



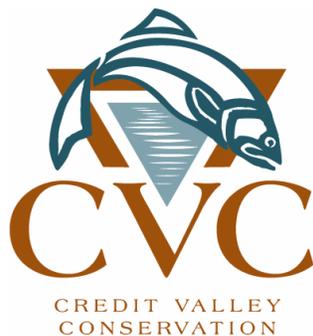
**A Cooperative Management Planning Initiative
for the Credit River Fishery**

Ministry of Natural Resources

and

Credit Valley Conservation

2002



Ministry of Natural Resources
Ministère des Richesses naturelles



(Department of Planning and Development 1956).

The Credit River Valley presents the most rugged topography of any in Southern Ontario. This gives the river many advantages such as striking scenery, clear cold water, farm and orchard land and large areas of reforestation land where trees could be economically maintained as permanent cover. These advantages, however, combined with the proximity of the river to large urban centers are the very factors which could make it vulnerable to exploitation and their preservation presents a challenge to all people interested in true conservation (Department of Planning and Development 1956).

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November 2002

As Ontario's Minister of Natural Resources, I am pleased to present the Credit River Fisheries Management Plan.

The Credit River is a very special place in the Greater Toronto Area. It is home to close to fifty different species of fish in spite of being adjacent to the biggest urban centre in Canada.

Over a one-year period from 1998 to 1999, a steering committee of dedicated people met at least once a month to identify challenges to the health of the Credit River and its fisheries resource. The committee took stock of the existing resources and developed a plan of action to achieve one main goal: a river that is as healthy for the fish that live in it as for the people who work, play and reside around it. Throughout the committee's work, many people came together on weekends and evenings to share their knowledge and to promote a vision of a bright future for the Credit River.

I express my gratitude to all those who generously devoted their time and effort to the preparation of this plan, especially the members of the steering committee. Without all of you, it would not have been possible.

The next step, and definitely the most exciting part, is putting the plan into action. As efforts to implement the plan begin, I look forward to learning more about its progress. I invite everyone to join in making this plan a reality so that the Credit River will continue to provide the same abundance for our children and grandchildren that it gives us today.

A handwritten signature in blue ink that reads "Jerry J. Ouellette".

Hon. Jerry J. Ouellette
Minister of Natural Resources



EXECUTIVE SUMMARY

The upper Credit truly is one of the last bastions of wildness in the shadow of urban sprawl, one of few remaining cold-water streams in southern Ontario that has genuine blue-ribbon trout fishing.

From G. Ellis, Ontario Out of Doors, March 2000.

The Credit River offers one of southern Ontario's most spectacular opportunities to fish for salmonines, namely brook trout, brown trout, rainbow trout, chinook salmon, coho salmon and Atlantic salmon. It is also one of the few places in southern Ontario where you can cast for brook trout in a natural setting. While the Credit presents these incredible angling opportunities against the beauty of the Niagara Escarpment and the Oak Ridges Moraine, these resources are under the threat of development.

The Credit River Fisheries Management Plan (CRFMP) is a joint effort of the Ministry of Natural Resources and Credit Valley Conservation in partnership with other government and non-government representatives, providing a wide range of recommendations to protect, enhance and rehabilitate the aquatic ecosystem of the Credit River watershed. The CRFMP is part of the watershed plan that guides protection and enhancement initiatives for the entire watershed.

Fish communities are recognized as indicators of the health of a watershed. As such, they also serve as barometers of human health and well-being (Loftus *et al.* 1980). It is the economic and social value of the fishery, in addition to its importance as a biological indicator, that makes it an important resource to protect. It also explains the broad participation and interest it generated during the CRFMP planning process. Participants in the Steering Committee, Technical Committee, workshops, stakeholder meetings and public open houses included representatives of the municipal, provincial and federal government, fishing clubs and conservation groups, agricultural, aggregate, baitfish, development and other private industries, and the public.

Through the first stage of public consultation, a list of issues of concern was generated and these were organized under the broad headings: Habitat, Species Mix and Partitioning, Education, Enforcement and Regulations, Rehabilitation, Public Access and Fishing Opportunities, and Other Issues. During the second stage of consultation, solutions and actions to resolve the issues were identified. The result of all the input was a comprehensive list of approximately 90 issues, 140 strategies and 350 tactics (Appendix A – separate document). From this long list, a more feasible and short-term priority list was developed (Table 12). Some of the strategies from the priority list, presented in no particular order, include:

Water quantity

- Develop a water budget to determine the quantity of water available for water-takings and the minimum required to sustain healthy fish populations.

Water quality

- Monitor and enforce sediment controls during development and maintenance.
- Undertake studies to ensure that the assimilative capacity of the Credit River is not exceeded.

Physical habitat

- Stronger enforcement of fisheries habitat violations.
- Remove or mitigate the effects of on-line ponds that are not used for fisheries management purposes.

Angling opportunities

- Determine the feasibility of allowing smallmouth bass above the Streetsville Dam.
- Determine the feasibility of a new barrier above the Norval dam to allow rainbow trout access to more suitable spawning and rearing grounds.
- Stocking of public and private ponds and stormwater management ponds.

Enforcement

- Increase support for the enforcement of fishing and habitat violations through additional funding or partnerships such as the Ministry of Natural Resources Guardian Program.

Awareness

- Increase fish-viewing opportunities and education about non-consumptive uses through interpretive materials and migratory fish viewing opportunities.

Species Mix & Partitioning

- The following table is a summary of the more actively managed fish species in the Credit River and their management objectives as determined through public consultation and technical expertise.

Summary of fisheries management objectives by species.

Fish Species	Management Objective (s)
Brook trout	Protect brook trout from other competing species above the Niagara Escarpment, in the main Credit River upstream of Inglewood, including the East Credit River, and in upper Black and Silver creeks through barrier and habitat management.
Atlantic salmon	Support the re-establishment of this natural heritage species throughout their historical range in the Credit River.
Pacific salmon (chinook and coho)	Continue to stock Pacific salmon at the rates set by the Lake Ontario Management Unit, and continue to stop the upstream migration of adult fish at the Streetsville Dam to help ensure the egg collection for the Lake Ontario stocking program.

Fish Species	Management Objective (s)
Rainbow trout	<p>Rainbow trout will continue to be stocked in the Credit River at current levels and locations (Table 11).</p> <p>Study the feasibility of a new barrier upstream of Norval and downstream of the confluence of the East Credit River to allow rainbow trout access to suitable spawning and rearing habitat.</p>
Sea lamprey	<p>Continue to stop sea lamprey spawning migrations at the Streetsville Dam.</p> <p>Continue lampricide applications where necessary to control sea lamprey production.</p>
Northern pike	<p>Continue to manage the pike fishery in Island Lake and reduce escapement from the lake to the Credit River.</p>
Smallmouth bass	<p>Determine the feasibility of re-establishing self-sustaining populations of smallmouth bass above the Streetsville Dam</p>
Brown trout	<p>Protect the migration of resident overwintering brown trout.</p> <p>Consider allowing migratory brown trout access above the Streetsville Dam.</p>

To ensure the implementation of the recommendations outlined in the CRFMP, four companion documents are recommended for creation through working groups. These groups developed the four documents to tackle the challenges of turning the Plan into action. The four documents are:

Planner's Guide

A guide that provides directions for planners, developers and consultants for the implementation of the protection strategies outlined in the CRFMP.

Fisheries Rehabilitation Strategy

A strategy to outline the steps needed to bring groups in the watershed together to act on priority rehabilitation projects to improve water quality and fish habitat in the Credit River.

Citizen's Guide

A document to promote the CRFMP and to inform the public of ways they can actively protect the aquatic resources of the Credit River watershed.

Monitoring and Measures Report

A monitoring and assessment program with defined performance measures and targets to determine the success or failure of the implementation of the CRFMP. A bi-annual report card will be published.

These companion documents, although separate, complement the fisheries management plan and provide specific information to key groups.

During the planning process, the watercourses of the watershed were classified by fish community (Figure 13). This map was developed by looking at existing fish communities and potential fish communities, as determined through physiography. The fish communities determined for the watercourses will guide protection and rehabilitation efforts throughout the Credit River watershed.

The new fisheries management plan for the Credit River guides environmental protection, rehabilitation and restoration, ensures that benefits to fish and wildlife will continue, and sustains natural areas for public education and recreation.

TABLE OF CONTENTS

1.0	INTRODUCTION	1-1
1.1	<i>Purpose</i>	1-1
1.2	<i>Background.....</i>	1-2
1.3	<i>Rationale.....</i>	1-5
1.4	<i>Key Concepts</i>	1-6
1.4.1.	Strategic Plan for Ontario Fisheries (SPOF II)	1-6
1.4.2.	Fish Community Management	1-6
1.4.3.	Ecosystem Approach	1-6
1.4.4.	Lake Ontario Fisheries Management	1-7
1.4.5.	Adaptive Environmental Management	1-8
1.5	<i>Scope 1-8</i>	
1.6	<i>Study Process.....</i>	1-11
1.6.1	Government, Non-Government and Public Involvement	1-11
1.6.2	Issue and Solution Identification.....	1-13
2.0	WATERSHED CHARACTERISTICS	2-1
2.1	<i>Settlement.....</i>	2-1
2.2	<i>Land Use</i>	2-2
2.3	<i>Physiography.....</i>	2-5
2.3.1	Upper Watershed	2-5
2.3.2	Middle Watershed	2-6
2.3.3	Lower Watershed.....	2-6
2.4	<i>Climate.....</i>	2-13
2.5	<i>Hydrological Characteristics</i>	2-14
2.5.1	Water Quantity	2-14
2.5.2	Water Quality	2-17
3.0	PRESENT FISH COMMUNITY	3-1
3.1	<i>Approach to Fisheries Resource Management.....</i>	3-1
3.2	<i>Historic and Current Fish Species.....</i>	3-1
3.2.1	Native Species	3-4
3.2.1.1	Atlantic salmon.....	3-4
3.2.1.2	Brook trout	3-8
3.2.1.3	Northern pike	3-8
3.2.1.4	Smallmouth bass	3-9
3.2.1.5	Largemouth bass	3-9
3.2.2	Exotic, Introduced and Naturalized Species.....	3-10

3.2.2.1	Brown trout - Migratory.....	3-11
3.2.2.2	Brown trout - Resident	3-11
3.2.2.3	Pacific salmon.....	3-11
3.2.2.4	Rainbow trout - Migratory.....	3-12
3.2.2.5	Sea Lamprey.....	3-13
3.2.2.6	Fish Stocking	3-13
3.2.3	Vulnerable, Threatened and Endangered Species.....	3-14
3.2.3.1	Redside Dace	3-14
3.3	<i>Fish Community Diversity and Productivity</i>	3-14
3.4	<i>Fish Habitat Management</i>	3-15
3.4.1	Management Zones	3-15
3.4.2	Methodology.....	3-16
3.4.3	Results	3-16
4.0	FISHERIES MANAGEMENT ISSUES	4-1
4.1	<i>Habitat</i>	4-2
4.1.1	Water Quantity	4-3
4.1.2	Water Quality	4-4
4.1.3	Physical Habitat	4-5
4.1.4	Planning & Monitoring.....	4-7
4.2	<i>Species Mix and Partitioning</i>	4-10
4.3	<i>Education</i>	4-19
4.4	<i>Enforcement and Regulations</i>	4-20
4.5	<i>Rehabilitation</i>	4-23
4.6	<i>Public Access and Fishing Opportunities</i>	4-25
4.7	<i>Other Issues</i>	4-30
5.0	PLAN IMPLEMENTATION.....	5-1
5.1	<i>Getting Organized</i>	5-1
5.1.1	Habitat Protection.....	5-27
5.1.2	Habitat Enhancement.....	5-35
5.1.3	Fisheries Management.....	5-36
5.1.3.1	Barrier Management	5-36
5.1.4	Communications	5-41
5.1.5	Monitoring and Future Studies	5-42
5.2	<i>Coordination of Plan Implementation</i>	5-44
5.2.1	Roles of Various Organizations & Agencies.....	5-44
5.2.2	Funding	5-48
5.2.3	Implementation Committee	5-48
6.0	MONITORING THE PLAN	6-1
7.0	REFERENCES.....	7-1
8.0	BIBLIOGRAPHY	8-1

9.0 ACRONYMS.....9-1
10.0 GLOSSARY10-1

APPENDIX A - Complete list of issues, strategies and tactic.....Separate document

LIST OF FIGURES

Figure 1.	The Credit River watershed.....	1-3
Figure 2.	The status of subwatershed plans in the Credit River watershed.....	1-9
Figure 3.	The Credit River Fisheries Management Plan study process.	1-12
Figure 4.	Land use of the Credit River watershed.....	2-3
Figure 5.	Wetlands of the Credit River watershed.....	2-7
Figure 6.	Forest cover in the Credit River watershed.....	2-9
Figure 7.	Physiographic zones of the Credit River watershed.....	2-11
Figure 8.	The hydrologic cycle.	2-15
Figure 9.	Water quality monitoring stations, gauge stations and sewage treatment plants in the Credit River watershed.	2-19
Figure 10.	Peak periods of in-migration, spawning, fry emergence and out-migration of selected fish species found in the Credit River.	3-5
Figure 11.	Physiography-based fish communities of the Credit River watershed...	3-17
Figure 12.	Existing fish communities of the Credit River watershed.....	3-19
Figure 13.	Fish community management zones of the Credit River watershed.	3-21
Figure 14.	Legislation affecting stream systems.	4-9
Figure 15.	Fish ladders and selected barriers of the Credit River watershed.....	4-11
Figure 16.	Access points and trout season opening weekend creel surveys along the Credit River.	4-27
Figure 17.	Construction timing windows during which in-water works are allowed.....	5-31
Figure 18.	Field environmental planning procedure.	5-39
Figure 19.	Conceptual impact model for the Credit River.....	5-43
Figure 20.	Agency and municipal areas of jurisdiction.	5-45

LIST OF TABLES

Table 1.	Fish as environmental indicators.....	1-1
Table 2.	Regions, counties and lower tier municipalities of the Credit River watershed.....	1-2
Table 3.	Goals and objectives for the Credit River Fisheries Management Plan.....	1-6
Table 4.	Population trends in the Region of Peel from 1951 to 2020.....	2-1
Table 5.	Current and historical land use in the Credit River watershed.....	2-5
Table 6.	Water quality parameters measured in the Credit River watershed.....	2-17
Table 7.	Fish species of the Credit River watershed: 1954 and 1999.....	3-2
Table 8.	Life history characteristics of select fish species found in the Credit River.....	3-7
Table 9.	Fish community management zones of the Credit River watershed.....	3-23
Table 10.	Rainbow trout stocking by location, based on survival from an allocation of 250,000 eggs per year.....	4-17
Table 11.	Municipal by-laws affecting fish habitat.....	4-21
Table 12.	Priority strategies and tactics for implementation and agency roles.....	5-2
Table 13.	Construction timing windows for inwater works and recommended natural buffer widths.....	5-29
Table 14.	Legislation relevant to sedimentation.....	5-34
Table 15.	Performance measures for the Credit River Fisheries Management Plan.....	6-3

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1.0 INTRODUCTION

1.1 Purpose

The fishery of the Credit River is an essential component of the ecological health and sustainability of the entire Credit River watershed. Any changes to the surrounding land use practices could lead to changes in the river, for example changes in water quality, water quantity or channel form. These changes could then result in a change in the fish community and/or its productivity. The need for active protection and management of the fisheries resource stems from the importance of fish as environmental indicators of the health and condition of the watershed (Table 1).

Table 1. Fish as environmental indicators.

<p>Fish are excellent environmental indicators for a number of reasons:</p> <ol style="list-style-type: none">1) extensive life-history information is available;2) fish occupy a variety of trophic levels, including 'top' positions;3) species are relatively easy to identify;4) fish are typically present in all waters;5) the general public can relate to statements of fish community conditions and the results of the studies can be directly related to the recreational programs of a fishery; <p>Karr 1981</p>
--

The distribution of various fish communities can impact where development can occur including buffer widths. Through education and awareness of the fisheries resources, local landowners gain a sense of stewardship resulting in further protection and enhancement of the river.

Fish are also important from a social perspective. Viewing fish as they attempt to jump over a barrier or through a fishway, or watching thousands of salmon in a river as they move upstream can be exciting. Whether you are an angler or simply enjoy being outdoors, the intrinsic value of the outdoors can provide an incredible experience.

The Credit River Fisheries Management Plan (CRFMP) was developed through a public process by the Ministry of Natural Resources (MNR), in co-operation with Credit Valley Conservation (CVC). This Plan guides aquatic resource protection and enhancement within the Credit River watershed, based on the principle of biological sustainability, while taking into consideration socio-economic resource values.

1.2 Background

The Credit River is one of the most popular angling rivers in Ontario (Legg 1985) with a variety of fishing opportunities found throughout the watershed. The coldwater fishery in the upper watershed provides high-quality fly fishing opportunities for brook trout and brown trout. The lower watershed is known for its spectacular runs of chinook salmon, coho salmon and rainbow trout. Small lakes and ponds scattered throughout the watershed also offer panfish, bass and pike fishing opportunities.

The Credit River watershed extends from Lake Ontario at Port Credit, northwest approximately 60 km, with its headwaters north of the Town of Orangeville, and covers an area of 871 km². The Credit River flows for approximately 100 km through the watershed. The Credit River watershed encompasses some of southern Ontario's most scenic and diverse landscapes. In addition to the deep valleys and abundant wetland areas, the watershed is bisected by the World Biosphere Niagara Escarpment and the western limit of the Oak Ridges Moraine (Figure 1).

From the headwaters, the watershed encompasses portions of nine area municipalities, two counties and two regions before draining into Lake Ontario (Table 2). Occupying roughly 20% of the watershed are the major urban centres of Orangeville, Georgetown, Brampton and Mississauga. The watershed is home to nearly 500,000 people, and the population is expected to grow to more than 700,000 by the year 2021.

At the southern end of the Credit River watershed, there are a number of streams that drain directly into Lake Ontario, within the area of jurisdiction of the CVC. These small southern drainage areas were not specifically included as part of this planning exercise, but many of the principles recommended in this plan may be appropriate in these areas as well.

Table 2. Regions, counties and lower tier municipalities of the Credit River watershed

Regional Municipality of Peel	Town of Caledon, City of Brampton, City of Mississauga
Regional Municipality of Halton	Town of Halton Hills
Wellington County	Town of Erin
Dufferin County	Township of Amaranth, Township of East Garafraxa, Town of Mono, Town of Orangeville

Based on 1996 Ecological Land Classification data (CVC unpublished data), land use in the basin is primarily urban (22.7%), agricultural (29.5%), forest (13.6%), pasture land / old field (16.2%), wetlands (5.5%) and waterbodies (7.4%). However, the Credit River watershed is under active urbanization along much of its length. Urbanization, sewage

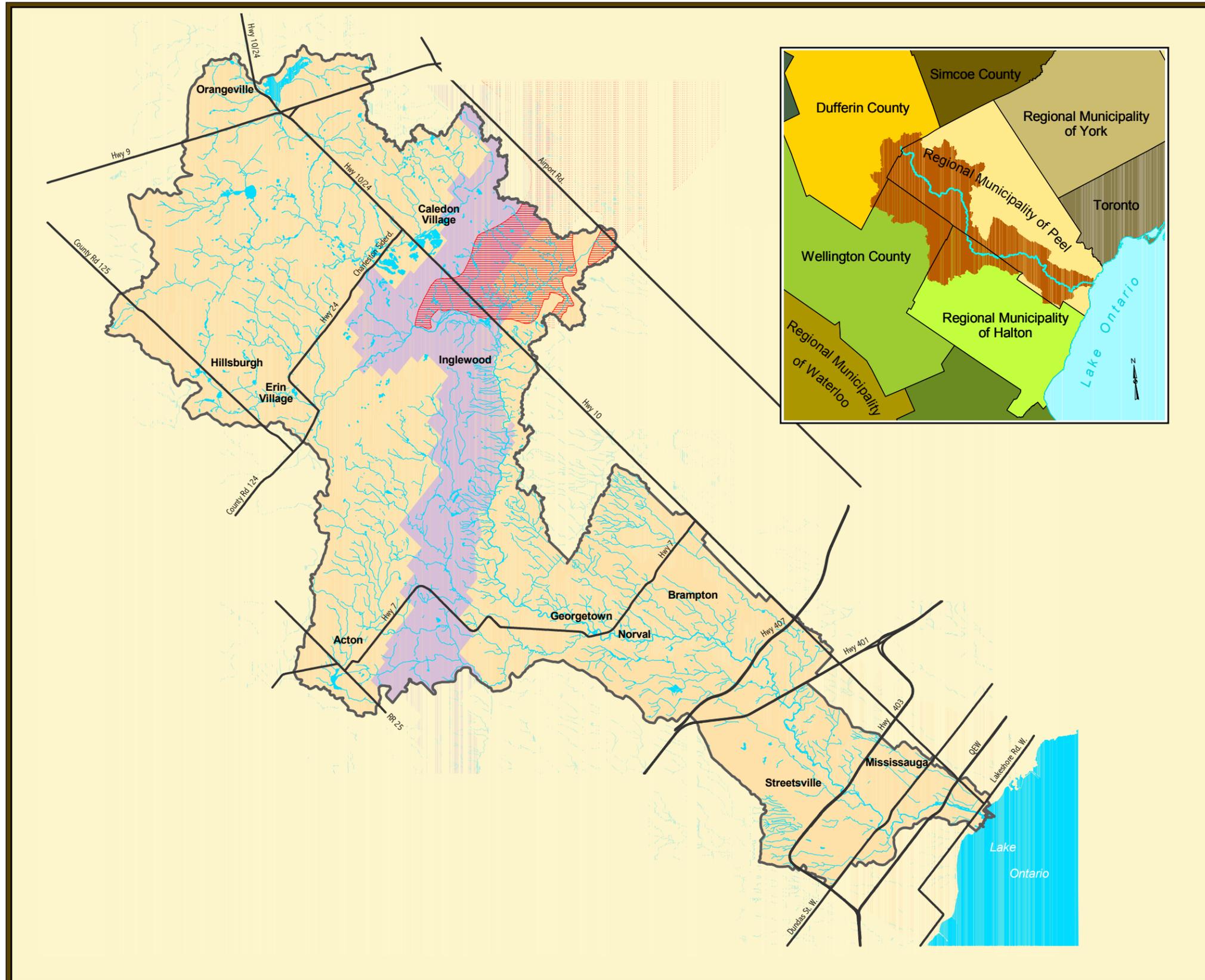


Figure 1. The Credit River watershed.

