommendations of the State of the Watershed Report.

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Appendix 1 - Available Mapping and Aerial Photography

National Topographic Series (NTS)
Surveys and Mapping Branch, Department of Energy, Mines and Resources
1991 Series - Data accurate as of 1988 (Scale 1:50 000)
1970 Series - Data accurate as of 1967 (Scale 1:25 000)

Ontario Base Mapping (OBM)
Surveys and Mapping Branch, Ontario Ministry of Natural Resources
1984 Series - Aerial Photography: 1982 (Scale 1:2000) - Trenton Area only
1982 Series - Aerial Photography: 1979 (Scale 1:10 000)

Mayhew Creek Flood Plain Mapping
Lower Trent Region Conservation Authority
1976. Aerial Photography: 1974 & 1976 (Scale 1:2000)

Ministry of Environment and Energy
Overburden Well Yields - Lake Ontario Drainage Basin. Map 5926-2 (Scale 1:500 000)

Ontario Geological Survey
The Physiography of Southern Ontario, 3rd Ed. Map P.2715 (Scale 1: 600 000)

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Soil Research Institute, Research Branch, Canada Department of Agriculture
1966. Soil Capability for Agriculture. Catalogue No. En 64/2-31C.
1966. Soil Capability for Wildlife - Ungulates. Catalogue No. RE 64/4u-31C.
1966. Soil Capability for Wildlife - Waterfowl. Catalogue No. RE 64/4w-31C.

Aerial Photographs
1953. Lines 4404-4407 (Scale 1:12 000)
1969. Lines 4405-4409 (Scale 1:12 000)
1993. Lines 7-11 (Scale 1:10 000)
1999. Lines 4-11 (Scale 1:8000)

Appendix 2 - Contacts

Lower Trent Conservation:

Barry Jones, QRAP Habitat Coordinator
Mike Lovejoy, Watershed Monitoring Technician
Glenda Rodgers, Watershed Planner

441 Front St., Trenton, ON, K8V 6C1

Tel: (613) 394- 4829
Fax: (613) 394-5226

Ministry of the Environment:

Bruce Metcalfe, Senior Environmental Officer (Water Resources Unit)

133 Dalton Ave., PO Box 820, Kingston, ON, K7L 4X6

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Ministry of Natural Resources:

Karen Bellamy, Area Biologist (Peterborough District)
Gary McLaren, Aggregate Resource Specialist (Peterborough District)

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300 Water St., Peterborough, ON, K9J 8M5

City of Quinte West (Murray Ward Office):

Art McKay, Area Planner
Ed Woods, Manager of Planning Services

P.O. Box 490, Trenton, ON, K8V 5R6

Tel: (613) 392-4435
Fax: (613) 392-7151

Quinte West Public Utilities Commission:

Steve McDonald, Supervisor of Plant Operations & Water Quality

18 Pelham St., Trenton, ON, K8V 5A7

Tel: (613) 392-4978
Fax: (613) 392-8321

Appendix 3 - Landowner Survey

1.0 Please indicate your location below and on the attached map

Municipal Ward: ☐ Trenton ☐ Murray

Street Address: _____

Lot and concession (Murray Ward): _____

2.0 Flooding and Drainage

2.1 If a watercourse passes through your property, please complete Section 2. A watercourse may include an area that is wet seasonally, but dry for part/most of the year, or the watercourse may exist as a permanent or seasonally flooded area.

i) Circle the following responses (A or B) that describes the watercourse through your property.

A. Dry part/most of the year
B. Water exists year round

ii) Is the creek presently being used for water supply purposes (e.g. irrigation, livestock, fishing)?

☐ YES ☐ NO

If yes, please indicate the type of use below.