-  Oak Ridges Moraine
 -  Niagara Escarpment Planning Area
- Transportation Network*
-  Highway
- Drainage Network*
-  Lakes and ponds
 -  Rivers and streams
-  Credit River watershed boundary



1:250,000



Credit Valley Conservation, 2000; Ministry of Natural Resources, 2000; Toronto and Region Conservation Authority, 2000; Niagara Escarpment Commission, 1997

disposal, agricultural practices, water-taking and historical factors such as deforestation and dams have resulted in drastic modifications to the natural balance of the river system. There is now increased streambank erosion, increased sediment in the river and likely increased water temperatures. These changes to the natural system have resulted in negative changes to fish habitat and the fish community.

1.3 Rationale

Fish found in Ontario public waters belong to the people of Ontario. The Ministry of Natural Resources (MNR) develops plans for the management of these resources. Through co-operation with Credit Valley Conservation (CVC) a public process involving numerous agencies, interest groups, stakeholders and members of the public provided valuable input to this fisheries management plan.

The MNR has 26 Districts throughout Ontario. The Credit River watershed is found in the Midhurst, Guelph, and Aurora Districts. In 1989, these three Districts produced district-wide fisheries management plans that included a section dedicated to the Credit River within their jurisdiction. The CRFMP provides one fisheries management plan for the entire Credit River watershed.

Many significant changes have taken place in the Credit River watershed since the last fisheries management planning exercise was completed in 1988 (MNR 1988) such as:

- urban development is taking place at a rapid pace and there are concerns for the future health of the river;
- barriers to fish passage have been removed (i.e. Georgetown Papermill Dam, Inglewood electric barrier), resulting in potential competition for habitat and food for some species of fish;
- new information about certain fish species and habitat conditions are now available, such as Atlantic salmon, a natural heritage species of the river;
- data from watershed and subwatershed studies are available, including the Credit River Water Management Strategy and several subwatershed plans;
- public interest to manage particular species has increased; and
- changes to the Lake Ontario Fish Community Objectives (Stewart *et al.* 1999) will have implications for the management of the Credit River fisheries.

This Plan addresses these new issues and concerns and others affecting the diverse fisheries resources and aquatic ecosystems of the Credit River.

1.4 Key Concepts

The following key concepts were used throughout the development of this document.

1.4.1. Strategic Plan for Ontario Fisheries (SPOF II)

After extensive public consultation, the Ontario government adopted the *Strategic Plan for Ontario Fisheries II* (MNR 1992) to guide policy direction for fisheries management. *SPOF II* adopts the ecosystem approach for managing aquatic resources, and supports the concept of ecological sustainability. Based on this policy, the goals and objectives for the CRFMP were developed (Table 3).

Table 3. Goals and objectives for the Credit River Fisheries Management Plan.

<p>Goals</p> <p>‘...to have healthy aquatic ecosystems that provide long-term benefits to help satisfy society’s need for a high-quality environment, wholesome food, employment and income, recreational activity, and cultural heritage.’</p> <p>Objectives:</p> <ol style="list-style-type: none"> 1. Protect healthy aquatic ecosystems; 2. Rehabilitate degraded ecosystems; and 3. Improve cultural, social and economic benefits from the aquatic resources of the Credit River watershed. <p>As adopted from <i>SPOF II</i> (MNR 1992)</p>

1.4.2. Fish Community Management

As recommended in *SPOF II*, this Plan manages the fisheries of the Credit River at a fish community level. However, it also recommends species-specific management decisions, particularly for the gamefish. The CRFMP manages the fisheries of the Credit River at a community level, but also recognizes the need for species management.

1.4.3. Ecosystem Approach

All living and non-living elements within an ecosystem are related in some way. Examples of these inter-relationships include the food web and the hydrological (water) cycle, where disturbance in one part of the system has implications for the rest of the system. Ecosystem-based management requires knowledge about the various components of the system, how those components are linked among one another and how one component of the system would respond if there are changes in another portion of the system. For the purposes of this Plan, we have defined the ecosystem as the Credit River watershed.

One of the largest impacts in the Credit River ecosystem is land use change and development. In order to effectively manage for development, subwatershed and watershed studies are undertaken. These studies identify significant features such as environmentally sensitive lands, significant wetlands, significant forests, valleylands and stormwater management opportunities. The information gathered in these studies are used to develop recommendations and provide input to Official Plans and development applications. As of spring 2000, twelve Credit River subwatershed plans have been completed (Figure 2). Other ecosystem-based management planning initiatives in the watershed include the *Credit River Water Management Strategy* (Beak Consultants Limited *et al.* 1992) and the *Natural Heritage Strategy* (CVC 2000a). Though the CRFMP is developed to specifically manage the fisheries of the Credit River, this Plan recognizes the importance of an ecosystem approach.

1.4.4. Lake Ontario Fisheries Management

It is important to recognize that while the Credit River watershed is the scale for this Plan, regional impacts to and from the watershed were also taken into consideration. The Lake Ontario fisheries management planning exercise involved representatives from both New York and Ontario, and defined objectives for the lake, based on sound scientific evidence and the needs and preferences of stakeholders. These objectives provide a framework for managing the fish communities and fisheries of Lake Ontario, and are intended to be “a starting point for discussion with management agencies, interest groups, and the general public for developing more specific fisheries, habitat, and watershed management plans” (Stewart *et al.* 1999). Lake Ontario will be managed in a way that supports diverse recreational, commercial and aboriginal fisheries, based on native and stocked fish. Objectives also address the need for healthy human and aquatic environments.

Consideration was given to the Fish Community Objectives for Lake Ontario (Stewart *et al.* 1999) in the development of the CRFMP. The Credit River provides a number of very important contributions to the Lake Ontario fishery. For example, chinook and coho salmon are stocked annually below Norval in the Credit River. The young fish migrate to the lake, where they grow and are recruited to the fishery. The returning adults provide fishing opportunities in the nearshore areas of the lake and in the river. At this time, the Credit River is the only established chinook and coho salmon egg collection site for the Lake Ontario stocking program.

Furthermore, the Credit River also contributes to the Lake Ontario fish community objectives through the production of wild rainbow trout and other salmonids. Efforts to restore native species *e.g.*, Atlantic salmon and the control of sea lamprey are of common interest to the Lake Ontario objectives.

From the perspective of non-salmonid fisheries, the Credit River provides important habitat for species that likely migrate to and from the lake, such as smallmouth bass. This plan recognizes these important linkages with Lake Ontario and its' fish community objectives (Stewart *et al.* 1999).

1.4.5. Adaptive Environmental Management

The CRFMP recognizes that resource management decisions are based on current knowledge and data of a complex ecosystem. New knowledge must be integrated into the fisheries management decisions as it becomes available. An *adaptive environmental management* approach to the implementation of the CRFMP provides an opportunity to incorporate changing knowledge and priorities into this Plan.

The CRFMP will be updated when there is:

- No longer a consensus among partners on direction for the CRFMP;
- Change in agency direction;
- New knowledge that requires a major change of direction;
- All tactics in this Plan have been successfully implemented; or
- There has been no progress completing the CRFMP tactics.

Further scientific information will be gathered through ongoing environmental monitoring of the river ecosystem (CVC 2000b). A wide range of components are measured under this monitoring plan, including water quality, fish and invertebrate communities. Monitoring allows us to gauge the effect of our current management actions and helps us to understand where alternative management options should be tested.

As part of the CRFMP, a monitoring plan (Section 6.0) was developed to help assess the success of the management and implementation activities outlined in this plan.

1.5 Scope

An ecosystem is defined as the interaction and interdependence of living organisms with the physical, chemical and biological environment. An ecosystem operates on a wide variety of scales in which there is continuous movement of matter, energy and nutrients. The watershed is the basic ecosystem unit used for planning and managing the resources of the Credit River.

Although this Plan speaks specifically to fish, it also recognizes the link this resource has to the other components of the watershed. As such, the CRFMP can be considered a chapter of an overall watershed plan. A watershed plan discusses biological, physical and chemical impacts to the natural environment at a watershed scale.

Whereas a watershed plan studies issues at a watershed scale, subwatershed plans look at issues at a more local scale. The CRFMP is primarily written to address issues at a watershed scale and provides information to the more detailed subwatershed plans. The subwatershed plans, in turn, provide more specific information for a variety of management initiatives.

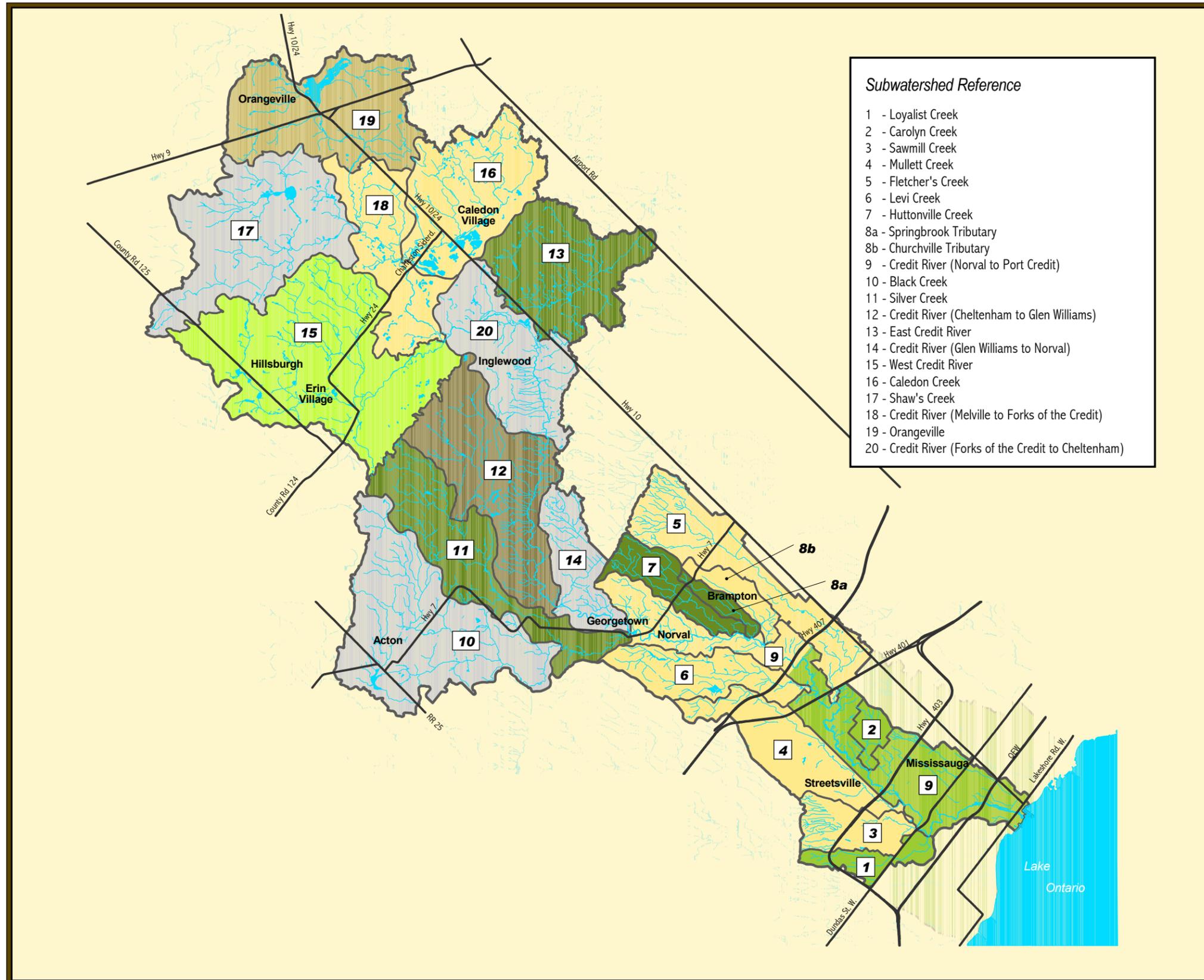


Figure 2. The status of subwatershed plans in the Credit River watershed.

- Study Status**
- No assessment to date
 - Study underway
 - Phase 1 completed
 - Phase 1 completed, phase 2 starts Sept.'99
 - Phase 1 and 3 completed
 - Phase 1, 2, 3 completed
 - Mississauga Water Quality Study
- Transportation Network**
- Highway
- Drainage Network**
- Lakes and ponds
 - Rivers and streams

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Several others chapters of an overall watershed plan have been developed, including the *Conservation Areas Strategy* (CVC 1994) and the *Natural Heritage Strategy* (CVC 2000a). Other components, include the *Water Quality Strategy* (CVC and Member Municipalities 2000c), *Stewardship Strategy* (CVC 1999), the *Greenlands Protection Strategy* (CVC 2002) and more recently the Groundwater Study (CVC in progress) and Water Budget study (CVC in progress).

1.6 Study Process

In March of 1998, the Minister of Natural Resources, John Snobelen, initiated the CRFMP process. The process was coordinated through a partnership between the MNR, Aurora District Office, and CVC. Many government agencies, non-government organizations (NGOs) and members of the general public participated in committees, working groups and workshops to help identify problems, provide valuable information and offer advice on possible solutions throughout the process (Figure 3). The central planning process was guided by the Steering Committee with technical advice from the Technical Committee.

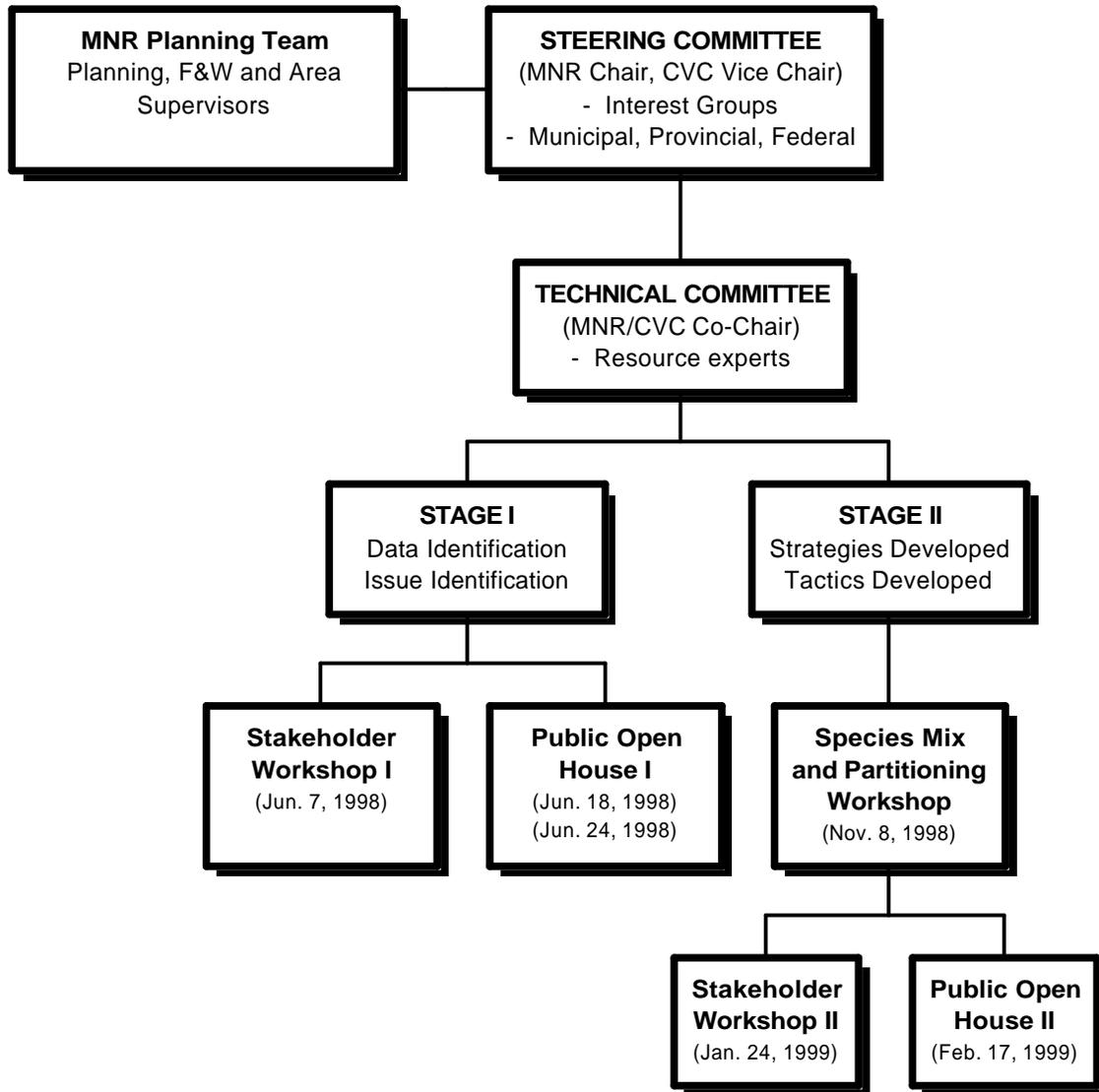
1.6.1 Government, Non-Government and Public Involvement

Broad direction for the fisheries management planning process were provided by the MNR Planning (T. Farrell), Fish and Wildlife (C. Willox) and Halton / Peel / Toronto Area (J. Orendorff) supervisors.

With input from the stakeholders, the public and the Technical Committee, the Steering Committee developed the CRFMP. The committee members from both government and non-government agencies, were chosen for their knowledge and interest in the Credit River and its aquatic resources. The Technical Committee consisted of agency representatives that provided technical support to the Steering Committee.

Community involvement in the development and implementation of the CRFMP is an integral component of the process. Through public open houses and stakeholder workshops, the fisheries management plan tapped into the diverse interests, expertise and local knowledge of the Credit River fisheries. The meeting process provided them with an opportunity to ensure that their interests were addressed by the Plan. A number of workshops and open houses were held to provide a forum for the public to voice their concerns about fisheries management in the Credit River, and to comment on the work by the committees. In addition, members of the public were invited to attend all Steering Committee meetings, access the CRFMP website, or provide input to the Steering Committee members at any time.

Figure 3. The Credit River Fisheries Management Plan study process.



In accordance with the requirements of the Environmental Bill of Rights (EBR), notices of the CRFMP planning initiative were posted on the EBR registry for public input.

1.6.2 Issue and Solution Identification

In Phase I of the planning process, several hundred fisheries-related issues in the Credit River were identified. These results were organized under the following categories of issues:

- HABITAT
- SPECIES MIX AND PARTITIONING
- EDUCATION
- ENFORCEMENT AND REGULATIONS
- REHABILITATION
- PUBLIC ACCESS AND FISHING OPPORTUNITIES
- OTHER ISSUES

The complete list of issues were presented at stakeholder and public meetings to provide further opportunity for public input to the identification of issues facing the Credit River fishery. It is important to note that the need for more data and data analysis was a common issue among all seven categories. It was agreed to address this need separately with each category.

In Phase II of the planning process, methods to resolve the issues identified in Phase I were debated. Each Steering Committee meeting was devoted to a set of issues to determine strategies and tactics to manage each identified concern. Section 4.0 provides an overview of the Issues, Strategies and Tactics, while Appendix A (separate document) provides the complete list of Issues, Strategies and Tactics.

The category of *species mix and partitioning* required special attention. A professional facilitator led a workshop in which consensus, defined as “a decision that everyone could ‘live with’”, was reached (MNR unpublished report). These results were then presented at stakeholder and public open houses for further input.

2.0 WATERSHED CHARACTERISTICS

2.1 Settlement

The first known inhabitants of the Credit watershed were the Iroquois First Nation. They were followed in the 1700s by the Mississaugas, members of the Ojibway Nation (Department of Planning and Development 1956). Europeans began visiting the area in the mid 1600s, with the first map showing the location of the Credit River from 1688. By 1847, the Mississaugas of the Credit River left the area and relocated to Brant County where they settled and remain there today as the “Mississaugas of the New Credit”.

By the mid 1800s, approximately 87 dams had been built on the Credit River, mainly to support milling operations and other industries (Turnball 1963). By 1867, the period of “settlement” in the Credit River watershed ended. The 1956 Credit Valley Conservation Report (Department of Planning and Development 1956) documented many of the early industrial impacts that existed in the watershed. These included sewage treatment problems, industrial waste from saw and grist mills poured directly into the river, and sedimentation from sand and gravel extraction operations. This report also documented a number of sections of the river that did not support fish due to pollution levels.

Although a number of the historical impacts and sources of pollution are no longer of concern, one of the largest, ongoing concerns in the Credit River watershed is the increasing human population. The major urban centres in the watershed include Brampton, Caledon and Mississauga. Census and projected population information for these urban areas and the Region of Peel shows growth in the order of 44% in the coming years, from 935,000 to 1,344,000 (Table 4).

Table 4. Population trends in the Region of Peel from 1951 to 2020.

Year	Brampton	Caledon	Mississauga	Peel Region
1951 ^a	13,996	8,767	33,310	56,073
1961 ^a	24,503	12,697	74,875	112,075
1971 ^a	70,838	16,994	172,042	259,874
1981 ^a	149,030	26,645	315,056	490,731
1991 ^a	235,000	35,000	465,000	735,000
1996 ^a	270,000	40,000	545,000	855,000
1997 ^b	280,000	42,000	559,000	881,000
1998 ^b	290,000	44,000	568,000	902,000
1999 ^b	301,000	45,000	589,000	935,000
2016 ^b	510,000	76,000	694,000	1,280,000
2020 ^b	554,000	82,000	708,000	1,344,000

^aStatistics Canada

^bForecasted from Region of Peel (1998).

The anticipated population increase in the Credit River watershed and surrounding areas is expected to result in a proportional increase in the number of anglers and other recreationalists that utilize the river corridor. We need to work towards protecting, enhancing and rehabilitating our fisheries and fish habitat in the Credit River to ensure a high quality river corridor to meet these increased demands.

2.2 Land Use

Land use in a watershed can directly impact the water quantity and water quality in streams, which may result in changes to the fish community. For example, activities may result in increased nutrients, bank erosion, sedimentation, increased peak flows, decreased baseflow, toxic spills, or contamination of groundwater sources. Whether rural or urban, many land use practices can directly or indirectly affect water quality, water quantity and aquatic habitat.

Land use of the Credit River watershed was first mapped in the summer of 1954 (Department of Planning and Development 1956). At that time, dairy farming was the principal type of farming in the lower part of the Credit watershed, with specialized farming such as vegetables and fruits, mainly south of Highway 5, in the area of Huttonville (Huttonville Sandy Plain) and on the lake plain (Port Credit Sandy Plain). In the upper portions of the watershed above the Niagara Escarpment, beef cattle was a significant industry.

In 1954, forests covered approximately 14,176 ha or 16.3% of the Credit River watershed (Department of Planning and Development 1956). This was a considerable amount of land, but over 4040 additional hectares were described as poor soil and therefore had limited potential agricultural value. Tree plantations covered only about 200 ha. In 1956, 3% (2486 ha) of the watershed was under urban land use. This does not include road allowances, some recreational lands, hobby farms, gravel pits, limestone quarries or other such uses. Farmsteads, including houses, kitchen gardens and various out-buildings, surprisingly took up 1408 ha, or 1.7% of the watershed.