_____

_____

2.2 Please indicate below if you have experienced problems with the following and how frequently these problems have occurred. Please indicate the approximate location on the attached map.

i) Surface / field flooding ? ☐ YES ☐ NO
Frequency: _____

ii) Basement / home flooding? ☐ YES ☐ NO
Frequency: _____

3.0 Erosion

Are you aware of any erosion problems in the watershed? If yes, please explain below and indicate the approximate location on the map.

_____

_____

_____

4.0 Natural environment

4.1 Are there any concerns related to fish and wildlife or pollution in the watershed? If yes, please explain below and indicate the approximate location on the map.

_____

_____

_____

4.2 Are there any interesting natural areas or features in the watershed that make it attractive or unique? Please describe and add the approximate location on the map.

_____

_____

_____

5.0 Well Water

Have you experienced problems with either the supply or quality of your well water? If yes, please indicate how frequently the problem occurs (e.g. once every year, once every three years, etc.).

A. Low supply: _____

B. Well water quality: _____

6.0 Land Use

6.1 Have you noticed any major changes to the overall use of the watershed?

☐ YES ☐ NO

If yes, please explain below.

_____

_____

_____

6.2 Have you changed the land use on your property in the last 10 years (e.g. pasture land to orchards, land developed, etc.)? Please explain below.

_____

_____

_____

6.3 Are you proposing to change the use of your property in the future? Please explain below.

_____

_____

_____

7.0 Future Initiatives

Are there any future changes that you would like to see in the watershed?

☐ Environmental Protection
☐ Less Development
☐ More Development
☐ Establishment of Greenspaces
☐ Other (Please Specify): _____

☐ Increased Erosion Control
☐ Water Quality Initiatives
☐ Wildlife Management
☐ Increased Flood Control

8.0 Additional Concerns / Comments?

_____

_____

_____

_____

9.0 Optional

Name: _____

Address: _____

_____

Telephone Number: _____

☐ I am interested in participating on a committee to assist in developing the watershed plan.

My interest in the watershed planning process is primarily related to issues involving:

☐ Future Development
☐ Nature/Land Conservation
☐ Agriculture
☐ Flood and Erosion Control
☐ Water Quality/Quantity
☐ Private Property
☐ Other (Please Specify): _____

☐ Please ensure that my name is on the mailing list, so that I may receive further information about the Mayhew Creek Subwatershed Plan.

For more information, contact: Jeff Brinsmead, Assistant Watershed Planner at 394-3915 ext. 20

Please return questionnaires to the Lower Trent Conservation Office or Quinte West (Murray Ward) Office by February 25, 2000 or mail to:

Jeff Brinsmead
Lower Trent Conservation
441 Front St.
Trenton, ON
K8V 6C1

Summary of the Mayhew Creek Questionnaire

In February 2000, 125 landowner questionnaires were mailed to residents/landowners of the Mayhew Creek watershed. Questionnaires were sent to all landowners with parcels of land greater than 14.2 hectares (35 acres), and a random sample of 30 Murray Ward landowners and 30 Trenton Ward landowners. Twelve questionnaires and one letter from a concerned landowner were returned to the Lower Trent Conservation office.

The following is a summary of the issues identified through the review of the questionnaires. It should be noted that some questionnaires were incomplete. The answers that were provided are included in the results below. Results indicate the number of respondents that considered each issue to be important in the development of the *Mayhew Creek Watershed Plan.*

ISSUE	RESPONDENTS
Development Less Development More Development	9 4 2
Agricultural Issues	4
Water Quality and/or Quantity	8
Nature and/or Land Conservation	7
Flood and/or Erosion Control	4
Private Property Issues	2
Wildlife Management	6
Reforestation	1