Land use in the Credit River watershed has changed dramatically over the past 40 years (Table 5), with the broad trend of increasing urban areas readily apparent. Associated with the historical and future urban growth in the watershed, some of the impacts include increased water-taking and sewage treatment plant expansions, including proposed communal septic systems in Inglewood, Cheltenham, Alton and Caledon Village.

Aggregate extraction is currently concentrated in the northern portion of the watershed (Figure 4). This is especially evident in the Town of Caledon, where vast gravel pits are visible along Highways 10 and Regional Road 24 (formerly Highway 24). From 1956 to the present, over half of the rural and agricultural areas have been converted to urban/settled areas or have reverted to old field and natural areas.

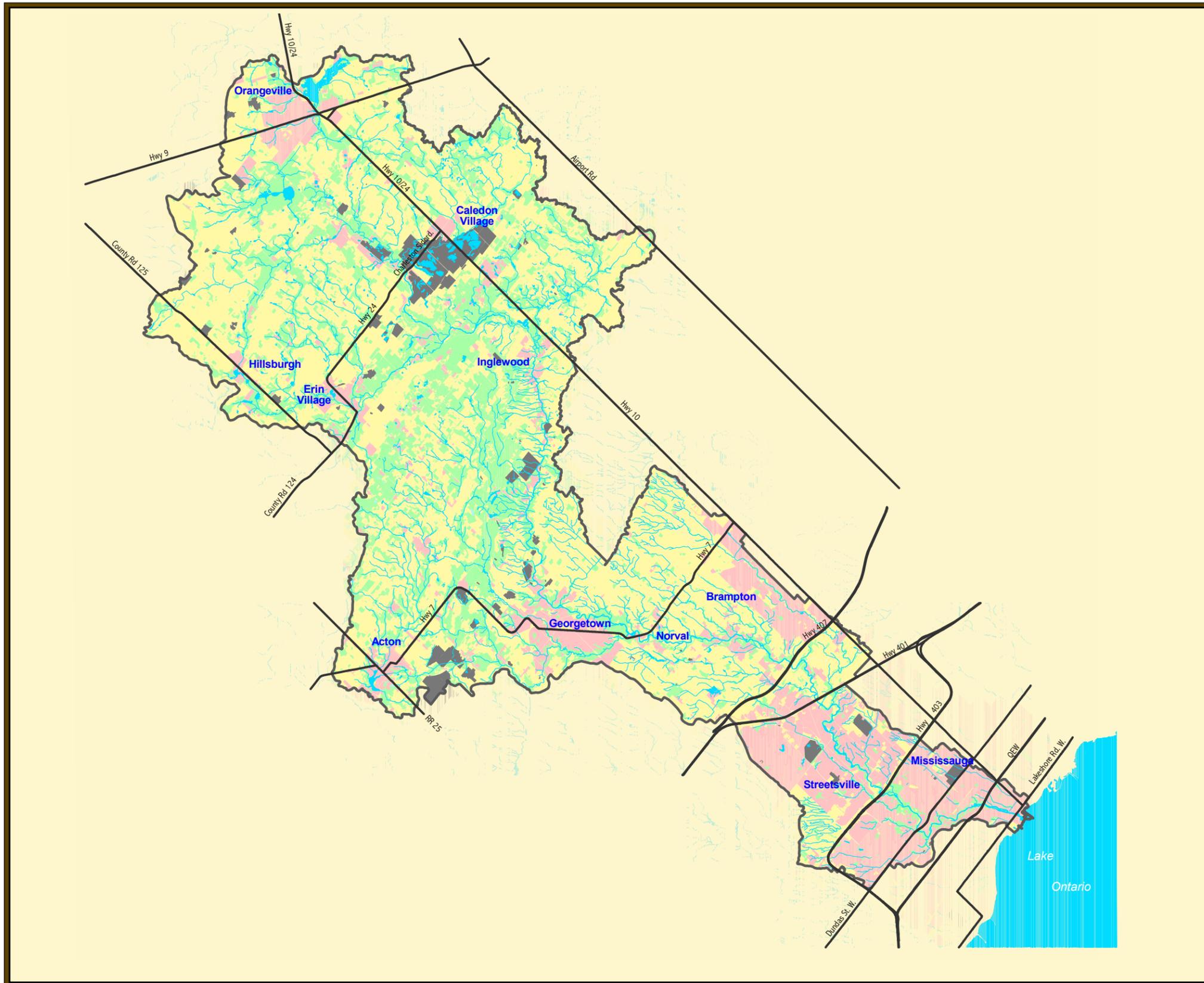


Figure 4. Land use of the Credit River watershed.

- Existing Land Use**
- Natural areas
 - Agricultural / rural areas
 - Urban areas
 - Aggregate extraction areas
- Transportation Network**
- Highway
- Drainage Network**
- Lakes and ponds
 - Rivers and streams
- Credit River watershed boundary

Land use derived from interpretation of 1996 aerial photos.



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Table 5. Current and historical land use in the Credit River watershed.

Land Use	Year	
	1956 ^a	1996 ^b
Natural areas	16.6%	26.5%
Agricultural / rural areas	80.4%	45.7%
Urban / settled areas	3.0%	22.7%
Aggregate extraction areas	N/A	1.5%

^a Department of Planning and Development 1956

^b Based on 1999 Ecological Land Classification data, Credit Valley Conservation

Wetlands are often lost when land use changes. The majority of the remaining wetlands are found in the upper and middle portions of the watershed (Figure 5), while a significant forested area is associated with the Niagara Escarpment (Figure 6). Of particular note, a very high number of golf courses and driving ranges are found scattered throughout the watershed with increasing pressure to develop additional golf courses on large tracts of land.

2.3 Physiography

The Credit River watershed contains three distinct physiographic zones (Figure 7). Each zone is comprised of four to seven subcatchment areas, representing major tributaries or river reaches. The key attributes of each watershed zone have been revised from the *Credit River Water Management Strategy Phase II* (Beak Consultants Limited *et al.* 1992) and are described below.

2.3.1 Upper Watershed

The upper watershed includes all areas north of Inglewood. This section of the watershed lies on or above the Niagara Escarpment, where the main stem of the river and most of the tributaries remain in a relatively natural condition. Baseflow is maintained from springs and groundwater discharge, and water quality is generally good. Significant exceptions to this include Island Lake, the Credit River downstream of the Orangeville sewage treatment plant, and areas surrounding mineral extraction.

The eastern portion of the upper watershed is drained by the East Credit River. This area includes the western limits of the Oak Ridges Moraine, an area dominated by sandy till soils. Dominant vegetation associations include deciduous forest and white cedar swamps. The river valley varies from a complex and highly developed system around the upper end of the Escarpment to flat marshy areas in the headwater regions. The main land use in the area has traditionally been agriculture, however in the past

decade the amount of land under cultivation has decreased significantly. Some of this land may be considered for rural estate development or golf courses.

The major urban centres in the upper watershed include Orangeville, Erin, Alton, Caledon and Hillsburgh. These towns were primarily agricultural centres, but all are now experiencing significant growth due to the increasing population of the Greater Toronto Area.

2.3.2 Middle Watershed

The middle watershed includes the area between Inglewood and Norval. The major feature along this section is the Niagara Escarpment. The top of the Escarpment is a relatively flat plateau, but to the east, the terrain becomes rugged and the eastern edge of the Escarpment is sharply defined by a cliff face. The Credit River in this zone flows through a steep-walled narrow valley. Numerous small spring-fed and seasonal creeks drain over the Escarpment plateau into the main stem of the Credit River.

The two major tributaries of the Credit River in this zone, Silver Creek and Black Creek, begin above the Escarpment. Most of the tributaries arise in massive headwater wetland complexes that cover approximately 40% of the Escarpment plateau. Below the Escarpment, the river cuts through clay plains and is characterized by steep-walled valleys with floodplains of varying widths. The Escarpment plateau is heavily forested with mixed deciduous stands in upland areas and white cedar swamps in lowland regions. Land use on the Escarpment is regulated by the Niagara Escarpment Commission.

Acton and Georgetown are the largest urban centres situated within this watershed zone. Acton is located on Black Creek, while Georgetown is located at the junction of Silver Creek and the main stem of the Credit River. Both Acton and Georgetown have water pollution control plants that discharge into Black Creek and Silver Creek respectively. Serious water quality and aquatic habitat degradation has occurred in the vicinity of these centres (Beak Consultants Limited *et al.* 1992).

2.3.3 Lower Watershed

Below Norval, the lower watershed gradually flattens southward to Lake Ontario in a clay soil tract known as the Peel Plain. This area is highly urbanized and urban growth is anticipated to continue relatively rapidly. The area includes the western edge of Brampton, and most of Mississauga. Many of the tributaries in the lower watershed have been channelized or placed in sewers. Below Highway 401, water quality in the main stem of the Credit and its tributaries is generally poor. Very few wetlands (Figure 5) and woodlots (Figure 6) remain in this portion of the watershed.

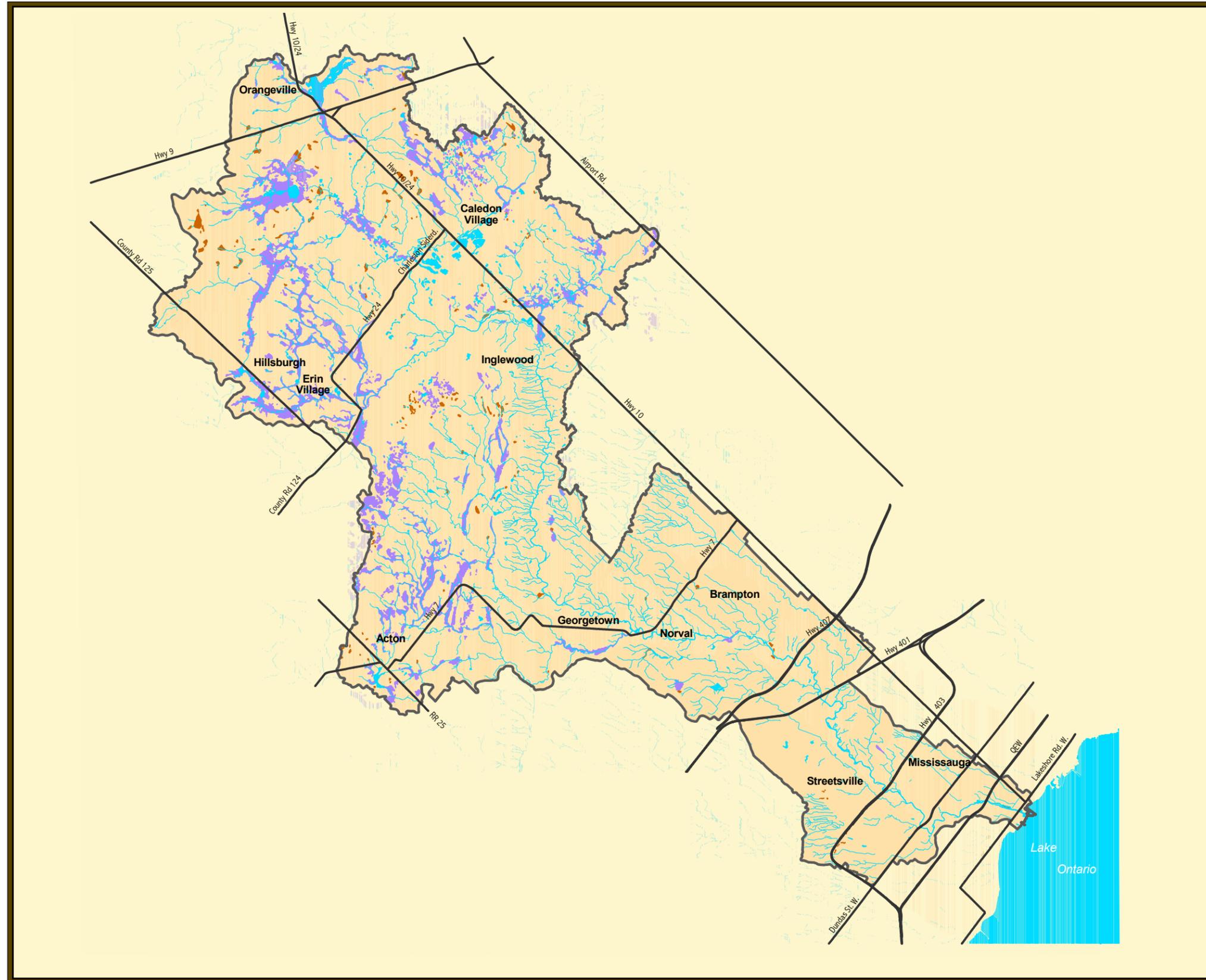


Figure 5. Wetlands of the Credit River watershed.

- Feature Type**
- Evaluated wetland
 - Unevaluated wetland
- Transportation Network**
- Highway
- Drainage Network**
- Lakes and ponds
 - Rivers and streams
- Credit River watershed boundary



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Figure 6. Forest cover in the Credit River watershed.

Feature Type

■ Woodland *

Transportation Network

↘ Highway

Drainage Network

■ Lakes and ponds

↘ Rivers and streams

□ Credit River watershed boundary

* Woodlands consist of forests, swamps, thickets, plantations and cultural woodlots.



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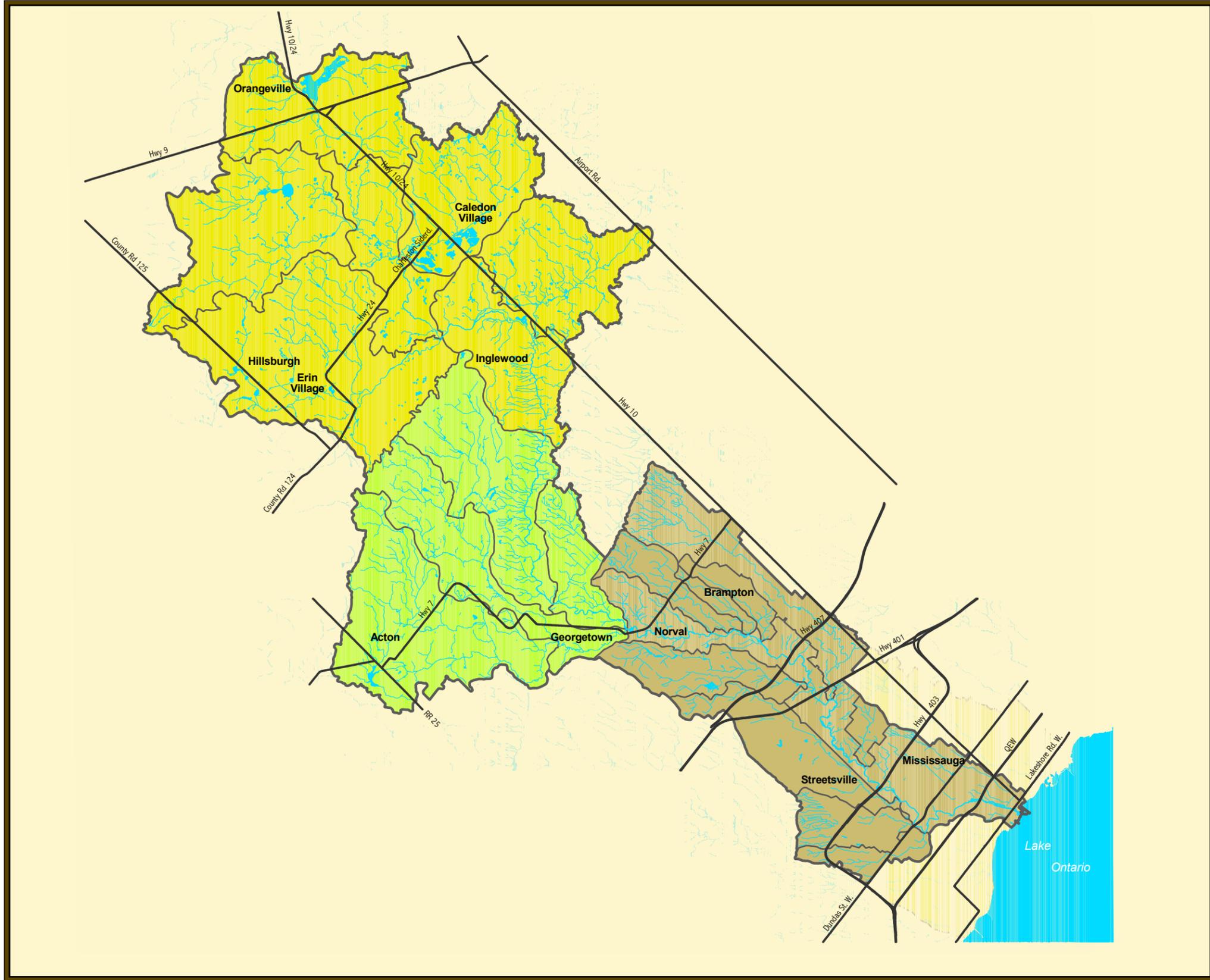


Figure 7. Physiographic zones of the Credit River watershed.

- Zone**
- Upper watershed
 - Middle watershed
 - Lower watershed
- Transportation Network**
- Highway
- Drainage Network**
- Lakes and ponds
 - Rivers and streams
- Credit River watershed boundary
 - Subwatershed boundary



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2.4 Climate

Climate, or the long term average weather condition, helps to shape the natural heritage system. Trends in weather help to establish such things as length of sunlight, wind, amount and timing of precipitation, snow and so on. These factors, in turn, affect the hydrologic cycle, vegetation communities and other aspects of the Credit River watershed.

Despite its relatively small size, the Credit River watershed exhibits considerable diversity, including a mean annual temperature variance of approximately 2.2°C (CVC 1995) between the headwaters and outlet at Lake Ontario. The regional climate of the Credit River watershed varies as you move from the headwaters to the mouth. The upper watershed, above the Niagara Escarpment, has cooler temperatures, longer snow cover, and more wind and rain than the other parts of the watershed. These conditions, in addition to the hummocky terrain, make it ideal for infiltrating precipitation and contributing to the groundwater supply. The Niagara Escarpment has a moderate orographic effect separating the cooler, and more moist region above from the drier, warmer region below. The lower watershed has a much flatter terrain, and experiences a lake effect where it is cooler in summer and warmer in the winter.

External factors alter these natural climatic trends. The effects of global warming due to greenhouse gases is expected to result in the warming of the earth's average temperature, leading to a change in precipitation patterns, a warming of the waters and a stress on the vegetation communities. Also, development is creating hardened surfaces, which can increase local temperatures and create a micro-climatic zone, also known as the heat island effect.

Volume IV of the Canada Country Study (Smith *et al.* 1998) suggests that climate change will compound the stresses aquatic organisms currently experience as a result of watershed modification and contamination by humans, through a number of mechanisms:

- Surface runoff to streams will decrease significantly (*e.g.*, though data are not available for the Credit River, it is estimated at 12% to 35% for the Grand River) and will change in its seasonal patterns.
- Rates of groundwater recharge will decrease significantly (in the order of a 15 to 35% reduction for the Grand River watershed), and groundwater discharge to streams will drop correspondingly (estimated at a 17% to 39% drop for the Grand River).
- Streamflow will decrease by an estimated 8 to 25% across the Great Lakes basin, with the increased possibility of winter floods and decreased summer flow. A greater variability of water levels and flows is also anticipated.
- Summer water temperatures will be warmer, causing a decrease in salmonid and percid (walleye and yellow perch) populations, and a major increase in the area occupied by warm-water communities such as bass.

- Reduced water flow may concentrate pollutants, disrupt nutrient cycling, and increase competition among aquatic organisms.
- Aquatic ecosystems may be more vulnerable to species invasion, particularly by species from the Mississippi and Atlantic coastal basins.

Climate variability and climate change must be taken into consideration when making resource decisions for the fisheries resources of the Credit River.

2.5 Hydrological Characteristics

2.5.1 Water Quantity

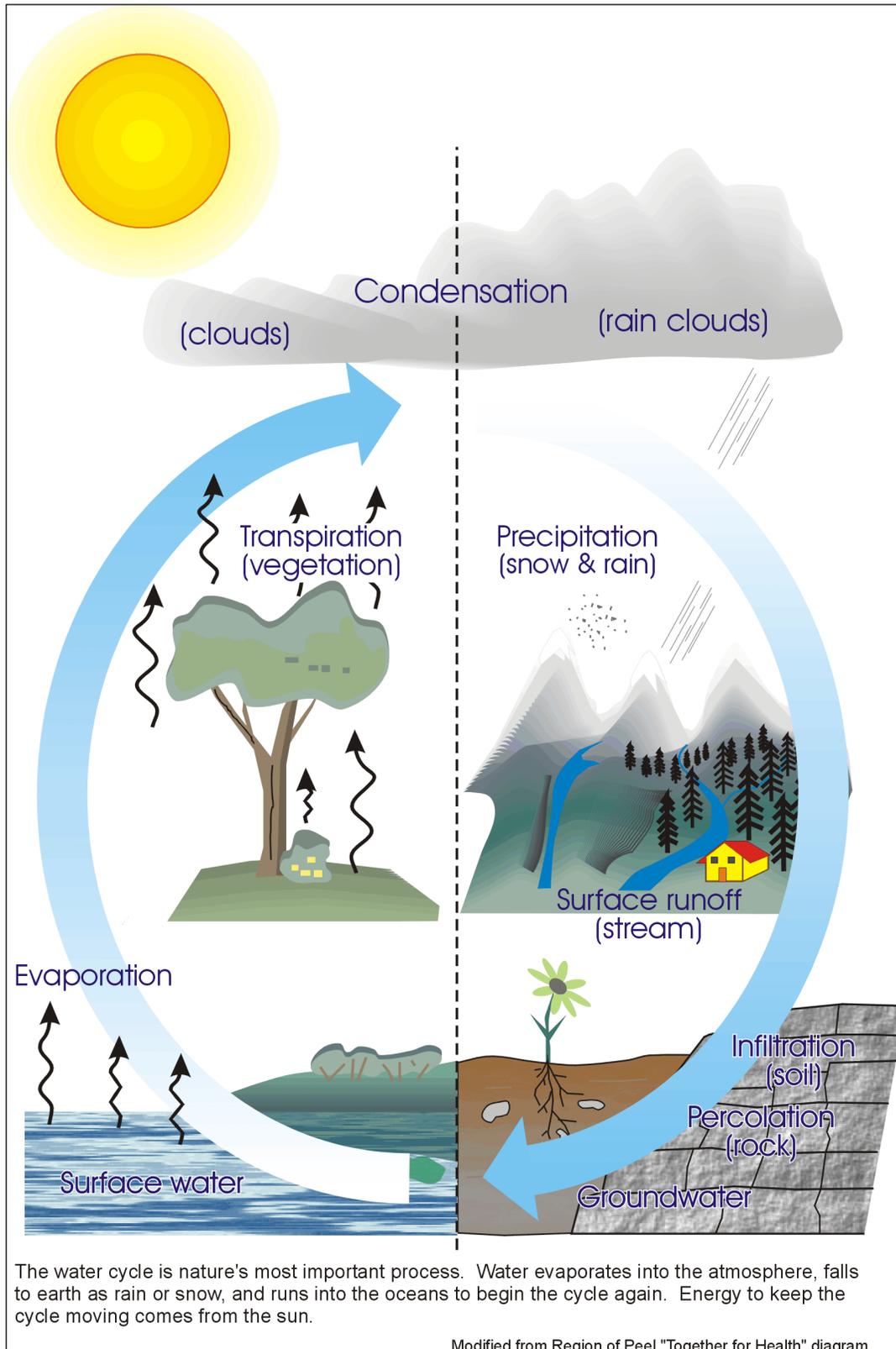
The hydrologic cycle (Figure 8) within the watershed is greatly influenced by climate, topography, surficial soils, land use and vegetation. The topography of the watershed is a direct result of the deposition and erosion processes during glacial and post-glacial times. The Niagara Escarpment, which cuts diagonally across the watershed, is characterized by a sharp topographic break, formed by cliffs of erosion resistant dolostone overlying softer shale. Both surface and subsurface flow is influenced by these factors, resulting in a predominant north to south flow direction. Smaller drainage units, known as subwatersheds (Figure 2), influence flow patterns on a more local scale.