Appendix 4 - Fish Inventory

Mayhew Creek

American Brook Lamprey	*Lampetra lambada*
Blacknose Dace	*Rhinichthys cataractae*
Bluegill	*Lepomis macrochirrus*
Bluntnose Minnow	*Pimephales notatus*
Brook Stickleback	*Culaea inconstans*
Brook Trout	*Salvelinus fontinalis*
Brown Bullhead	*Ameiurus nebulosus*
Brown Trout	*Salmo trutta*
Chinook Salmon	*Oncorhynchus tshawytscha*
Coho Salmon	*Oncorhynchus kisutch*
Common Shiner	*Luxilus cornutus*
Creek Chub	*Semotilus atromaculatus*
Fallfish	*Semotilus corporalis*
Fantail Darter	*Etheostoma flabellare*
Largemouth Bass	*Micropterus salmoides*
Logperch	*Percina caprodes*
Longnose Dace	*Rhinichthys cataractae*
Northern Pike	*Esox lucius*
Northern Redbelly Dace	*Chrosomus eos*
Pearl Dace	*Semotilus margarita*
Pumpkinseed	*Lepomis gibbosus*
Rainbow Trout	*Salmo gairdneri*
Sea Lamprey	*Petromyzon marinus*
Walleye	*Stizostedion vitreum*
White sucker	*Catostomus commersoni*
Yellow Perch	*Perca flavescens*

Tremur Lake

Bluegill	*Lepomis macrochirus*
Brown Bullhead	*Ameiurus nebulosus*
Creek Chub	*Semotilus atromaculatus*
Golden Shiner	*Notemigonus crysoleucas*
Pumpkinseed	*Lepomis gibbosus*
Rock Bass	*Ambloplites rupestris*
White Sucker	*Catostomus commersoni*

Appendix 5 - Bird Inventory

Phalacrocoracidae (Cormorants)

Double-crested cormorant	*Phalacrocoruax auritus*

Ardeidae (Herons and Bitterns)

American Bittern	*Botaurus lentiginosus*
Great Blue Heron	*Ardea heodias*
Great Egret	*Casmerodius albus*
Green Heron	*Butorides striatus*

Anatidae (Waterfowl)

Canada Goose	*Branta canadensis*
Wood Duck	*Aix sponsa*
Green-winged Teal	*Anas crecca*
American Black Duck	*Anas rubripes*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Hooded Merganser	*Lophodytes cucullatus*

Cathartidae (American Vultures)

Turkey Vulture	*Carthartes aura*

Accipitridae (Hawks)

Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Coopers Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*

Falconinae (Falcons)

American Kestrel	*Falco sparverius*

Phasianidae (Quail)

Ring-necked Pheasant	*Phasianus colchicus*

Tetraonidae (Grouse)

Ruffed Grouse	*Bonasa umbellus*

Rallidae (Rails)

Virginia Rail	*Rallus limicola*
Common Gallinule (Moorhen)	*Gallinula chloropus*
American Coot	*Fullica americana*

Charadriidae (Plovers)

Killdeer	*Charadrius vociferus*

Scolopacidae (Sandpipers)

Spotted Sandpiper	*Actitis macularia*
American Woodcock	*Philohela minor*
Common Snipe	*Capella gallinago*

Laridae (Gulls and Terns)

Ring-billed Gull	*Larus delawarensis*
Common Tern	*Sterna hirundo*
Black Tern	*Chlidonias niger*

Columbidae (Pigeons and Doves)

Rock Dove (Domestic Pigeon)	*Columba livia*
Mourning Dove	*Zenaida macroura*

Cuculidae (Cuckoos)

Black-billed Cuckoo	*Coccyzus erythropthalmus*

Strigidae (Typical Owls)

Great Horned Owl	*Bubo virginianus*
Barred Owl	*Strix varia*
Short-eared Owl	*Asio flammeus*

Caprimulgidae (Goatsuckers)

Whip-poor-will	*Caprimulgus vociferus*
Common Nighthawk	*Chordeiles minor*

Apodidae (Swifts)

Chimney Swift	*Chaetura peligica*

Trochilidae (Hummingbirds)

Ruby-throated Hummingbird	*Archilochus colubris*

Alcedinidae (Kingfishers)

Belted Kingfisher	*Megaceryle alcyon*

Picidae (Woodpeckers)

Common Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Hairy Woodpecker	*Picoides villosus*
Downy Woodpecker	*Picoides pubescens*

Tyrannidae (Flycatchers)

Eastern Kingbird	*Tyrannus tyrannus*
Great-crested Flycatcher	*Myiarchus crinitus*
Eastern Phoebe	*Sayornis phoebe*
Willow Flycatcher	*Empidonax traillii*
Alder Flycatcher	*Empidonax alnorum*
Least Flycatcher	*Empidonax minimus*
Eastern Pewee	*Contopus virens*

Alaudidae (Larks)

Horned Lark	*Eremophila alpestris*

Hirundinidae (Swallows)

Purple Martin	*Progne subis*
Tree Swallow	*Iridoprocne bicolor*
Bank Swallow	*Riparia riparia*
Rough-winged Swallow	*Stelgidopteryx ruficollis*
Barn Swallow	*Hirundo rustica*
Cliff Swallow	*Petrochelidon pyrrhonota*

Corvidae (Jays and Crows)

Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*

Paridae (Titmice)

Black-capped Chickadee	*Parus atricapillus*

Sittidae (Nuthatches)

White-breasted Nuthatch	*Sitta carolinensis*
Red-breasted Nuthatch	*Sitta canadensis*

Certhiidae (Creepers)

Brown Creeper	*Certhia familiaris*

Troglodytidae (Wrens)

House Wren	*Troglodytes aedon*
Winter Wren	*Troglodytes troglodytes*
Marsh Wren	*Cistothorus palustris*

Mimidae (Mimic Thrushes)

Gray Catbird	*Dumetella carolinensis*
Brown Thrasher	*Toxostoma rufum*

Turdidae (Thrushes)

American Robin	*Turdus migratorius*
Wood Thrush	*Catharus guttatus*
Swainson's Thrush	*Catharus ustulatus*
Veery	*Catharus fuscescens*

Bombycillidae (Waxwings)

Cedar Waxwing	*Bombycilla garrulus*

Sturnidae (Starlings)

European Starling	*Sturnus vulgaris*

Vireonidae (Vireos)

Red-eyed Vireo	*Vireo olivaceus*
Warbling Vireo	*Vireo gilvus*

Parulidae (Wood Warblers)

Black-and-white Warbler	*Mniotilta varia*
Nashville Warbler	*Vermivora ruficapilla*

Northern Parula Warbler	*Parula americana*
Yellow Warbler	*Dendroica petechia*
Magnolia Warbler	*Dendroica magnolia*
Cape May Warbler	*Dendroica tigrina*
Black-throated Blue Warbler	*Dendroica caerulescens*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Green Warbler	*Dendroica virens*
Blackburnian Warbler	*Dendroica fusca*
Blackpoll Warbler	*Dendroica striata*
Pine Warbler	*Dendroica pinus*
Ovenbird	*Seiurus aurocapillus*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Northern Waterthrush	*Seiurus noveboracensis*
Mourning Warbler	*Oporornis philadelpia*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
American Redstart	*Setophaga ruticilla*

Ploceidae (Weaver Finches)

House Sparrow	*Passer domesticus*

Icteridae (Blackbirds)

Bobolink	*Dolichonyx oryzirorus*
Red-winged Blackbird	*Agelaius phoeniceus*
Eastern Meadowlark	*Sturnella magna*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Northern (Baltimore) Oriole	*Icterus galbula*

Thraupidae (Tanagers)

Scarlet Tanager	*Piranga olivacea*

Fringillidae (Finches)