The areas above the Escarpment consist predominantly of materials such as sands and gravels. These permeable materials allow water to soak into the ground and provide extensive recharge capabilities to the groundwater flow system. The areas below the Escarpment consist of clay, silt soils. These soils do not allow water to soak into the ground as quickly as the sands and gravel. As a result, the main areas of high to very high groundwater recharge coincide with the areas above the Escarpment. Numerous areas of groundwater discharge are associated with topographically low areas, such as the valleys of rivers and creeks.

The occurrence, flow and quality of water are also influenced by the underlying geologic conditions. The predominant type of bedrock above the Escarpment is dolomite which has many interconnected openings (fissures and fractures) which are favourable for the storage and transmission of water. The main type of bedrock below the Escarpment is shale which is dense, poorly interconnected and is therefore limited in terms of providing sufficient water supplies.

Water-takings from both ground sources such as wells, and surface sources such as creeks and rivers, occurs for many purposes such as irrigation, drinking water supplies and industrial processes. The demand for water supplies has increased with urbanization and industrialization. The increasing urbanization pressures have influenced the total area of pervious and natural conditions within the watershed. This, in turn, has contributed to changes in the hydrologic regime within the watershed. Increased impervious areas limits the recharge potential, unless steps are taken to ensure that pre and post development infiltration conditions are maintained.

Figure 8. The hydrologic cycle.



2.5.2 Water Quality

In general, the quality of groundwater is influenced by the length of time the water moves through the subsurface and the different materials through which it passes. For example, water passing through shale tends to have higher mineral contents or elevated iron concentrations, while shallower groundwater from the overburden sands and gravels may exhibit higher nitrate concentrations which may have originated from a surface or shallow subsurface source.

Surface water quality has been measured on a regular basis at 14 stations located throughout the watershed over the past 20 years (Figure 9). These stations form part of the Provincial Water Quality Monitoring Network operated by the Ontario Ministry of Environment (MOE). The monitoring program is based on monthly grab samples from each station. CVC monitors additional stations located throughout the watershed. Each sample is measured to ensure they do not exceed the maximum allowable levels set out in the Provincial Water Quality Objectives (PWQO) (Ministry of Environment and Energy 1994).

Several sewage treatment plants are located throughout the watershed (Figure 9). These plants are located downstream of urban centres to treat wastewater. The effluent criteria for the sewage treatment plants, as set by MOEs Certificate of Approval, is meant to protect aquatic life in the receiving stream. One of the many parameters tested included phosphorus (Table 6).

“The PWQOs are set at a level of water quality which is protective of all forms of aquatic life and all aspects of the aquatic life cycle during indefinite exposure to the water. The Objectives for protection of recreational water uses are based on public health and aesthetic considerations.”

Water Management: Policies, Guidelines, Provincial Water Quality Objectives for the Ministry of Environment and Energy (MOE 1994)

Table 6. Water quality parameters measured in the Credit River watershed.

- | | |
|------------------------------------|-------------------------------|
| • solids (suspended & dissolved) | • oxygen-demanding substances |
| • nutrients (phosphorus, nitrogen) | • dissolved oxygen |
| • bacteria | • dissolved salts |
| • phenolics | • trace metals |
| • pH | • hardness |
| • temperature | |

Water quality in the Credit River watershed is generally good, with several parameters increasing over the past 20 years. Due to the removal of phosphates from detergents in the early 1970s and better sewage treatment technologies, phosphorus loading has been significantly reduced, particularly in the upper and middle watershed. However,

some reaches in the upper and middle Credit still have phosphorus levels above the PWQO. Nitrates, bacteria and chlorides appear to be increasing over the last 20 years. There has been no trend analysis on ammonia toxicity, but average volumes over a 20 year period in the middle watershed do not indicate problematic levels (Beak Consultants Ltd. 1993; Ecological Services for Planning and Triton Engineering Services Ltd. 1990). Recent surveys indicate that in some reaches and tributaries of the Credit, dissolved oxygen levels drop significantly at night (CVC unpublished data).

The presence and distribution of brook trout in many tributaries indicates temperatures are suitable for coldwater species. Main river temperatures, however, may be of concern.

High density developments serviced by individual septic systems that are not properly maintained may contribute to elevated nitrate levels. Aging gas stations with leaking underground storage tanks are also a source of introducing pollution into the subsurface. Since groundwater has the potential to discharge to the surface water, there is also a risk of further impacts to watercourses and associated natural features.

There are over 30 waste disposal sites that have been identified in the Credit River watershed. Specific details of their location, type and size are provided in *Groundwater Resources of the Credit River Watershed* (Beak 1991). The majority of the sites are presently closed. Of those that are closed, the type of waste disposed therein is generally known. However, the possible impacts of leachate upon groundwater requires closer study for many of the sites, including the Caledon Sanitary Landfill.

There are a number of ponds, lakes and small tributaries in the watershed for which there is a lack of water quality information. Lakes and ponds have different ecological processes (e.g., stratification) that effect water quality. Therefore water quality trends in the river cannot be applied to ponds and lakes and so site specific assessments will be required. For example oxygen levels in Island Lake can be very low. Currently water quality assessments in lakes and ponds are limited. Sport fish contaminant analysis are being completed for some lakes and ponds.

Several initiatives are now underway to better understand and manage water quality. A five-year watershed-wide water quality study was initiated in January 2000. From this study, a strategy will be developed to guide long-term management of water quality in the watershed. Also, a new watershed monitoring program will integrate the present long term water quality database with other parameters such as benthic invertebrate or fish data to provide a more holistic view of watercourse health.

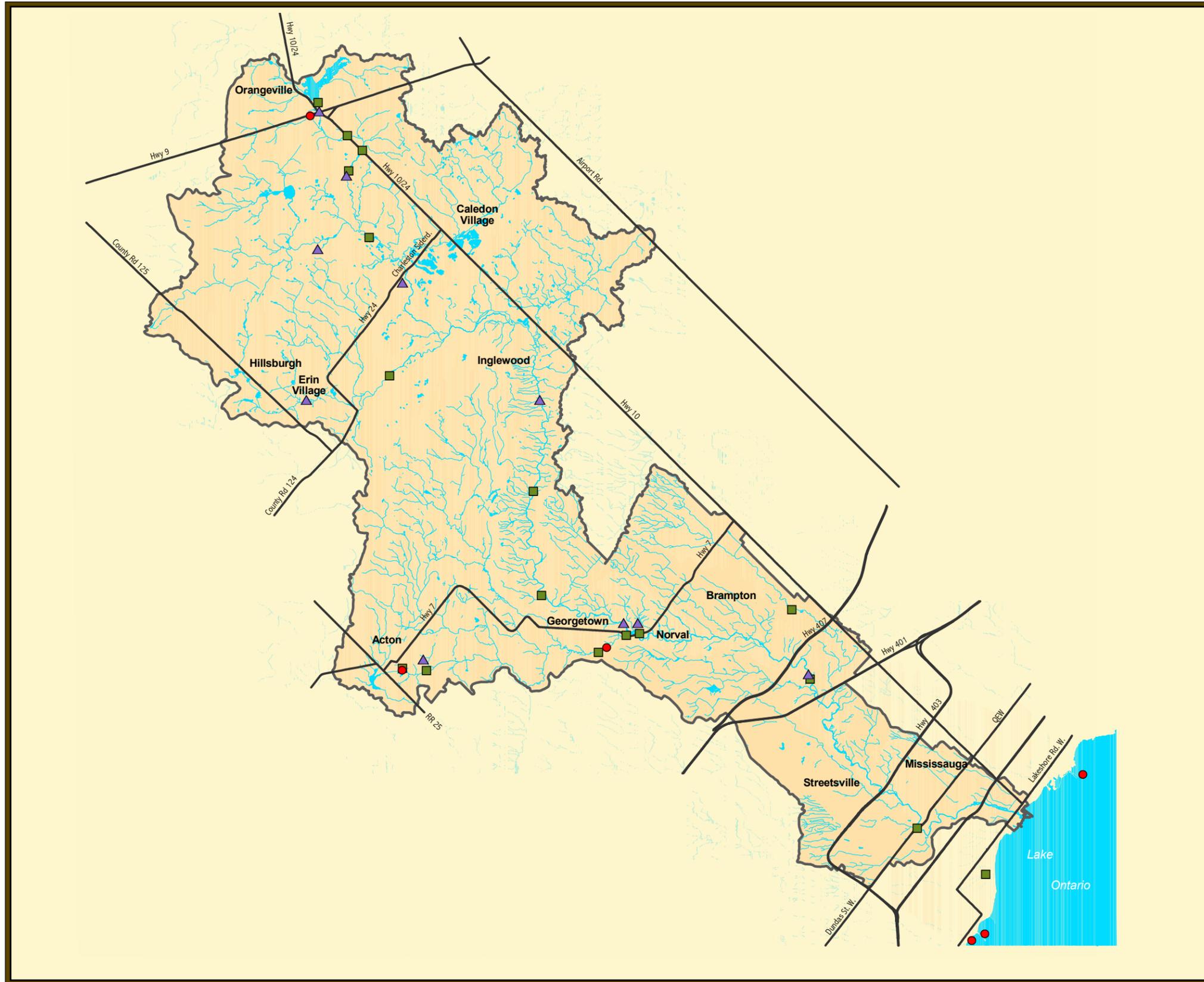


Figure 9. Water quality monitoring stations, gauge stations and sewage treatment plants in the Credit River watershed.

- ▲ Gauge station
- Sewage treatment plant
- Provincial water quality monitoring station

Transportation Network
 ∨ Highway

Drainage Network
 ■ Lakes and ponds
 ∨ Rivers and streams

□ Credit River watershed boundary



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3.0 PRESENT FISH COMMUNITY

3.1 Approach to Fisheries Resource Management

Traditional resource management involved the management of one part of an ecosystem in isolation of all other parts. For example, in the 1980s, efforts were focussed on rehabilitating brook trout habitat through bank stabilization projects for portions of the upper Credit River. However, these projects may have provided a band-aid solution to a larger scale habitat problem. By looking at the channel form and function upstream and downstream of a particular site, appropriate management actions to compliment the characteristics of the stream reach can be used to achieve the most effective solution.

With the creation of *SPOF II* (MNR 1992), fisheries resource management shifted the focus from managing individual species to managing fish communities. For example, projects shifted from managing brook trout populations to managing the coldwater community.

While fish community management provides the context in which fisheries biologists now work, individual fish species are still important to recognize and understand on several levels:

1. Society has placed values on certain species such as sportfish;
2. Ontario's fishing regulations manage the fisheries by species;
3. Each species has unique characteristics and behaviours that require recognition; and
4. Predatory species act as indicators of the fish community as a whole.

This Plan identifies the need to manage the watershed by fish community, but also recognizes the importance of managing individual species.

3.2 Historic and Current Fish Species

The 1956 Department of Planning and Development report cites a 1954 survey that found 36 species of fish in the Credit River watershed. Historically, factors such as deforestation, dams, siltation, thermal warming, agriculture, industry (e.g., Acton tannery), sewage, aggregate extraction, landscape alterations and urbanization had strong negative effects on the river and aquatic life. Interestingly, some of these problems are still occurring, but current studies show almost 60 species are found in the Credit River watershed (Table 7). Some of this increase in fish species diversity is likely attributable to legal and illegal introductions of fish and more effective sampling techniques.

Table 7. Fish species of the Credit River watershed: 1954 and 1999.

COMMON NAME	SCIENTIFIC NAME	1954 ^A	1999 ^B
Lamprey Family	PETROMYZONTIDAE		
American brook lamprey	<i>Lampetra lamottei</i>		X
sea lamprey	<i>Petromyzon marinus</i>		X
Herring Family	CLUPEIDAE		
alewife*	<i>Alosa pseudoharengus</i>	X	
Salmon and Trout Subfamily	SALMONIDAE		
pink salmon*	<i>Oncorhynchus gorbuscha</i>		X
coho salmon*	<i>Oncorhynchus kisutch</i>		X
chinook salmon*	<i>Oncorhynchus tshawytscha</i>		X
rainbow trout*	<i>Oncorhynchus mykiss</i>	X	X
Atlantic salmon	<i>Salmo salar</i>		X
brown trout*	<i>Salmo trutta</i>	X	X
brook trout	<i>Salvelinus fontinalis</i>	X	X
lake trout	<i>Salvelinus namaycush</i>		X
Pike Family	ESOCIDAE		
northern pike	<i>Esox lucius</i>	X	X
Mudminnow Family	UMBRIDAE		
central mudminnow	<i>Umbra limi</i>	X	X
Sucker Family	CATOSTOMIDAE		
white sucker	<i>Catostomus commersoni</i>	X	X
northern hog sucker	<i>Hypentelium nigricans</i>	X	X
Redhorse	<i>Moxostoma sp.</i>	X	
silver redhorse	<i>Moxostoma anisurum</i>		X
Minnow Family	CYPRINIDAE		
goldfish*	<i>Carassius auratus</i>		X
northern redbelly dace	<i>Phoxinus eos</i>	X	X
finescale dace	<i>Phoxinus neogaeus</i>	X	X
reidside dace	<i>Clinostomus elongatus</i>	X	X
carp*	<i>Cyprinus carpio</i>		X
brassy minnow	<i>Hybognathus hankinsoni</i>		X
hornyhead chub	<i>Nocomis biguttatus</i>	X	
river chub	<i>Nocomis micropogon</i>		X
golden shiner	<i>Notemigonus crysoleucas</i>		X
emerald shiner	<i>Notropis atherinoides</i>		X
common shiner	<i>Luxilus cornutus</i>	X	X
blacknose shiner	<i>Notropis heterolepis</i>	X	
spottail shiner	<i>Notropis hudsonius</i>		X
rosyface shiner	<i>Notropis rubellus</i>	X	X

COMMON NAME	SCIENTIFIC NAME	1954 ^A	1999 ^B
spotfin shiner	<i>Cyprinella spilopterus</i>		X
mimic shiner	<i>Notropis volucellus</i>	X	
bluntnose minnow	<i>Pimephales notatus</i>	X	X
fathead minnow	<i>Pimephales promelas</i>	X	X
blacknose dace	<i>Rhinichthys atratulus</i>	X	X
longnose dace	<i>Rhinichthys cataractae</i>	X	X
creek chub	<i>Semotilus atromaculatus</i>	X	X
pearl dace	<i>Semotilus margarita</i>		X
Catfish Family	ICTALURIDAE		
brown bullhead	<i>Ictalurus nebulosus</i>	X	X
stonecat	<i>Noturus flavus</i>		X
Killifish Family	CYPRINODONTIDAE		
banded killifish	<i>Fundulus diaphanus</i>	X	
Stickleback Family	GASTEROSTEIDAE		
brook stickleback	<i>Culaea inconstans</i>	X	X
Sunfish Family	CENTRARCHIDAE		
rock bass	<i>Ambloplites rupestris</i>	X	X
pumpkinseed	<i>Lepomis gibbosus</i>	X	X
smallmouth bass	<i>Micropterus dolomieu</i>	X	X
largemouth bass	<i>Micropterus salmoides</i>	X	X
black crappie*	<i>Pomoxis nigromaculatus</i>		X
Perch Family	PERCIDAE		
yellow perch	<i>Perca flavescens</i>		X
rainbow darter	<i>Etheostoma caeruleum</i>	X	X
lowa darter	<i>Etheostoma exile</i>	X	X
fantail darter	<i>Etheostoma flabellare</i>	X	X
johnny darter	<i>Etheostoma nigrum</i>	X	X
logperch	<i>Percina caprodes</i>	X	
walleye	<i>Stizostedion vitreum</i>		X
Sculpin Family	COTTIDAE		
mottled sculpin	<i>Cottus bairdi</i>	X	X
slimy sculpin	<i>Cottus cognatus</i>	X	

*Indicates species not native to the Credit River watershed.

(^A Department of Planning and Development 1956, ^BMNR unpublished data, CVC unpublished data)

Those species that are directly managed by partitioning, or have special protection status are discussed in the following section in terms of their management history, preferred habitats and life cycles. Life cycle descriptions for the major game fish in the Credit River were compiled through input from the Steering and Technical Committees.

A summary of the in- and out-migration, fry emergence and spawning times are found in Figure 10 and Table 8. These tables were used in the decision-making process for managing fish migration in the Credit River. The various species of fish are organized and described under the following categories: 1) native species; 2) exotic, introduced and naturalized species; 3) vulnerable, threatened and endangered species.

3.2.1 Native Species

Pre-settlement fish communities in the Credit River and in Lake Ontario are quite different than those found today. Through introductions, both legal and illegal, the number of species in the Credit has increased considerably. For example, historically the only native salmonids found in the Credit River watershed were brook trout, Atlantic salmon and lake trout in the lower reaches. Today, 8 salmonid species are potentially found in the watershed.

3.2.1.1 Atlantic salmon

Documentation from the first European settlers in the Credit River watershed indicated Atlantic salmon were plentiful. Large spawning runs were seen in the river and the young fish remained in the river 1 or 2 years before migrating to the lake. Atlantic salmon were found in the main river up to Cataract, where they were stopped by the natural falls at the Niagara Escarpment. Salmon that entered into the West Credit River most likely had access to the headwaters of that system, above the Belfountain falls. The existing Belfountain dam at these falls is a barrier to salmon migration.

Atlantic salmon were last reported in the Credit River around 1847 (Department of Planning and Development 1956). Their demise was the result of over harvesting, habitat degradation due to land use change and dams in the rivers which prevented them from reaching their preferred spawning habitat during migration. The re-establishment of a self-sustaining population of this natural heritage species in the Credit River would provide an excellent indication of ecosystem health because Atlantic salmon require high quality riverine habitats for reproduction.

“...This river has long been celebrated for it’s salmon fishing, immense quantities have been annually taken, in the spring, during their passage up the stream to deposit their spawn. But, from the great number of mills which have been erected on the river during the last four years, the fishing is destroyed, the salmon being unable to make their way over the dams. Immense quantities of lumber are sawn at the mills on the river, and shipped at Port Credit.” (Smith 1846)

Historically, Terra Cotta was known as ‘Salmonville’

Figure 10. Peak periods of in-migration, spawning, fry emergence and out-migration of selected fish species found in the Credit River.

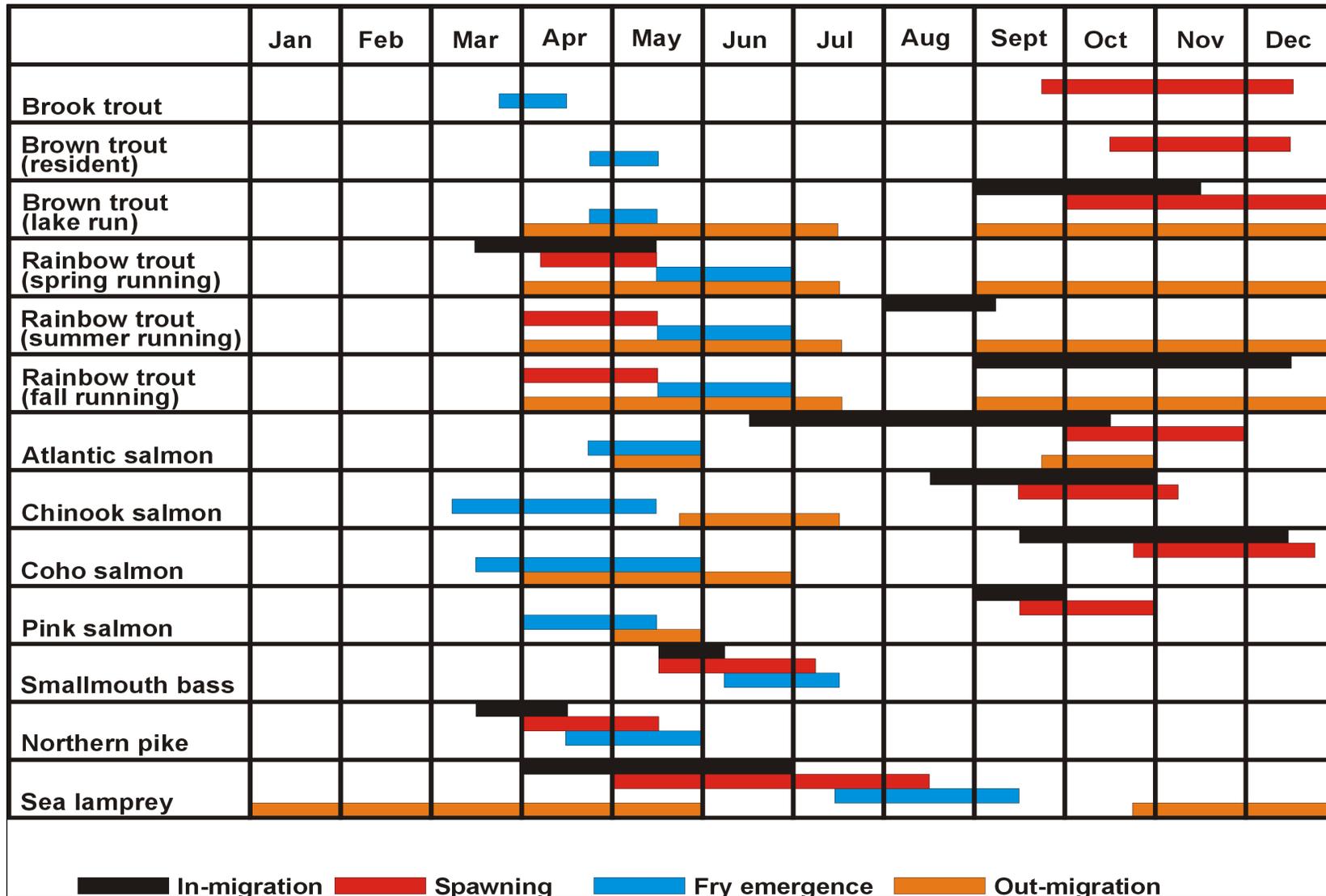


Table 8. Life history characteristics of select fish species found in the Credit River.