Northern Cardinal	*Cardinalis cardinalis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Indigo Bunting	*Passerina cyanea*
Purple Finch	*Carpodacus purpureus*
House Finch	*Carpodacus mexicanus*
Pine Siskin	*Carduelis pinus*
American Goldfinch	*Carduelis tristis*
Rufous-sided Towhee	*Pipilo erythrophthalmus*
Savannah Sparrow	*Passerculus sandwichensis*
Grasshopper Sparrow	*Ammodramus savannarum*
Vesper Sparrow	*Pooecetes gramineus*
Northern (Dark-eyed) Junco	*Junco hyemalis*
Chipping Sparrow	*Spizella passerina*
Field Sparrow	*Spizella pusilla*
White-throated Sparrow	*Zonotrichia albicollis*
Swamp Sparrow	*Melospiza georgiana*
Song Sparrow	*Melospiza melodia*

Appendix 6 - Mammal Inventory

Note: The majority of the Mayhew Creek Watershed falls in parts on UTM 'squares' 18 TD 88 and 18 TD 98. Small portions are also located in 'squares' 18 TD 89 and 18 TD 99. Unless otherwise noted, the following list includes only species in 'squares' 18 TD 88 and 18 TD 98. Species indicated with an "*" are found in adjacent UTM 'squares'. They have been included because they are known to be common in the Lower Trent Region.

Insectivora	
Common Shrew*	*Sorex cinereus*
Northern Short-tail Shrew*	*Blarina brevicauda*
Star-nosed Mole*	*Condylura cristata*
Chiroptera	
Little Brown Bat	*Myotis lucifuga*
Silver-haired Bat	*Lasionyctenis noctivagans*
Big Brown Bat	*Eptesicus fuscus*
Lagomorpha	
Eastern Cottontail	*Sylvilagus floridanus*
European Hare	*Lepus europaeus*
Rodentia	
Eastern Chipmunk	*Tamias striatus*
Woodchuck or Groundhog	*Marmota monax*
Grey Squirrel	*Sciurus carolinensis*
Red Squirrel	*Tamiasciurus hudsonicus*
Northern Flying Squirrel	*Glaucomys sabrinus*
Beaver	*Castor canadensis*
White-footed Mouse*	*Peromyscus leucopus*
Deer Mouse	*Peromyscus maniculatus*
Meadow Vole	*Microtus pennsylvanicus*
Muskrat	*Ondatra zibethicus*
Norway Rat	*Rattus norvegicus*
House Mouse	*Mus musculus*
Meadow Jumping Mouse*	*Zapus hudsonius*
Porcupine	*Erethizon dorsatum*
Carnivora	
Coyote	*Canis latrans*
Red Fox	*Vulpes vulpes*
Black Bear	*Ursus americanus*
Raccoon	*Procyon lotor*
Mink	*Mustela vison*
Striped Skunk	*Mephitis mephitis*
Artiodactyla	
White-tailed deer	*Odocoileus virginianus*

Appendix 7 - Herptofauna Inventory

Amphibia

Caudata (Salamanders)

Red-spotted Newt	*Notophthalmus viridescens*
Mudpuppy	*Necturus maculosus*
Blue-spotted Salamander	*Ambystoma laterale*
Spotted Salamander	*Ambystoma maculatum*
Eastern Red-backed Salamander	*Plethodon cinereus*

Salientia (Toads and Frogs)

American Toad	*Bufo americanus*
Spring Peeper	*Hyla crucifer*
Gray Treefrog	*Hyla versicolor*
Bullfrog	*Rana catesbeiana*
Green Frog	*Rana clamitans*
Wood Frog	*Rana sylvatica*
Northern Leopard Frog	*Rana pipiens*
Pickerel Frog	*Rana palustris*

Reptilia

Testudines (Turtles)

Common Snapping Turtle	*Chelydra serpentina*
Blanding's Turtle	*Emydoidea blandingi*
Map Turtle	*Graptemys geographica*
Midland Painted Turtle	*Chrysemys picta*

Serpentes (Snakes)

Eastern Garter Snake	*Thamnophis sirtalis*
Northern Red-bellied Snake	*Storeria occipitomaculata*
Northern Brown Snake	*Storeria dekayi*
Northern Water Snake	*Nerodia sipedon*
Eastern Milk Snake	*Lampropeltis triangulum*

* List is based on amphibians and reptiles found in Presqu'ile Provincial Park (ERM 1970a). Common names and taxonomic names are based on Johnson (1989).