Species	Spawning Period	Swim-up Fry Emergence	Age at Maturity	Length at Maturity – females (cm)	River Residency	Out - Migration (smolt)		Lake Residency (summers)	In - Migration	
						When	Age (yrs)		When	Age (yrs)
Brook trout	Late Sept – mid Dec	Late Mar - mid Apr	2 male 3 female	> 20	5 - 8 years	<i>river residents</i>				
Brown trout (resident)	Mid Oct – mid Dec	Late Apr - mid May	3 male 4 female	> 35	6 - 8 years	<i>river residents (N.B. after spawning, adults will likely move downstream to overwintering areas)</i>				
Brown trout (lake run)	Beginning of Oct – end of Dec	Late Apr - mid May	2 - 4	> 35	1 - 3 years	Beginning of Apr – mid July & Beginning of Sept – end of Dec	1 - 3	1 - 5	Beginning of Sept – mid Nov	2 - 6
Rainbow trout (spring running)	Beginning of Apr – mid May	Mid May – end of June	2 - 5	> 60	1 - 3 years	Beginning of Apr – mid July & Beginning of Sept – end of Dec	1 - 3	2 - 6 male 3 - 6 female	Mid Mar – mid May	2 - 8
Rainbow trout (summer running)	Beginning of Apr – mid May	Mid May – end of June	2 - 5	> 60	1 - 3 years	Beginning of Apr – mid July & Beginning of Sept – end of Dec	1 - 3	2 - 5	Beginning of Aug – early Sept	2 - 8
Rainbow trout (fall running)	Beginning of Apr - mid May	Mid May – end of June	2 - 5	> 60	1 - 3 years	Beginning of Apr – mid July & Beginning of Sept – end of Dec	1 - 3	2 - 6 male) 3 - 6 female	Beginning of Sept - late Dec	2 - 8
Atlantic salmon	Beginning of Oct – end of Nov	Late Apr – end of May	3 - 5 male 4 - 6 female	> 60	1 - 3 years	Month of May & late Sept – end of Oct	1 - 3	1 - 4 male 2 - 4 female	Mid June - mid Oct	2 - 8
Chinook salmon	Mid Sept – early Nov	Early Mar - mid May	2 - 4	> 80	few weeks (mostly) to 1 - 2 years	Late May – mid July	0+ - 2	2 - 4	Mid Aug – end of Oct	2 - 5
Coho salmon	Late Oct - late Dec	Mid Mar – end of May	3 - 5 male 4 - 6 female	> 60	0 - 1 year	Beginning of Apr – end of June	0 - 1	1 - 2 male 2 - 4 female	Mid Sept – mid Dec	2 - 3
Pink salmon	Mid Sept – end of Oct	Beginning of Apr – mid May	2			Month of May	0+		Month of Sept	
Smallmouth bass	Mid May – early July	Early June – mid July	4 - 5	> 30	~ 17 years	<i>General dispersal</i>			Mid May – early June	
Northern pike	Beginning of Apr - mid May	Mid Apr – end of May	2 - 3	> 50	~ 15 years	<i>General dispersal</i>			Mid Mar – mid Apr	
Sea lamprey	Beginning of May – mid Aug	Mid July - mid Sept.	4		3 - 4 years	Late Oct – end of May	3 - 4	1 - 1 ¾	Beginning of Apr – end of June *	4 - 19

*Pers. comm. Andrew Hallett, DFO - Sea Lamprey Control 2001.

The Atlantic Salmon Restoration Plan for Lake Ontario (MNR 1995), led by the MNR, Lake Ontario Management Unit, is a 20-year plan designed to assess the feasibility of re-establishing Atlantic salmon in the Lake Ontario basin. To date, the program has completed 5 years of research and the analysis of the data will guide future steps for the program. A synopsis of the 5 years of research is anticipated in the year 2001.

Current fishing regulations protect returning adult Atlantic salmon from angling in the Credit River above the QEW. Below the QEW and in Lake Ontario, there is a daily catch and possession limit of one Atlantic salmon, with a minimum size of 63 cm (24.8 inches) for a sport fishing licence, and a zero catch and possession limit for a conservation licence.

3.2.1.2 Brook trout

Resident brook trout populations require high quality habitats including clear, well-oxygenated, cold streams making them excellent indicators of ecosystem health. Supplementary stocking efforts for brook trout were conducted off and on from the 1940s through to 1981 in Black Creek, Silver Creek, West Credit River, Terra Cotta Conservation Area and the main Credit River (MNR unpublished data). Today brook trout are generally found in the main river and tributaries that occur above and along the Niagara Escarpment. They are also found throughout Black Creek, Silver Creek and the East Credit River.

Brook trout have survived in the more pristine reaches of the watershed sustained by groundwater discharge near and above the Escarpment. In fact, one of the highest biomass locations of brook trout on a large river in southern Ontario can be found in the Credit River watershed at Regional Road 24 (formerly Highway 24). Spawning surveys for brook trout have been conducted on an annual basis.

Currently, brook trout are segregated from potential competition with rainbow trout and Pacific salmon throughout the upper watershed, and upper Black and Silver Creek through barrier management.

3.2.1.3 Northern pike

The northern pike is native to all of the Great Lakes, however, in the Credit River their distribution has expanded from the Lake Ontario waterfront and lower Credit River, to the entire main stem of the Credit River system. The increase in distribution of the pike can be attributed to the illegal stocking of Island Lake many years ago, and the resulting downstream movement of pike through the discharge pipe into the main branch of the Credit River. There are concerns for the potential impacts these pike may have on the largemouth bass population in Island Lake and on the brook trout population in the upper Credit. Pike have also been historically found in Fairy Lake.

Pike prefer clear, warm, slow, meandering, heavily vegetated rivers or warm, weedy bays of lakes or reservoirs. In general, they spawn in the heavily vegetated shallows or

floodplains of rivers, marshes and bays of lakes or reservoirs. Spawning may occur in the main Credit River, however young-of-the year pike have only been found in Monora Creek, upstream of Island Lake.

Under the present management plan, several measures have been taken to control pike populations beyond their natural distribution:

1. Pike Derbies have been held on an annual basis in the winter and spring to control pike populations in Island Lake. Fish from the spring derbies have been transferred to other waterbodies while fish from the winter derbies have been harvested.
2. The upper Credit fishery is not actively managed for pike, rather the upper Credit is managed for a coldwater brook trout fishery.
3. A screen over the discharge pipe at the south dam of Island Lake, which is also the beginning of the main branch of the Credit River, prevents the movement of the pike downstream.

Even with these preventative measures, there are concerns that the pike are moving over the south dam into the main Credit River.

3.2.1.4 Smallmouth bass

Smallmouth bass is a legendary fish attracting many anglers worldwide. Smallmouth bass can be found in the shallows of lakes and large rivers with rock or log cover and in coolwater systems. In the Credit River watershed, smallmouth bass are common in Lake Aquitaine, along the Lake Ontario waterfront and in the lower Credit River downstream of the Streetsville Dam.

Prior to the construction of the Streetsville Dam, it is thought that smallmouth bass were found upstream to a point where habitat is no longer suitable. Several theories for the disappearance of smallmouth bass above Streetsville have been proposed, including Streetsville Dam preventing the seasonal migration of smallmouth bass to and from overwintering habitat in Lake Ontario, extreme summer and/or winter conditions, or overfishing.

In the early 1990s, smallmouth bass were collected from the Credit River at Erindale Park and transferred to the Credit River at Meadowvale in an attempt to establish a self-sustaining smallmouth bass population above the Streetsville Dam. Due to the low number of young-of-the-year fish transferred and the likely downstream homing tendencies of adult smallmouth bass these transfers were not likely successful.

Currently, the Streetsville Dam prevents smallmouth bass from migrating upstream.

3.2.1.5 Largemouth bass

Largemouth bass are native to the lower watershed. Largemouth bass are a popular sportfish, having broad distribution in the Credit River watershed. Scattered populations of largemouth bass occur in the main river and some of its tributaries such as Monora

Creek. However, they are mostly successful in ponds and lakes, such as Island Lake, Fairy Lake, Lake Aquitaine, Stanley Park, Roman Lake, and Ken Whillans, plus several other smaller ponds.

Largemouth bass prefer the upper levels of small, shallow lakes or shallow bays of larger lakes. Although smallmouth and largemouth bass are often found in the same lake, their habitats seldom overlap.

Currently, largemouth bass are managed in Lake Aquitaine as an urban fishery and at Island Lake as a potential trophy bass fishery. They are also actively managed in Wolf Lake at Terra Cotta, Ken Whillans Resource Management Area and other ponds in the watershed. Largemouth bass are not actively managed in the main river or its tributaries.

3.2.2 Exotic, Introduced and Naturalized Species

Stocking is generally discouraged because stocking can result in the introduction of exotic species, the loss of unique genetic material and fisheries that are not self-sustaining. On the other hand, stocking can be beneficial for the re-establishment of a fishery or the naturalization of a species. Nevertheless, hatcheries do play an important role in maintaining a number of angling opportunities.

Fish are also introduced illegally in the watershed through the emptying of baitbuckets and intentional introductions.

Angler reports and fish monitoring programs indicate that some fish may be escaping from hatchery facilities into the Credit River. The MNR is currently developing and preparing to implement new hatchery policies. These policies will set the minimum standards for hatcheries, including methods to control fish from escaping.

Many introduced and naturalized species continue to interact within the native fish community. With continued urban growth, climate change, increased water demand, conservation efforts and management plans, fish communities can be expected to change in the future.

SPOF II (MNR 1992) recognizes that “naturally reproducing fish communities, based on native fish communities, provide predictable and sustainable benefits with minimal long-term cost to society”.

Exotic species: a species not present in Ontario

Introduced species: a species relocated to an area where it does not occur naturally. Introductions can be deliberate or accidental, and can include exotic species, naturalized species, and native species which are stocked beyond their natural range

Native species: a species indigenous to a particular region or area

Naturalized species: an introduced species which is now self-sustaining

SPOF II (MNR 1992)

Introduced species that threaten the Credit River fishery include the round goby, river ruffe, carp and goldfish.

3.2.2.1 Brown trout - Migratory

Migratory brown trout are stocked on an annual basis in Lake Ontario and its tributaries such as Duffins Creek and Bronte Creek to provide nearshore fishing opportunities. During the fall migratory run, some brown trout can be found in the lower Credit River.

Currently, migratory brown trout are stocked annually below the Norval dam by the Credit River Anglers Association for a put, grow and take fishery, and their fall migration in the Credit River is stopped at the Streetsville Dam, where they are selectively passed above the dam and subsequently stopped by the Norval dam.

3.2.2.2 Brown trout - Resident

Records indicate that brown trout were stocked in the Credit River watershed from 1948 to 1957, with one additional stocking that took place in 1981 (MNR unpublished data). Now established in the Credit River system as a naturalized species, the brown trout is one of the more elusive fish sought after by anglers. Brown trout have a competitive co-existence with brook trout, but due to their temperature tolerances their range extends further downstream into the cold/cool water habitats.

The brown trout is found mostly in the main Credit River with abundant populations found in the Inglewood and Forks of the Credit areas. Scattered populations are found further downstream in the river and in the tributaries of the East Credit River, lower Black Creek, lower Silver Creek and the lower West Credit River. Barriers have excluded them from the upper reaches above Belfountain and Cataract and the East Credit River.

Spawning surveys for resident brown trout are conducted on an annual basis. Young brown trout may be misidentified as Atlantic salmon.

Currently, lower Silver Creek and the main river from Norval to the Niagara Escarpment is managed as a coldwater community, which includes brown trout.

3.2.2.3 Pacific salmon

After Atlantic salmon and lake trout populations in Lake Ontario declined, Pacific salmon were introduced to fill the same ecological niche. Chinook and coho salmon were stocked into Lake Ontario to introduce a top predator and to provide sport fishing opportunities. Though Pink salmon have never been stocked into Lake Ontario, there are reports of pink salmon in the Credit River. However this species of fish is not actively managed in Lake Ontario or its tributaries. The MNR - Lake Ontario Management Unit does, however, continue to stock chinook and coho salmon annually in the Credit as part of a put, grow and take fishery. The stocking has become a

management success in terms of socio-economic benefits, such as the Lake Ontario Salmon Hunt and active charter industry.

The Credit River plays a very important role in the stocking of Pacific salmon. All of the chinook and coho salmon that are stocked into Lake Ontario are the result of eggs that are collected annually from the fall migration run in the Credit River at the Streetsville Dam. As well, chinook and coho salmon are stocked annually in the Credit River above the Streetsville Dam at Norval, Huttonville and Eldorado Park to ensure the return of the fish for egg collections. The stocked fingerlings migrate to Lake Ontario within a few months of release, but they return to the Credit to spawn at age 4 for Chinook salmon and age 3 for coho salmon. Although the majority of Chinook salmon are prevented by the Streetsville dam from migrating to coldwater areas more suitable for successful spawning, some fish do pass over the dam to the Norval dam. Based on assessment work (Bowlby *et al.* 1998), the Credit River produces significant numbers of wild Chinook salmon smolts. The study by Bowlby *et al.* (1998) also indicated the Chinook salmon spawning habitat may be suitable below the Streetsville dam. The young fish leave the river before the river gets too warm for survival. Questions still remain about the survival of these fish that have prematurely entered the lake. This issue must be addressed and integrated by this plan and the Lake Ontario Fish Community Objectives (Stewart *et al.* 1999).

Significant natural reproduction of Chinook salmon is occurring in the Credit River, although this may be limited by the Streetsville Dam preventing Pacific salmon from migrating to coldwater areas more suitable for successful spawning. The Pacific salmon are considered to be an introduced species in the watershed.

In the event that chinook or coho salmon pass the Streetsville dam, they are stopped from moving further upstream at the Norval dam.

3.2.2.4 Rainbow trout - Migratory

Rainbow trout, originating from the west-coast of North America, have been stocked and subsequently naturalized in many lakes and rivers in Ontario. The present rainbow trout stocking program in the Credit River began in 1970, in an effort to utilize the abundant alewife populations in Lake Ontario and provide sport fishing opportunities.

A significant spring run of rainbow trout from Lake Ontario occurs in the Credit River, with a smaller spawning run in the fall. The fall migratory rainbows are selectively passed above the Streetsville Dam for increased natural reproduction. Once above the dam, these fish have access up to the Norval dam where it is anticipated these fish have increased spawning success.

Prior to this fisheries management plan, rainbow trout access above the Norval dam was recognized as a management option, but was limited to experimental transfers. As well, the Maple District Fisheries Management Plan (MNR 1988) permitted rainbow trout

access above the Norval dam to the electric barrier in Inglewood in the early 1990's, while the electric barrier was functional.

Currently, rainbow trout are stocked on an annual basis above the Norval Dam to ensure they return to the Credit River, increasing angling opportunities in the lower Credit and Lake Ontario.

3.2.2.5 Sea Lamprey

Sea lamprey are likely not indigenous to Lake Ontario, rather, scientific evidence indicates they gained access to Lake Ontario from the Hudson River via the New York Erie Canal, which opened in 1819. (Aron and Smith 1971, Krueger 1980, Brussard *et al.* 1981, Wright *et al.* 1985). The parasitic sea lamprey pose a significant threat to the salmonids in Lake Ontario. Therefore, their populations are controlled by dams which prevent their spawning migrations from gaining access to spawning areas in tributaries, such as the Credit River, and by chemical applications by the DFO – Sea Lamprey Control.

To effectively prevent the upstream migration of sea lamprey above a barrier, a minimum 40 cm high dam face and steel lip is needed (pers. comm. Andrew Hallett DFO – Sea Lamprey Control 2001). Streetsville Dam has been fitted with a steel lip along the top of the dam.

Sea lamprey prefer gravelly rivers for spawning and sandy or soft bottom systems for burrowing. The Credit River offers these habitat conditions. Therefore, sea lamprey in the Credit River, are stopped at the Streetsville Dam, where they are anticipated to have limited success.

Furthermore, DFO also controls the sea lamprey populations through lampricide applications both upstream and downstream of the Streetsville Dam. This process is both time consuming and expensive.

3.2.2.6 Fish Stocking

Ponds that are not connected to Ontario waters and are not in the flood plain do not require permits from the MNR for fish stocking. All other ponds require a *License to Stock Fish*. Ponds represent opportunities for creating new fishing opportunities in the Credit River basin.

Some species, such as Northern Pike, have been introduced in the Credit River through transfers. These transfers can seriously damage fish populations and are illegal, including the release of baitfish, crayfish or any other live fish, except into the body of water from which they were taken (MNR 1999). Species introduced in the Credit River watershed, both legally and illegally, include: carp, goldfish, brown bullhead, pumpkinseed, rock bass, yellow perch, black crappie, northern pike, largemouth and

smallmouth bass and several baitfish. Some of these species have become established in certain areas of the watershed and have overtaken the native fish community.

3.2.3 Vulnerable, Threatened and Endangered Species

3.2.3.1 Redside Dace

Redside dace have been found in a number of locations in the Credit River watershed, most of which are being impacted by land use changes. This species is classified as threatened with extinction by the Committee On the Status of Endangered Wildlife In Canada (COSEWIC) and thereby is protected under the *Provincial Policy Statement* (Province of Ontario 1997). This plan supports the recommendations of the Redside Dace Recovery Plan (in development).

The threatened redside dace has a limited range in Ontario, occurring in clear streams flowing into western Lake Ontario (Scott and Crossman 1973). Redside dace prefer coolwater habitats with overhanging vegetation, and are sensitive to turbidity. The vegetation provides the fish with cover and a source of invertebrate forage. Fish collection records for the Credit River watershed indicate the redside dace occur throughout much of the watershed, including the middle river, Black Creek, Silver Creek, and Huttonville Creek, Fletchers Creek, Rogers Creek, Springbrook Creek and Caledon Creek.

Currently, redside dace are managed as a coolwater species and efforts are being made to protect and enhance the overhanging vegetation along the streambanks where redside dace are found.

3.3 Fish Community Diversity and Productivity

There are a number of fish species in the Credit River for which there is a poor understanding of their life history and status, though they are an important part of the fish community. Along with community diversity and productivity measurements, some of these species act as valuable environmental indicators for the aquatic ecosystem and the land from which it drains. Fish communities are a product of habitat conditions including water quality and quantity, and the physical features of a watercourse.

At a watershed scale, the River Continuum Concept predicts rivers increase in productivity as you move downstream (Vannote *et al.* 1980). This is related to increased sunlight reaching the water column as streams widen, and shade trees become less effective, resulting in increased water temperatures. These larger warmwater streams also provide more diverse habitats, and therefore more diverse and productive aquatic communities (Larimore 1981).

In small upstream reaches, decaying terrestrial plant litter is the main energy source. Fewer and smaller animals such as bacteria and invertebrates, also known as

“shredders”, reside in these areas. As more sunlight reaches the stream, the growth of algae and other plants increases and are eaten by invertebrate “grazers” and fish. Further downstream, predatory insects and greater fish populations are found.

Larger streams allow for the partitioning of fish species due to preferred stream depths and with greater access to nutrient-rich sedimentary and wetland environments in the floodplains or river mouth. Both the increase in habitat productivity and diversity is reflected in fish communities. The increase in fish diversity downstream has also been well documented (Hynes 1970, Evans and Noble 1979, Lotrich 1973).

Before we can utilize diversity and productivity measurements to estimate the health of a fish community, we must develop a model to predict potential fish communities. The model for the Credit River is discussed in the following section.

3.4 Fish Habitat Management

3.4.1 Management Zones

Fish communities are known to be associated with three broad environmental conditions:

- Coldwater: Fish community comprised primarily of fish species intolerant of water temperatures that exceed 22°C. Communities usually found only in groundwater rich areas.
- Mixed Water: Fish communities comprised of fish species that can tolerate more variable water temperatures and conditions. This will include species that are coolwater tolerant and some species of salmonids that can tolerate maximum summer temperatures up to 24°C for brief periods of time. Communities usually found where occasional groundwater discharges occur.
- Warmwater: Fish communities comprised of species that are highly tolerant of wide temperature and flow fluctuations and can withstand temperatures in excess of 26°C for prolonged periods of time. Communities usually found where groundwater discharge is minimal.

These broad environmental conditions are determined by the geology and climate of an area, and are valuable tools in predicting historical fish species composition and setting restoration targets.

Possible reasons for deviation from these categories and from historical presence can include land use changes such as the modification of vegetation cover, groundwater volumes and surface water hydrology, and other significant modifications such as dams and other on-line impoundments. Other differences to potential fish communities have been attributed to the extension of the influence of coldwater discharge areas downstream or the existence of minor or seasonal aquifers. By managing habitat, or

land use change, we can significantly reduce the number of negative impacts development can have on fish communities.

3.4.2 Methodology

A technical sub-committee comprised of fisheries biologists, developed a methodology to predict fish communities for the Credit River system. The methods included comparing the existing fish community and the fish community predicted from physiography. The sub-committee divided into two groups: one group focussing on the prediction model and the other group focussing on the existing fish communities.

The prediction model is based on the approach that geology and climate create potential conditions or habitat suitable for specific fish communities. Information on each portion of the watershed was assessed and analyzed in a specific sequence:

1. Composition and structure of bedrock;
2. Composition and location of overburden;
3. Overburden thickness and valley cross-section;
4. Human-based modifications; and
5. Local climatic conditions.

A fish community map was then produced that assessed the functions such as groundwater contributions, temperature and flow potential in relation to the three major fish community types of coldwater, mixed water and warmwater (Figure 11).

The biological classification group used fish species distribution data collected on the Credit over the past 30 years (Figure 12) to map fish communities. Three major community classifications were used (Table 9) for this portion of the study, but additional sub-divisions were made in order to provide a greater level of detail.

3.4.3 Results

There is a high correlation between fish habitat potential derived from physiography (Figure 11) and the existing fish communities (Figure 12). This confirms that physiography is a good predictor of fish communities. Though the physiography predicts the native communities, these communities are not necessarily in a healthy state because the analysis was only based on presence or absence of indicator species.

The resulting overlay in maps, or Fish Community Management Zones (Figure 13), will be used by planners and biologists to guide fisheries management decisions, including the review of development proposals and species mix issues, and by non-government agencies when determining rehabilitation projects. This provides a valuable tool for government agencies, non-government organizations and the public to better understand and manage the watershed. A description of the aquatic community management zones is found in Table 9. A discussion of the species management decisions can be found in Section 4.2.