Appendix 8 - Glossary of Terms

100 Year Storm Event: A storm event that has an average return time of 100 years. There is a 1% chance of this storm occurring or being exceeded in a given year.

Aquifer: Underground areas of soil or rock where substantial quantities of groundwater are found.

Benthic invertebrates: Organisms living on or in the surface sediment of a waterbody (i.e. stream, lake, or wetland).

Calcareous: Materials (especially referring to soils) consisting of or containing calcium carbonate or limestone.

Cyprinid: Fish from the taxonomic family *Cyprinidae* (Minnows and Carp). There are 44 species of this family in Canadian waters. This family includes dace, minnows, shiners and chubs.

Epoch: A division of geologic time that is a subdivision of a Period.

Flood Plain: The area, usually low lands, adjoining a watercourse which has been or may be covered by water.

Glacio-Lacustrine: Activities and effects that occur due to lakes formed by glacial meltwaters.

Hybrid: The offspring resulting from the crossbreeding of two different species.

Hydric: A soil characterized by an abundance of moisture.

Lacustrine: An extensive area of flat land underlaid by lake-bottom sediments, which are sediments deposited in lake basins.

Mesic: Classification referring to upland soils with a moderate level of moisture. This class falls between the hydric (moist) and xeric (dry) soils.

Moraine: Any material, usually consisting of debris of rock and gravel, eroded or transported by, and directly deposited by a glacier.

Official Plan: A document, which in general terms, describes the development policies of the municipality. Zoning by-laws and other by-laws implement the intent of the official plan, and must conform to the official plan.

Ordovician: A geological time period within the Paleozoic era (approximately 425 to 500 million years ago).

Overburden: The layer of unconsolidated material (eg. soil and rock) that overlies the bedrock.

Period: A division of geologic time that is a subdivision of an Era.

Physiography: The study of the development, configuration and distribution of the surface features of the earth.

Pleistocene: The most recent epoch of geological time, which began approximately one million years ago (Note: some geologists consider the past 7000 years to be the Holocene Epoch). The Pleistocene and Holocene Epochs are divisions of the Quaternary Period.

Quaternary: The geologic time period including the last two to three million years.

Rufugia: A localized or reduced area where habitat conditions are favourable for the continued survival of a species at certain times of the year.

Timmins Storm: A storm that occurred in the vicinity of Timmins, Ontario in 1961, in which 173 mm of rain fell over a 12 hour period. The flood that results from such a storm forms the basis of Lower Trent Conservation's Flood Plain Management policy. To produce a flood of this magnitude, 168 mm of rain would have to fall in a watershed the size of that of Mayhew Creek in the 12 hour period.

Two-zone Flood Plain Concept: An approach whereby certain areas of the flood plain are considered to be less hazardous than others such that development potentially could occur. The flood fringe defines that portion of the flood plain where development may be permitted, subject to appropriate flood proofing. The floodway defines that portion of the flood plain wherein development is prohibited. This concept is only implemented after the completion of a comprehensive study to evaluate implications.

UTM Squares: For the Universal Transverse Mercator (UTM) System, the globe is divided into sixty zones, each spanning six degrees of longitude. Each zone is divided into 'blocks' that are 100 km x 100 km. In turn, each block is divided into 100 'squares', which are 10 km x 10 km.

Wisconsinan: The most recent large-scale continental glacier advance in North America.

Xeric: A soil having a low or deficient supply of moisture. Only plant species that are adapted to drier conditions will grow on such soils.

Zoning By-Law: A precise document used by the municipality to regulate the use of land. It states exactly what land uses are currently permitted in the municipality.

'orking with local communities to protect our natural environme