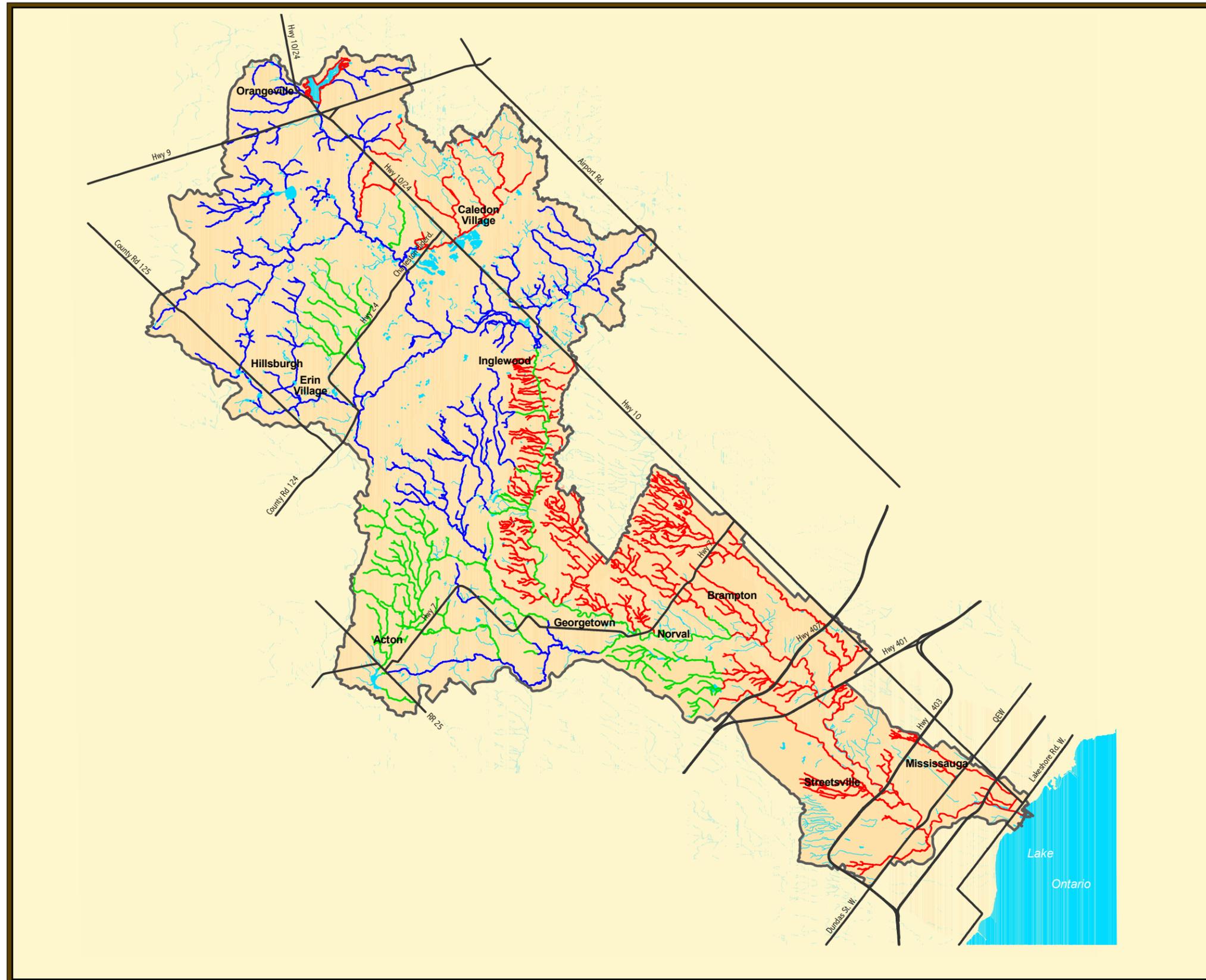


Figure 11. Physiography-based fish communities of the Credit River watershed.

Fish Community Type

- ↘ Coldwater community
- ↘ Mixed community
- ↘ Warmwater community

Transportation Network

- Highway

Drainage Network

- Lakes and ponds
- Rivers and streams

- Credit River watershed boundary



1:250,000



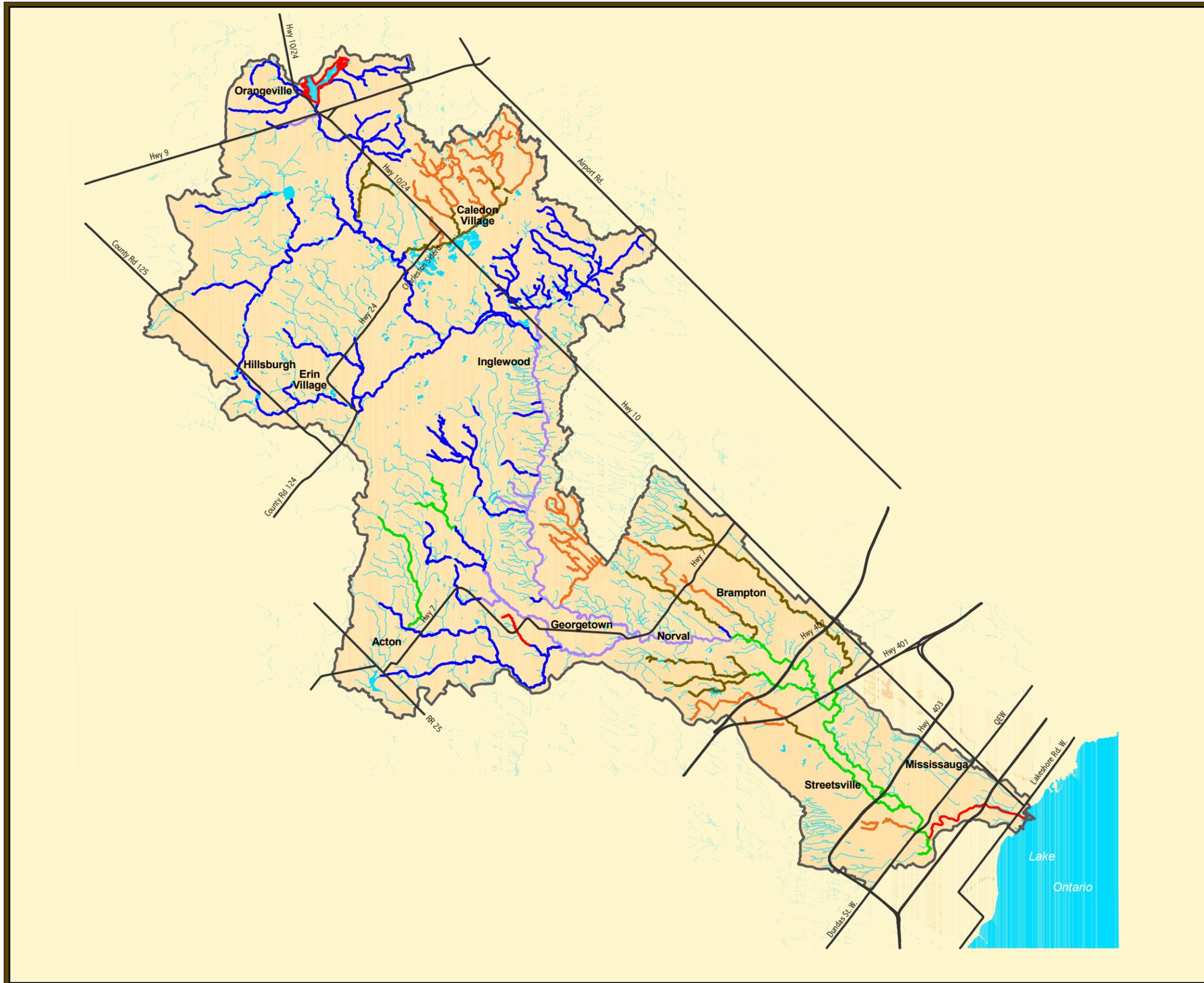


Figure 12. Existing fish communities of the Credit River watershed.

- Fish Community Type**
- ↘ Coldwater community
 - ↘ Mixed cold/cool community
 - ↘ Mixed cool/warm community
 - ↘ Small warmwater community
 - ↘ Warmwater community (dominated by Cyprinids)
 - ↘ Warmwater community (with top predators)

- Transportation Network**
- ↘ Highway

- Drainage Network**
- Lakes and ponds
 - ↘ Rivers and streams

- Credit River watershed boundary



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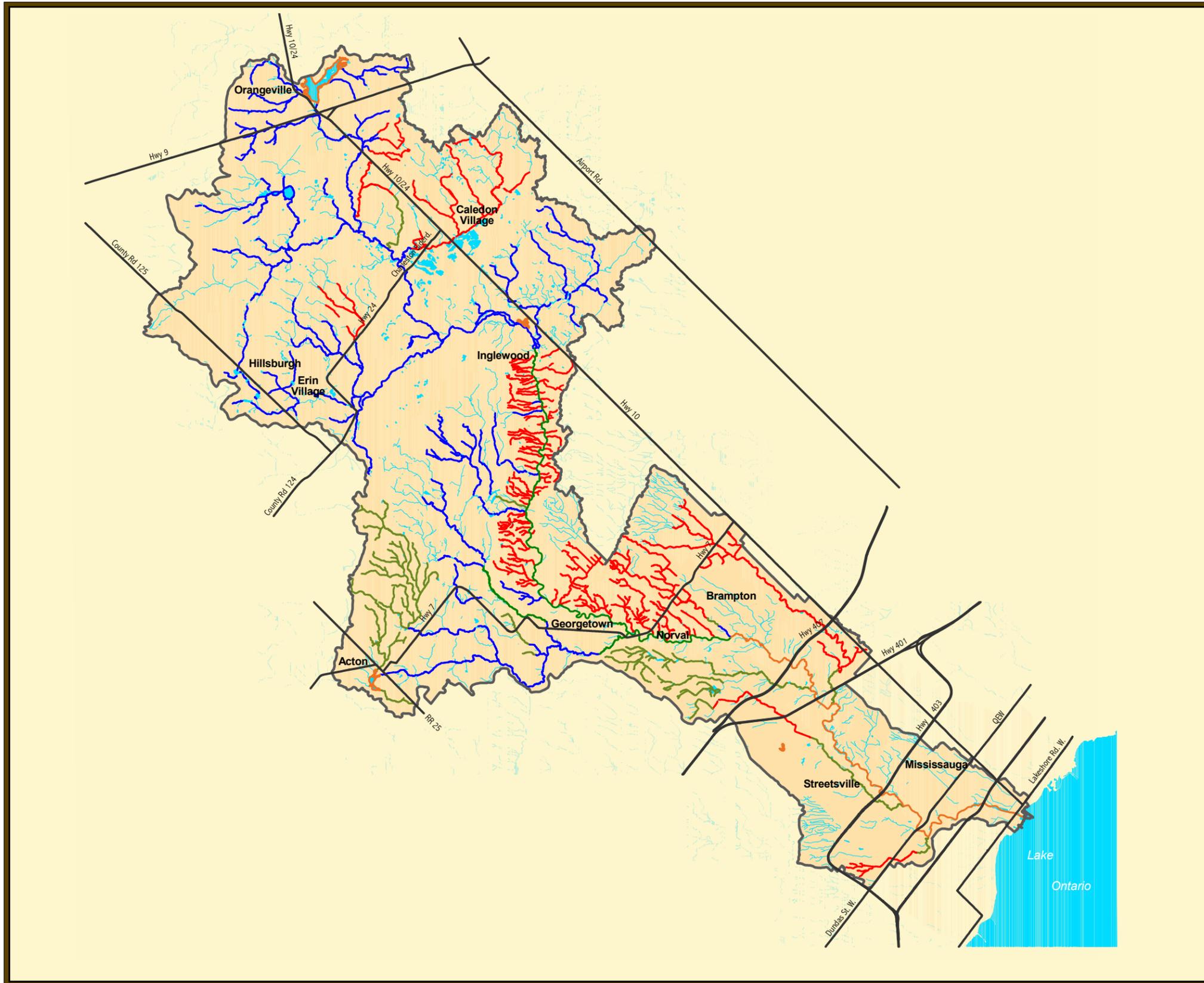


Figure 13. Fish community management zones of the Credit River watershed.

- Fish Community Type**
- ↘ Coldwater community
 - ↘ Mixed cool/cold community
 - ↘ Mixed warm/cool community
 - ↘ Small warmwater community
 - ↘ Large warmwater community
- Transportation Network**
- Highway
- Drainage Network**
- Lakes and ponds
 - ↘ Rivers and streams
- Credit River watershed boundary



1:250,000



Credit Valley Conservation, 2000; Ministry of Natural Resources, 2000

The discrepancies among the overlay of the two maps can be explained through land use change, such as deforestation and water quality degradation, or local changes to physiography. For example, upper Levi Creek is predicted to have a mixed fish community, however agriculture and several on-line ponds have resulted in a warmwater fish community. Likewise, some coldwater reaches extend further downstream than predicted from the physiography maps because these cool waters can continue downstream until they warm up.

Fish community monitoring should continue to update and assess changes to the existing and aquatic community management maps as needed. They should also be overlaid again with the habitat potential physiography map to fine-tune and accurately monitor protection and restoration efforts.

The Credit River Integrated Monitoring Program (CVC 2000b) began in 1999 and will utilize fish communities as environmental indicators at approximately 30 stations. This program will also include associated data collection on water quality, benthic invertebrates, geomorphology and hydrology. Data standards and sharing among all agencies and the public will be essential for a successful program.

Table 9. Fish community management zones of the Credit River watershed.

Coldwater

- Brook trout are the indicator species.
- Sculpins although often associated with brook trout are not found above the Niagara Escarpment and more common in Cool / Coldwater.
- Species diversity can be naturally very low in pristine cold headwaters.
- Brown and rainbow trout may be present but are more dominant in Cool / Coldwater
- Includes all tributaries above the Escarpment (Monora, Mill, Shaws, lower reaches of Caledon Creek, West Credit, East or Little Credit, Black and portions of Silver Creek). Only those small tributaries that have their headwaters above the Escarpment, such as Rogers Creek have brook trout. The main River from Orangeville to Inglewood is also Coldwater habitat.
- Only Huttonville Creek has potential brook trout habitat that is now utilized by migratory rainbow trout.

Mixed Cold / Coolwater

- Provides coldwater refuge areas and relatively less trout production than Coldwater streams. Brook trout are rare and do not reproduce in these areas.
- Brown and rainbow trout have adapted to these reaches and are the primary indicator species along with mottled sculpin and American brook lamprey.
- Other common species include rainbow and fantail darter, northern hog sucker and stonecat.
- Overall species diversity is higher than Coldwater streams.
- The main river from Inglewood to Huttonville is classified as Cold / Coolwater.

Mixed Cool / Warmwater

- Seasonal use by brook trout in headwater areas draining to Coldwater habitats including some tributaries of the West Credit, Silver and Black Creeks.
- Utilized by migratory trout and salmon in lower reaches of watershed including Levis, Mullet and Fletchers Creeks. Reproduction is suspected but the relatively cooler waters to the main river can provide important refuge habitat for these young migratory species.
- Cool / Warmwater habitat extends to the upper reaches of Levis and Mullet Creeks. Cooler temperatures and better baseflows (associated with silt/sand/gravel lenses or wetland storage) than Small Warmwater streams should exist, but existing fish communities may not reflect this due to extensive land use impacts.
- Normally species associated with groundwater discharge headwater wetland areas such as central mudminnow and northern redbelly dace are common. However, these species are absent below the Niagara Escarpment in the Credit watershed.
- The redbelly dace should also be best associated with Cool \ Warmwater habitats but has also been reported in other stream types.
- Both Cool \ Warmwater and Small Warmwater streams have intermittent headwaters that certain species will utilize on a seasonal basis.

Small Warmwater

- The most dominant species found include creek chub and blacknose dace . These species are also found in other stream types and best utilize intermittent reaches along with brook stickleback. Other species tolerant of warm temperatures and lower dissolved oxygen include bluntnose and fathead minnows. White sucker is also often common.
- A greater diversity of minnows, some habitat specialists and water quality sensitive species may also be present, especially where access to larger Mixed or Warmwater streams are available.
- Most typical of clay till plains with few silt/sand/gravel components such as Fletchers and upper Mullet Creeks and other smaller streams. Caledon Creek is classified as Small Warmwater due to some till material but more so because watertables are often below streambed elevations, particularly along the main branch which can dry-up and then resurfaces as a Coldwater stream.

Large Warmwater

- A large order river or lake, often with wetland habitats and a diversity of common species and habitat specialists and including top predatory fish such as bass and pike.
- The best indicator species for the lower Credit is the smallmouth bass, its distribution is limited upstream by the Streetsville Dam. Its introduction above and upstream to the Norval Dam is recommended.
- A number of species are only found in the lower Credit and may be associated with access from Lake Ontario including river chub, emerald, spottail, rosyface and spotfin shiners. Many additional lake species not normally associated with the river will utilize the most lower reaches.
- Sunfish, perch and bullhead catfish seem to be more common in pond habitats.
- Includes a migratory corridor for salmonids.

4.0 FISHERIES MANAGEMENT ISSUES

As described in section 1.0, the Steering Committee, Technical Committee, stakeholders and members of the general public developed this fisheries management plan. During the first stage of consultation, each of the groups identified issues, or concerns, they felt were relevant to the fisheries of the Credit River watershed. In the second stage, everyone was challenged to develop strategies to address the issues and define the steps, or tactics, that need to be taken to carry out the strategy.

Due to the overwhelming number and range of issues identified by the groups, each issue is grouped under one of 7 major categories. These 7 categories are numbered in order of priority, as determined through public consultation and committee discussions:

- 1) Habitat;
- 2) Species Mix and Partitioning
- 3) Education
- 4) Enforcement and Regulations
- 5) Rehabilitation
- 6) Public Access and Fishing Opportunities
- 7) Other Issues

A set of principles was created in order to guide the overall approach to address each issue category. These guiding principles, adopted from *SPOF II* (MNR 1992) are highlighted for each issue.

Although data were collected in support of this Plan from a broad range of sources (e.g., subwatershed plans, water-taking and gauge stations, fish collection records), there were concerns about a lack of data to support management decisions. This issue arose in most of the Issue categories. It is important to note, however, that biologists, in discussion with other disciplines and the public, make resource management decisions based on the best available data.

The full list of the issues, strategies and tactics was extensive (Appendix A – separate document). This section presents a summary of the issues, strategies and tactics identified by the various groups and individuals during consultation in a discussion format. A priority list of issues, strategies and tactics can be found in Section 5.

Each of the groups adopted the overall goals and objectives set out in *SPOF II* (MNR 1992) to guide the development of the fisheries management Plan.

Goal of *SPOF II*:

“Healthy aquatic ecosystems that provide sustainable benefits, contributing to society’s present and future requirements for a high quality environment, wholesome food, employment and income, recreational activity, and cultural heritage.”

Objectives of *SPOF II*:

1. *Protect healthy aquatic ecosystems*
2. *Rehabilitate degraded ecosystems*
3. *Improve cultural, social and economic benefits from the aquatic resources of the Credit River.*

4.1 Habitat

Healthy fish populations require healthy habitats. The *Fisheries Act* defines fish habitat as “spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes”. The habitat requirements for healthy fish communities become complex when we consider various species and their life stages.

The physiography of the watershed broadly describes habitat conditions for fish. Physical features of a stream on a more local scale, including stream width, depth, shape, flow velocities, substrate composition, cover, bank and valley conditions, water quality and temperature, help to determine fish productivity and fish community dynamics. Such habitat assessments have been documented for the Credit River, beginning with descriptions in the *Credit Valley Conservation Report* (Department of Planning and Development 1956). More repeatable scientific methods have been developed and used in the main river, especially to assess Pacific salmonids and river resident brown or brook trout populations. MNR - Lake Ontario Management Unit scientists have now collected valuable habitat and biomass data in the middle and lower portions of the watershed.

Trout stream rehabilitation research and efforts in the 1980s and 1990s provided more detailed surveys along many tributaries and the upper Credit River. These include areas such as Shaw’s Creek, the West and East Credit River, Black Creek and Silver Creek. Habitat data available for the Credit River watershed includes habitat descriptions, spawning surveys and related biomass studies. However, most of these studies concentrated on trout populations only.

In the late 1990s, integrated habitat assessments have been developed for protection and monitoring programs. These include an MNR Stream Habitat Assessment Protocol, the Watershed Report Card, subwatershed studies (Figure 2) and Environmental Management Plans. Many of these studies are currently focusing on “urban” and other warmwater streams and wetlands in the lower portions of the watershed. The CVC Integrated Watershed Monitoring Program (CVC 2000b) also provides valuable habitat monitoring over the long term.

Due to urban expansion within the watershed, urban runoff is of increasing concern particularly for organic pollution, thermal warming, lower oxygen and toxic compounds leaking or being deliberately dumped into storm sewers. Rarely does urban runoff result in visible fish kills, but the effects are reflected in fish flesh samples, disease, parasites, and reduced lifespans and reproduction. According to Klein (1979), trout tend to disappear from watersheds that are 15% urbanized. To date, the Credit is approximately 20% urbanized.

The CRFMP identified protection and degradation of habitat as the most important issue facing the Credit River ecosystems. The issues reflect the philosophy of managing fish

as integral indicators and products of a watershed's health and maintaining sustainable harvest rates based on natural carrying capacities. The greatest challenges to effectively manage fish habitat are related to urbanization and water-taking allocations.

Guiding principles for the *Habitat* issue

1. Protect and/or improve water quantity.
2. Protect and/or improve water quality.
3. Protect and/or improve direct and indirect physical habitats.
4. Protect and/or improve sustainable productivity/diversity with an ecosystem approach.

4.1.1 Water Quantity

Refer to section 2.5.1.

ISSUES, STRATEGIES AND TACTICS

The greatest issue of concern identified during the development of the Plan was the issue of water quantity. Everyone was in agreement that the greatest potential limiting factor for healthy fish and fish populations was reductions in the quantity of water in the river due to water-taking, particularly during summer low flow periods. Groundwater and surface water from the Credit River watershed is used for many purposes such as irrigation, drinking water and water bottling.

Currently, there are no data available showing how much water is withdrawn from the watershed, or whether the maximum permitted withdrawals are exceeding supply. This could become disastrous particularly during a drought year, and with predictions of global warming, the concerns become even greater. Streams may not become visibly dry, but low flows can be lethal to fish due to warming, loss of oxygen, new migration barriers and the concentration of pollutants. For example, at times effluent from the Orangeville sewage treatment plant can represent a significant percentage of the Credit River flow. Further pressures on the system are anticipated with the increasing urbanization pressures in the watershed.

The top priority strategy for the CRFMP is to develop a water budget for the watershed and to set minimum baseflow criteria so they can be protected from water takings, thereby protecting fish habitat. A water budget requires all components of the water cycle be quantified including precipitation, evapotranspiration, runoff, stream flow, withdrawals, groundwater recharge, storage, travel times and discharge. By identifying how the water moves through the Credit River watershed we can assess the allocation of water, and identify locations where, through rehabilitation or land use change, we can increase the availability of water for use to effectively protect fish habitat.

What is a water budget?

A quantification of the local water cycle including precipitation, evapotranspiration, runoff, stream flow, withdrawals, groundwater recharge, storage, travel times and discharge.

An example of the impacts of development on the water budget of a watershed is the loss of recharge area. These recharge areas have important storage capabilities for “recharging” groundwater to the overall hydrological cycle. Groundwater discharge serves many important functions in streams and rivers, such as removing biological waste products from incubating fish eggs and providing coolwater refugia for fish in the summer. Co-operation, and a water allocation process developed by the MOE with input from MNR and CVC are essential to maintaining healthy baseflows for aquatic and riparian life in the Credit River.

More seasonal storage of surface water or better coordination between surface and groundwater use may help to meet water-taking demands while protecting fisheries resources. Land use planning by municipalities is required in order to protect groundwater recharge and wetland storage. Water conservation and the use of new technologies that reduce water takings by local communities and large-scale users is encouraged. Contingency Plans may include increased monitoring and enforcement of water-takings and a prioritized allocation of water between private, municipal and commercial wells and irrigation for agriculture and manicured landscapes.

4.1.2 Water Quality

Refer to section 2.5.2.

ISSUES, STRATEGIES AND TACTICS

Currently, there is a tremendous surge in development in the watershed, particularly in Mississauga and Brampton. While under construction, huge expanses of soil are typically left bare. These areas are particularly susceptible to erosion resulting in sedimentation and the destruction of fish habitat in the river during storm events. In fact, it has been reported that sediment production during the construction of urban developments is commonly increased by a factor of 50 (Cordery 1976). Sedimentation leads to the degradation of spawning habitats, and can have direct impacts on fish. Creating and subsequently enforcing soil by-laws on construction sites, and improving enforcement of the *Fisheries Act* to decrease sedimentation are highly recommended.

Development often results in the channelization of headwater streams, resulting in the loss of their function for improving water quality and quantity. Some of these functions are partially replicated by the use of stormwater management facilities. While stormwater ponds are reducing some of the problems associated with urban runoff,

older subdivisions typically did not use stormwater management facilities. Therefore, older subdivisions that lack stormwater management need to create stormwater facilities. One of the major concerns with stormwater management ponds is their impact on water temperature. Thermal impacts from stormwater ponds may have the greatest potential for mitigation by retrofitting facilities to cool the water before it is released. Stormwater management techniques are constantly evolving and new, more effective techniques will need to be utilized.

Sewage treatment plants are point sources of nutrients in the watershed. Phosphorus and other nutrients have the potential to negatively impact the health of the Credit River by causing excessive plant growth which can result in poor dissolved oxygen levels. The Credit River watershed has sewage treatment plants located in Acton, Georgetown and Orangeville (Figure 9). The Georgetown and Orangeville plants are two of the most advanced sewage treatment plants in the province. Expansions of the existing plants and new plants will be proposed to accommodate development, or to correct sewage problems related to faulty private septic systems. A proactive, detailed study to determine the river's ability to assimilate nutrients is only now being attempted through separate studies being coordinated by CVC. This assessment will provide an understanding of watershed wide, cumulative impacts in anticipation of future development environmental assessments. The products of this exercise include a water quality model for the watershed.

The watershed has numerous gravel pits and on-line or adjacent ponds. The cumulative impact of these open waters to the thermal regime of the groundwater and the river is potentially very high (Beak *et al.* 1996). Research into the subject is highly recommended.

4.1.3 Physical Habitat

The knowledge of stream habitats has been greatly advanced by studying stream form and function, also known as fluvial geomorphology. The science of fluvial geomorphology explains how streams move water, sediment and woody material and predicts how they meander across their valley in a sequence of riffles (shallow/fast/coarser substrates) and/or stepped pools (deeper/slower/finer sediments). A stable and healthy stream is expected to erode and deposit sediments over low, bankfull and flood stages in order to re-create and maintain habitats. Fish are intricately dependent on such physical processes for their entire life cycle.

Many streams in the watershed have been impacted by development, particularly first and second order streams. When a stream is straightened, the natural forces of the stream erode the banks in an effort to re-create a meandering pattern. More recently, engineering approaches for works within channels are taking into consideration natural channel design principles. For further information and management guidelines refer to the *Natural Channel Design: Perspectives and Practices* (Shrubsole 1994) or *Natural Channel Systems: An approach to Management and Design* (MNR 1994a) or *Applied River Morphology* (Rosgen 1996).

The collection of fluvial geomorphological data has become more standardized in recent years. These same standard methods are being used on the Credit whenever habitat is assessed. Stream type classifications based on topographic and channel measurements provide valuable tools for a basic understanding of the habitat characteristics, stream sensitivities, habitat potential and natural limitations for various species of fish. Some reaches of the Credit have already been assessed as part of subwatershed plans. Preliminary descriptions of many reaches of the river have been assessed, for rehabilitation purposes, in the Stewardship Strategy document (CVC 1999).

Some physical habitat data does exist for some of the ponds and lakes in the watershed. For example, bathymetric information, and qualitative descriptions of cover and substrate, and wetland evaluation information, have been collected for Fairy Lake, Island Lake, Lake Aquitaine and Ken Whillans. Rehabilitation projects provide further information. It should be noted that many ponds and reservoirs are the results of dams or dredging and these commonly exhibit environmental limitations (e.g., filling-in with sediment and excess nutrients) that require management to sustain a sport fishery. Many of these ponds and lakes have been identified as an issue in this plan in relation to their impacts on riverine ecology.

ISSUES, STRATEGIES AND TACTICS

Although there are several pieces of legislation that help to protect fish habitat, impacts still occur resulting in negative effects to fish communities. Common impacts include “clean-outs” of instream woody structure and bank vegetation, bank protection works, in-filling of watercourses, dredging and draining, dams and ponds by landowners. Although developers routinely obtain permits to work in and around water, the supervisors and “front-line” workers (e.g., construction workers) may misinterpret plans or adapt them to field conditions, resulting in violations. In these cases, it is often a matter of educating these workers to be more sensitive to fish habitat and comply with the permit requirements.

For these reasons, education programs should be extended, where feasible. One such existing set of pamphlets are the fact sheets “*Working Around Water?* (DFO *et al.* 1999). These fact sheets provide guidance to educate landowners, developers, and agency staff of the natural features that they are adjacent to, or in the vicinity of, and the importance of protecting those features. They also outline the legal, social and environmental responsibilities to protect fish habitat. Public recognition should be given to both developers and landowners that have worked in an environmentally friendly-manner.

The lack of riparian cover along many stretches of the Credit River, has resulted in a lack of instream woody cover in some areas. In the long-term, the planting of riparian trees and shrubs will result in a cooling of the water, due to shading, and the constant recruitment of woody cover to the stream. Traditionally, woody material in stream channels and valley systems has been recognized as a messy nuisance. However,

woody materials in streams provides important fish habitat for the various life stages of many species of fish. The addition of woody material to a stream can reduce erosion and scouring and stabilize sediment, resulting in increased fish production. Values reflected in terms such as woody “debris” and aquatic “weeds” need to be addressed in order to gain an appreciation for the fish habitat value of a “messy” stream, lake or pond. Education of the general public and municipal workers on the benefits of woody material is needed.

Protection of contributing habitat impacts such as the swales, buffer zones, recharge areas and wetlands is critical. There is a need to protect these larger or transitional areas through better guidelines and stronger policies. Buffer widths have been set to enhance the protection of these features (refer to Section 5.1.1). Consistent minimum standards are usually applied but can be difficult to enforce for many activities such as agriculture and landscaping (e.g., gardening, mowing, tree removal) because they do not require agency review or permits. Further research is required to better understand the function of swales and intermittent streams to fish habitat.

There has been growing concern about the effects of ponds throughout the watershed as outlined in the *Study of the Current and Cumulative Effect of Ponds, Water Taking and Diversions on the Water Resources within the Niagara Escarpment Plan Area* (Beak International Incorporated *et al.* 1996). The impacts related to on-line ponds and dams include thermal warming, siltation, flooding, erosion, nutrient enrichment and pollution, and fish migration barriers. An accurate inventory of the ponds in the Credit watershed has not been done, except in the West Credit subwatershed where over 300 ponds were identified (CVC 1999). Although some of the larger dams and ponds are easily identified and accepted as permanent features, they require active management and pose great potential risks and opportunities for rehabilitation. A complete inventory of the ponds and dams located in the Credit River watershed is needed.

The loss of wetlands has been slowed through the implementation of the *Provincial Policy Statement* (Province of Ontario 1997) that protects Provincially Significant Wetlands. Nevertheless, many other small wetlands that, as a whole, contribute to the health of the watershed and its fisheries, remain unprotected because they do not meet the criteria for provincial significance as set out in the Wetland Evaluation System, Southern Manual, 3rd Edition (MNR 1994b). Some subwatershed plans are helping to identify and protect these wetlands based on local hydrology, water quality and biological functions. Other protection mechanisms such as municipal zoning and the use of the Conservation Authority regulations should be supported. It is recommended that a complete inventory be undertaken to supplement the wetlands that have been identified (Figure 5).

4.1.4 Planning & Monitoring

Fish are excellent indicators of the state of the surrounding environment because they are sensitive to change and they live in the waters draining from all land uses. Therefore, protection of features contributing to the aquatic ecosystem will result in a

healthy fish community. Land use in a watershed can seriously affect an aquatic ecosystem through direct or indirect habitat changes. The *Planning Act* "...sets out the ground rules for land use planning in Ontario and describes how land uses may be controlled, and who may control them". This piece of legislation provides guidance for managing the land and its resources and provides an opportunity for agencies to provide input to development proposals. In particular, the *Provincial Policy Statements* (Province of Ontario 1997) issued under section 3 of the *Planning Act*, contains statements that relate specifically to the protection of water and fish habitat.

One of the strongest principles guiding the review of development applications and the protection of fish habitat in general, is the principle of "no net loss of fish habitat" under the *Fisheries Act*. Implementation of the *Fisheries Act* falls under the responsibility of several agencies in the Credit River watershed: DFO, DOE, CVC, MNR and MOE (see section 5.2.1 for a clarification of the roles of these agencies).

Many other pieces of legislation are used to manage the environmental features of the watershed, including the *Public Lands Act*, *Lakes and Rivers Improvement Act*, regulations under the *Conservation Authorities Act* etc. (Figure 14). Municipal by-laws can also help to protect fish habitat.

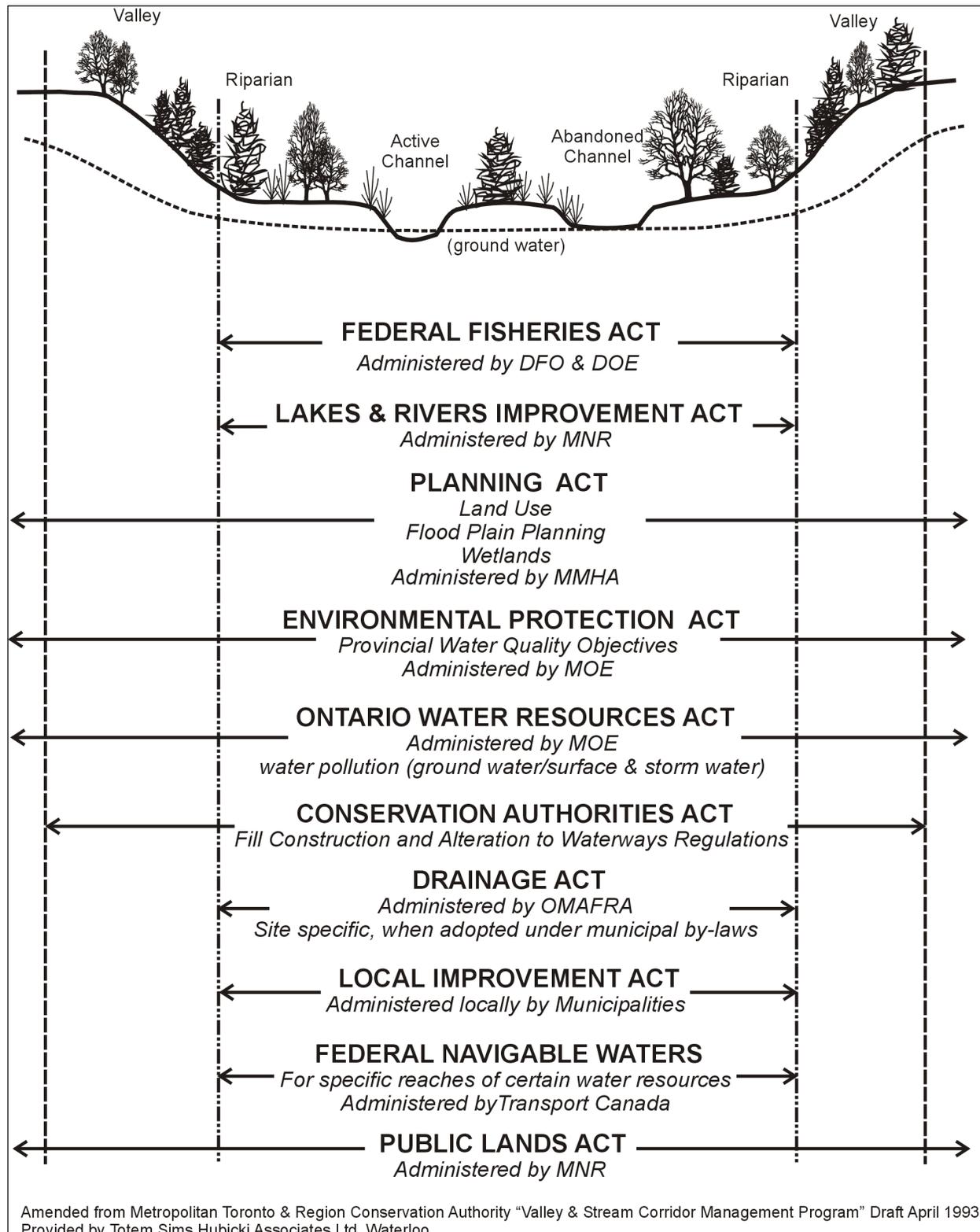
Protection of the fish communities of the watershed requires the monitoring of changes in the community over time that reflect habitat conditions on site and in upstream subcatchments. Regular sampling is imperative to ensure up-to-date data are used in reviewing development applications and in identifying potential changes to the aquatic ecosystem.

ISSUES, STRATEGIES AND TACTICS

There are concerns that there is a lack of strong protection for natural heritage features that contribute to fish habitat (i.e. valleys, recharge/discharge areas). Where policy or guidelines (i.e. buffers, timing windows) are found to protect the features, there is a lack of consistent standards among agencies to apply them. Generally, there is a need for better data, recognition, adoption and application of the natural heritage policies available to municipalities and CVC. Mapping of these natural heritage features is now underway using recently released MNR guidelines. Without a sufficient database and coordinated approach to protecting features through land use planning, no significant strides can be made. Current and historical data on critical fish habitat needs to be integrated into a database to allow planners and resource managers to base their management decisions on the best available data.

Land use planning and the potential impacts on fish habitat are proactively managed through detailed subwatershed plans that contribute significantly to Official Plans and development applications. Plan review guidelines (e.g., construction timing windows and buffer widths or permitted uses) should be updated regularly and be scientifically defensible. As part of the CRFMP, a separate companion document called the

Figure 14. Legislation affecting stream systems.



Planner's Guide will be created for planners and developers. This document will clearly communicate the value and requirements to protect and enhance the aquatic resources of the Credit River watershed.

Coordination among agencies is required to manage data and conduct long-term monitoring. A database of fish records, such as the one developed by the MNR, is needed to ensure decisions made during the review of development proposals are made on current and accurate information. The Credit River integrated monitoring program (CVC 2000b) will ensure approximately 35 stations will be assessed on an annual or bi-annual basis in the river. Monitoring of ponds and lakes occurs periodically though this is less frequent and less comprehensive. The monitoring program will also provide opportunities for the public and NGOs to participate and understand the importance of monitoring. The Credit watershed has some of the best spawning survey data available in the province. Spawning surveys must continue to be conducted, and mapped as critical fish habitat so it can be used to effectively protect these areas during land use planning.

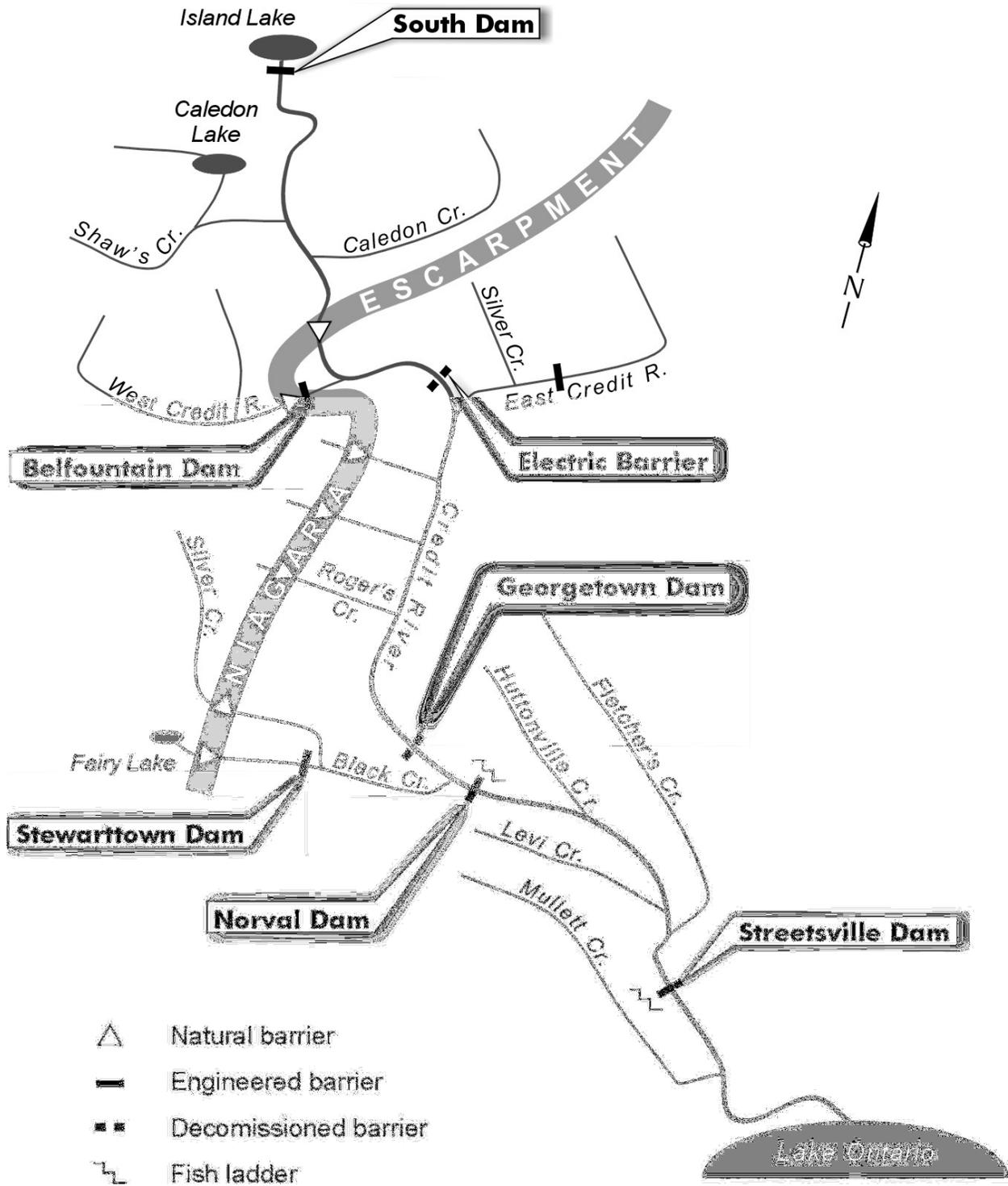
4.2 Species Mix and Partitioning

Species mix and partitioning refers to our ability as fisheries managers to manage sections of the river for various fish communities. This Plan establishes the fisheries management zones for the Credit River, while considering physiography, barriers (both natural and man-made) and the guiding principles set out during the development of the Plan. The priority sequence of these guiding principles recognizes the value of native and naturalized species, while taking into consideration improving fishing opportunities. These guiding principles are based on the provincial *Strategic Plan for Ontario Fisheries II* (MNR 1992).

The determination of fish management zones was a contentious issue with a number of differing opinions on the subject. Therefore, a professional facilitator was hired to host a workshop to help the Steering and Technical Committees develop consensus. Consensus was described as “a decision that everyone could ‘live with’”. The decisions made at the workshop (MNR unpublished report) were presented at stakeholder and public open houses, where they received support from both groups. Aquatic management zones were then developed to manage reaches of the Credit River watershed based on the decisions from the workshop (Figure 13). A description of the current distribution and management of fish communities can be found in Section 3.4.

Historically, there were many dams in the Credit River watershed, powering sawmills and gristmills. Turnball (1963) reported in the *Globe and Mail* that there were 87 mills on the Credit by about 1850. Today, a number of major dams remain in the Credit River watershed (Figure 15). Some of these dams are barriers to fish passage, but a number of them also create opportunities to manage migratory species. All of the dams in the Credit River should be investigated for potential mitigation opportunities. However,

Figure 15. Fish ladders and selected barriers of the Credit River watershed.



special management decisions will be needed for those barriers used to manage fish communities.

Guiding principles for the *Species Mix and Partitioning* issue

1. Enhance self-sustaining populations with consideration for their value as indicator species (i.e. sensitivity) and their adaptability (in order of priority):
 - a) Native species (e.g., brook trout, redbreast dace),
 - b) Investigate feasibility of restoring Atlantic salmon,
 - c) Naturalized species (e.g., brown trout and rainbow trout).
2. Integration with the Fish Community Objectives for Lake Ontario.
3. Improving fishing opportunities through fish stocking and transfers.

ISSUES, STRATEGIES AND TACTICS

Stocking is a way of increasing angling opportunities, supplementing an existing fishery or re-introducing an extirpated species. However, there are risks involved in stocking, including competition with native species, genetic mixing of existing and stocked species, and transferable diseases. This issue is especially relevant for fish escaping from stocked ponds or hatcheries mixing with the wild populations found in the Credit River system. In the long term, introduced species may not be as adaptable and productive as those native species that have evolved since the last ice age.

Similarly, new species can be introduced accidentally or intentionally to the Credit River system by escaping from ponds, hatcheries or by anglers dumping their bait buckets. Exotic fish that have now entered the Lake Ontario system, such as the round goby, sea lamprey and the river herring, threaten the ecosystem and must be controlled. One method of control may include barrier management. Creating an awareness of the potentially harmful actions by anglers and landowners, restricting use and transfers of baitfish and continuing to research and implement existing control programs are a few of the options to control illegal or unwanted introductions.

There is a need to identify non-game species that have been lost in historically known locations. For example, why have banded killifish disappeared in the Credit River watershed? Why have redbreast dace disappeared along the Niagara Escarpment? By identifying the reasons for their loss, a rehabilitation plan may be developed to improve the forage base and to improve the populations of fish that are important as environmental indicators.

Further to the issues identified above, concerns relating to specific fish species are discussed below. Only those species that require barrier management or have potential impacts through new interactions are discussed.

Implementation of this Plan will result in the potential interactions of brown trout, rainbow trout, and Atlantic salmon above the Norval dam and below the “new barrier”. It

is anticipated that the relative abundance of the three fish species will be determined through their interactions and habitat suitability. A description of barrier management based on the decisions outlined in this section can be found in section 5.1.3.1.

BROOK TROUT

Brook trout are highly valued as an environmental indicator and sport fish. Brook trout and Atlantic salmon are native and co-existed in the Credit River until Atlantic salmon were extirpated from the Lake Ontario watershed in the late 1800s (Dymond 1965). Today in the Credit River watershed, brook trout are found in the upper portions, above Inglewood, in Silver and Black Creeks, and a few other smaller tributaries along the Niagara Escarpment.

Concerns were raised for the protection of the existing brook trout population, from Atlantic salmon, but more so from rainbow trout. If rainbow trout are allowed access into the middle Credit and the Atlantic salmon program became successful, there are concerns that young rainbow trout may compete with these species for resources, and that angler success in catching brook and brown trout may be affected. There is less concern with the impact the Atlantic salmon may have on the brook trout population due to the historical co-existence. It should also be noted that the introduction of brown trout, also known to compete with brook trout would not be pursued above the Escarpment. Below the Escarpment, naturalized brown trout are valued for their sport fishery, and could not realistically be removed.

Decisions were made based on the overall objectives and our abilities to partition the various species. Based on the guiding principles set by the Steering Committee, the priority order of fish species for management decisions is:

1. Native species
2. Restoring Atlantic salmon
3. Naturalized species (including brown trout and rainbow trout)

Management Objective: Protect brook trout populations above the Niagara Escarpment, in the main Credit River upstream of Inglewood, including the East Credit River, and in upper Black and Silver Creek through barrier management.

ATLANTIC SALMON

Atlantic salmon can play a valued ecological role in both Lake Ontario and the Credit River as a top predator. Atlantic salmon are considered one of the most valuable game fish and economic resources worldwide. Since the last glaciers retreated approximately 10,000 years ago, Atlantic salmon co-existed with brook trout in the Credit River until they were extirpated in the mid 1800s (Dymond 1965; Department of Planning and Development 1956). Atlantic salmon existed below the Escarpment (Cataract) in the main branch of the Credit River watershed, and most likely had access above the Escarpment to the West Credit River at the Belfountain dam.

If research from the Atlantic Salmon Restoration Plan determines that it is feasible to re-establish this natural heritage species, it may be reintroduced into the Credit River system. The reintroduction would lead to a number of adjustments in the fish community as a result of inter-specific competition for space, food, and other limited resources.

The results of the past five years of research into the restoration of Atlantic salmon in Ontario are expected in the year 2001. Until then, the Credit River will remain as one of the research sites for the experimental re-introduction of Atlantic salmon.

Management Objective: Support the re-establishment of Atlantic salmon, a natural heritage species, throughout their historical range in the Credit River, if research indicates it is feasible. A synthesis of the first five years of research is planned for the year 2001. Management options will be discussed further with the Implementation Committee and public input.

NORTHERN PIKE

Two concerns were identified relating to northern pike in the Credit River watershed:

- 1) presence of northern pike in Island Lake and their potential impact on the largemouth bass population; and
- 2) downstream migration of pike from Island Lake into the main Credit River and their potential competition with the brook and brown trout populations.

Northern pike have become established in the main Credit River above the Niagara Escarpment to Orangeville due to large populations in Island Lake. In the reservoir northern pike do provide angling opportunities in the summer and also in the winter through a popular ice-fishing program. A screen has been placed over the discharge pipe to try to eliminate the fish escaping the reservoir and potentially harming the native brook trout populations downstream.

Largemouth bass are also found in Island Lake. While both northern pike and largemouth bass can successfully co-habit the same reservoir, the largemouth bass population may be reduced and the fish may become stunted if the pike population is not controlled. The greatest impact observed in the reservoir by the northern pike to date has been the decline of yellow perch.

Management Objective: Continue to control northern pike populations in the upper Credit watershed. In other areas of the watershed, northern pike may be managed as a fishery, e.g., Fairy Lake, lower Credit, off-line ponds, etc.

BROWN TROUT - RESIDENT

Brown trout were introduced into Ontario, in part, for their tolerance of degraded conditions and also because they are highly valued as a sport fish. In fact, the first specially regulated waters and landowner agreements to manage trout and their habitat

in the Credit River watershed was established by Trout Unlimited, in the brown trout waters above Inglewood.

While a self-sustaining population of brown trout has naturalized in the main Credit River from Norval to Cataract, poor populations and a lack of access points have created a lack of angling opportunities downstream of Inglewood. Population and habitat assessments are required to determine potential strategies to increase angling opportunities for brown trout in the middle river.

Observations from the operation of the former electric barrier in Inglewood indicate that brown trout populations in the Forks of the Credit area move downstream to the deeper pools for overwintering. Further research is required to confirm this movement and identify overwintering areas.

Management Objective: Continued protection of brown trout populations in the middle and upper Credit River. Protect and rehabilitate brown trout populations downstream of Inglewood. Conduct research to determine the overwintering habitat of brown trout. Research, protect and rehabilitate brown trout populations in lower Black and Silver Creek, and the East Credit River.

BROWN TROUT - MIGRATORY

No specific issues relating to the migratory brown trout population was identified. However, increased angling opportunities in the lower river were suggested, including access to the 'new' barrier, if it is built. This would likely result in increased wild production of brown trout. Currently, brown trout are given access to the Norval dam by selectively passing them over the Streetsville dam in the fall. If brown trout are considered for access to the 'new' barrier, the issue of mixing and / or segregation with existing resident and migratory trout and salmon will have to be addressed.

Management Objective: Manage migratory brown trout above the Streetsville Dam to Norval and consider giving them access to the 'new' barrier in order to increase angling opportunities in the lower river. This may include initial stocking efforts in these areas.

PACIFIC SALMON

Currently, Pacific salmon (primarily Chinook and Coho salmon) are stopped at the Streetsville dam to ensure the provincial hatchery egg collections for the continued stocking of the Lake Ontario fishery. However, some fish are able to pass the dam into the upstream waters where they are subsequently stopped at the Norval dam.

Anglers have expressed difficulty in understanding the regulations for Pacific salmon that get above the Streetsville dam, and for the tributaries located below the dam.

Management Objective: Continue to stock Pacific salmon, i.e. chinook and coho, at the rates set by the Lake Ontario Management Unit. Continue to stop the upstream

migration of adult fish at the Streetsville Dam to ensure the provincial hatchery egg collection for the Lake Ontario fishery. Clarification of the fishing regulations for Pacific salmon above Streetsville dam is required.

Special consideration and management alternatives may be required if Atlantic salmon restoration is considered for the Credit River.

RAINBOW TROUT

One of the most discussed issues was the expanded distribution of the migratory rainbow trout population above the Norval dam and into the middle watershed for the purposes of establishing a self-sustaining population. Concerns were raised that if rainbow trout were given access above Norval, there may be competition with the native fish community and naturalized brown trout populations resulting in impacts on the quality of the existing self-sustaining fisheries.

Through a facilitated workshop, the Steering and Technical Committees determined the upstream limit for rainbow trout migration should be between the confluence of the East Credit River with the main Credit River and Norval. The limit for access was based on protecting the resident brook and brown trout fish populations upstream, and particularly in the East Credit River, and the ability to effectively control the migration of rainbow trout while not negatively impacting brook and brown trout populations and their movements. Rainbow trout will be co-managed with brown trout and brook trout in the lower Black and Silver Creeks, Escarpment tributaries, and the middle Credit. A study into the feasibility and location of a new barrier will need to protect the overwintering range of resident brook trout and brown trout, the Atlantic salmon program, stream morphology and take into account the availability of land.

Management Objective: Create a self-sustaining rainbow trout population to provide an environmental indicator and a high quality sport fishery. Rainbow trout will continue to be stocked in the Credit River at current numbers and locations (Table 10), to establish a self-sustaining population. Conduct a feasibility study of a new barrier, or other management techniques that prevent rainbow trout access above Inglewood or into the East Credit River. If the Environmental Assessment determines that the environmental effects of building a new barrier for the management of rainbow trout can be mitigated, the barrier should be pursued.

Table 10. Rainbow trout stocking by location, based on survival from an allocation of 250,000 eggs per year.

System	Location	Life Stage	No. of Fish
Black Creek	Below Stewarttown Dam downstream to the 8 th Line	Swim up fry	Up to 20,000
Silver Creek	Cedarvale Park downstream to Highway 7	Swim up fry	Up to 70,000
Credit River	Papermill Dam downstream	Swim up fry	Up to 90,000
Credit River	Papermill Dam downstream	Fall fingerlings	Up to 10,000

LARGEMOUTH BASS

Largemouth bass can be found in Island Lake, Ken Whillans Conservation Area ponds, Fairy Lake, Erin Stanley Park ponds, Lake Aquitaine, Wolf Lake, Roman Lake, Hillsburgh ponds and several private ponds. Although occasionally caught in the river as fish move downstream from ponds and reservoirs, largemouth bass populations do not sustain themselves in most of the river, likely due to habitat requirements such as warmer, slow waters. They can be found in Port Credit Marshes and near the mouth of the Credit River.

Stocking largemouth bass in new locations, attached to public water or in the floodplain, may require an Environmental Assessment.

SMALLMOUTH BASS

Historically, smallmouth bass were found in Lake Ontario and so they had access to the Credit River. This plan assumes that smallmouth bass historically utilized portions of the river above the Streetsville Dam. As smallmouth bass require deep pools for over-wintering, adult over-wintering habitat likely only existed in Lake Ontario and portions of the lower and possibly middle Credit River. For this reason, it is felt that the creation of dams in the river has stopped migrating fish from returning and is seen as an opportunity to re-establish these populations through barrier management.

Currently, smallmouth bass can be found in Lake Aquitaine and in the main river below Streetsville Dam. It is believed the fish below Streetsville Dam could be both resident and/or migratory. Further studies would be required to confirm whether they are migratory or resident.

During the CRFMP planning process, concerns were raised about potential competition between smallmouth bass and trout if smallmouth bass were given access above the Norval dam. For this reason, it was recommended that smallmouth bass not be allowed above the Norval dam, until further studies were completed. It was also discussed, that habitat segregation will keep smallmouth bass out of the brown trout and brook trout habitat due to the size of the pools and water temperatures and velocities.

Based on the risks and uncertainty, it was recommended that smallmouth bass be maintained below Norval until further research could be done to describe the potential impacts on the existing brown and brook trout populations.

The Streetsville dam operation will need to be modified to pass smallmouth bass while not compromising the dam's efficiency at stopping sea lamprey.

Management Objective: Conduct a habitat assessment. If feasible, re-introduce smallmouth bass above Streetsville dam. Consider the potential risks of allowing smallmouth bass above the Norval dam.

VULNERABLE, THREATENED AND ENDANGERED SPECIES

Redside dace are designated a *Threatened* species by the Committee On the Status of Species At Risk in Ontario (COSSARO). It is the only designated Vulnerable Threatened or Endangered (VTE) species of fish found in the Credit River watershed. Although the presence of a VTE species allows for special protection status, a management plan specific to the protection of reidside dace and other species of interest is needed.

Redside dace will continue to be protected through planning policy and regulations. Special consideration will be given to maintaining riparian vegetation along the streams where reidside dace are found. The vegetation is critical to providing a source of invertebrates for food and for providing cover from predators.

Management Objective: Protect and rehabilitate reidside dace and their habitat, particularly the riparian vegetation. Guidance should be sought through the development of a recovery plan.

SEA LAMPREY

Despite control efforts such as the lamprey barrier at the Streetsville dam and annual lampricide applications, sea lamprey continue to remain as a pest species in Lake Ontario. These lamprey pose a tremendous threat to the Lake Ontario and the Credit River migratory fishery. Without the continued management of the Streetsville dam as a lamprey barrier, the height of the Norval dam and lampricide applications in the Credit River system, the sea lamprey population would increase and have a devastating impact on the local fisheries.

Management Objective: Continue to stop the upstream migration of sea lamprey at the Streetsville dam and continue to apply lampricide at Norval to control sea lamprey production.

4.3 Education

Effective communication and education will play an important role in helping to develop a sense of local stewardship for the protection and enhancement of the Credit River and its fisheries. However, there are several challenges we must recognize:

- People are overwhelmed by messages from community groups, marketers and so on, in a variety of forms ranging from print and broadcast media to the Internet;
- Fish and fisheries are of limited interest to some of the general public. With further education, this group may gain an appreciation of these resources.

We also recognize that there have already been significant efforts made, by highly reputable groups, to educate the public about fisheries issues. These range from the MNR Fishways school program, to DFO, CVC and Trout Unlimited's Yellow Fish Road program, to an array of initiatives by angling groups including children's events at Fishing Shows and other venues. Public programs include Ontario's widely promoted Family Fishing Weekend. Other environmental education programs, such as Project Wild or National Wildlife Week, attempt to draw the public's attention to issues closely related to the concerns of the CRFMP.

While education and communication are seen as vital to the successful implementation of this Plan, they must be developed strategically for the most effective results.

Guiding principles for the *Education* issue

1. To improve education and awareness.

ISSUES, STRATEGIES AND TACTICS

During the consultation stage, public open houses and stakeholder workshops reconfirmed the need to promote a stewardship ethic to the public, municipalities and businesses. Each of these groups need to understand and appreciate the intrinsic, as well as the ecological and social values of the fisheries of the Credit River. This, in turn, will promote responsible action and good stewardship practices.

Many of the recommendations relate to improving or increasing existing programs or product distribution. For example, by creating an umbrella organization that would highlight work conducted by all the NGOs in the watershed, communication among NGOs and to the public will become more clear. Or, by improving the distribution of existing materials, such as brochures about the fisheries of the Credit River, to tourism outlets, libraries and tackle shops, the public will become aware of existing access points and opportunities.

Seminars are also an excellent way of reaching out to those front-line workers, such as municipal staff, NGOs or private landowners, who are implementing an approved

project but are not aware of legislative requirements and approvals for works in or near the water. Also, increasing the emphasis of the non-angling values of fish is recommended as a method to increase a stewardship ethic. This can be accomplished through the distribution of printed materials, e.g., brochures, factsheets, guides, and also by increasing fish viewing opportunities for anglers and non-anglers alike.

Signs at public access points are an excellent way of communicating the fishing regulations for the area, non-angling values of fish, or fish that are likely to be found in that reach. However, it was recognized that the audience of the communication materials is culturally diverse, possibly requiring the translation of educational materials. Excessive signage, or inappropriate signage is also a concern. There is a need to coordinate such messages watershed-wide.

4.4 Enforcement and Regulations

The MNR is the provincial agency responsible for the management of fisheries resources in Ontario. Fisheries management includes issuing licences to commercial fishermen and anglers, adjusting existing fishing regulations and recommending new fishing regulations to the federal government. A *Summary of Ontario's Sport Fishing Regulations* is produced annually by the MNR and is available at locations where fishing licences are sold.

Furthermore, the *Fisheries Act* regulates many other aspects that affect fisheries resources, such as alterations to a watercourse, deleterious substances that may affect fish, dams and fish ladders among others. Several agencies are involved in the implementation of the Act. CVC staff review development applications under the *Planning Act* and *Fisheries Act* to determine if they will result in the *Harmful Alterations Disruption or Destruction (HADD) of Fish Habitat*. Similarly, the MNR reviews MTO projects and CFWIP projects to determine if they will result in a HADD of fish habitat. If a project is likely to result in a HADD of fish habitat, the project is referred to DFO. MNR is the lead agency for the enforcement of the section of the *Fisheries Act* dealing with the deposition of sediment (a deleterious substance) from entering a watercourse. MOE is responsible for assessing the impacts of chemicals on fish. DFO enforcement staff are responsible for these and all other aspects of the *Fisheries Act*.

The Ministry of Natural Resources is responsible for the *Lakes and Rivers Improvement Act* and the *Public Lands Act*. These Acts also provide protection to fish and their habitat.

The *Conservation Authorities Act* and its Regulations give Credit Valley Conservation the authority to regulate development within the floodplain and regulate any alterations to watercourses. The Act also gives CVC the mandate to be involved in watershed issues, including stormwater management planning and the protection of fisheries resources and habitat.

Municipal by-law enforcement staff enforce a number of bylaws (Table 11) that can be used to protect fish habitat. Table 11 provides a course overview of the municipalities and their bylaws. It is noted that the bylaw can be significantly different among municipalities. For example, a trees bylaw may protect individual trees or only woodlots greater than 2 ha.

Table 11. Municipal by-laws affecting fish habitat.

Municipality	By-law			
	Topsoil preservation	Fill	Trees	Peat extraction
City of Mississauga	Y	N	Y	N
City of Brampton	Y	Y	Y	N
Town of Caledon	N	Y	Y	N
Town of Halton Hills	N (Y) through Site Alteration bylaw	N (Y) through Site Alteration bylaw	N	N (Y) through Site Alteration bylaw
Town of Erin	Y	Y	N (Y) through Wellington County bylaw	N (Y) through topsoil bylaw
Town of Mono	Y	N	N	N
Township of Amaranth	N	N	N (Yes) - through Dufferin County bylaw	N
Township of E. Garafraxa	N	N	N (Yes) - through Dufferin County bylaw	N
Town of Orangeville	Y	N	N	N

The following section discusses enforcement and regulations concerns for fish habitat, and suggests new regulations for enhanced angling opportunities and concerns about non-compliance with the Ontario Sport Fishing Regulations.

The guiding principle for the *Enforcement and Regulations* issue

1. Enforce firmly and effectively.

Adopted from SPOF II (MNR 1992)

ISSUES, STRATEGIES AND TACTICS

This Plan recognizes the need for increased enforcement for the protection of the Credit River and Lake Ontario fisheries resources. Conservation Officers (CO) enforce legislation for the protection of fisheries, such as the sport fishing regulations, portions of the Fisheries Act, the Lakes and Rivers Improvement Act, and the Public Lands Act. Currently, MNR - Aurora District has a team of Conservation Officers (CO), including one CO dedicated to Peel Region and one CO dedicated to Halton Region.

In order to increase the enforcement efficiency, MNR is working in partnership with local groups on a variety of programs. The MNR *Guardian* program is designed to train people about the legislation and regulations used to protect our natural resources, and the methods they can use to report illegal activities. Also, the Credit River Anglers Association administers the *Streamwatch* program, whereby members patrol the Credit River and report illegal activities to COs. Furthermore, MNR has initiated a Deputy Conservation Officer (DCO) program, whereby DCOs assist COs. This provides COs with assistance in performing their duties and provides the DCO with valuable on-the-job training.

Not only do the public want to increase enforcement, they also wanted to know about what they could do when they observe illegal activities such as large quantities of sediment entering the river from construction sites, poaching or people fishing in sanctuary areas. Furthermore, they expressed concerns about other illegal activities such as dumping or toxic spills, especially when they go undetected or unreported due to limited enforcement resources. They wanted to empower themselves and have a better understanding of the legislative tools they can use to report illegal activities. They also requested more information about who is responsible for what legislation and whom they can call if they see illegal activities.

To provide people with the opportunity to better understand the legislation and to empower themselves, the *Citizens Guide*, will be created as part of this Plan. This guide will help people to understand the various pieces of legislation, clarify which agency is responsible for administering each piece of legislation and will provide a list of agency contact numbers for people to call when they observe violations. This guide will allow the general public the opportunity to take an active role in protecting the fisheries resources of the Credit River.

A lack of understanding or awareness of the fishing regulations was identified as a main reason for the number of violations of the sport fishing regulations. Therefore, it was suggested that the fisheries regulations should be distributed with the fishing licences, and that signs detailing the regulations could be strategically placed throughout the watershed to better inform the public. As well, a summary of the sport fishing regulations specific to the Credit River should be created and made available to the public. As part of the education process, this Plan recommends that violations and fines resulting from charges under the various legislation be reported to the media.

This fisheries planning exercise also provided local groups with an opportunity to have input into the fishing regulations. A number of regulation changes were recommended for consideration by the MNR for the protection of fisheries resources and the enhancement of fishing opportunities. When developing proposed new regulations or changes, consideration must be given to local resource sustainability, social concerns, enforcement issues and standardization or simplification of the fishing regulations across the Lake Ontario watershed.

The CRFMP proposes several changes to the fishing regulations, including:

- a closed-season above Norval dam (October 1 to the last Friday before the last Saturday in April) because of people fishing out of season or claiming they are angling for alternate open-season species, excluding warmwater lake and pond fisheries;
- increasing fishing opportunities in the lower river by opening some of the water currently set aside as sanctuaries; and
- consider reduced catch and possession limits of rainbow trout.

Regulation changes may be required to control increased harvest. Alternatives to regulation changes may involve controlling fishing pressure and fishing methods through landowner agreements, such as that found in the TUC Landowner Agreement Section.

As the river changes, due to impacts such as climate change and development, fishing regulations will likely continue to change.

4.5 Rehabilitation

Rehabilitation is being defined as “The re-establishment, enhancement or creation of ecological form and function through the alteration of activities and physical features to enhance biological productivity and/or diversity, that is sustainable.” This definition does not include activities such as fish stocking, improving trail access or signage projects.

Rehabilitation efforts in the Credit watershed in the 1980s were intense. Instream activities such as the stabilizing of banks, and the creation of spawning habitat and refuge areas were quite common. Volunteer participation was high, with several NGOs volunteering their time and effort to protect the fisheries of the Credit. Today, with funding cutbacks to the government agencies, such as MNR and CVC, more reliance has been placed on NGOs to contribute their time, effort and monies to implement rehabilitation projects.

Some of the NGOs that are actively implementing fisheries rehabilitation projects have developed strategies to help them organize and plan their initiatives in a more focussed and coordinated fashion. For example, the TUC - Greg Clark Chapter developed a *Rehabilitation Strategy for the Coldwater Fishery of the Upper Credit* (Trout Unlimited 1997), which led to the development of a more substantial *Upper Credit Rehabilitation*

Initiative Project (Credit Valley Conservation *et al.* 1999), involving several partners including Izaak Walton Fly Fishing Club, Upper Credit Trout Club, Ontario Streams, CVC and MNR.

Other active groups in the watershed include the Credit River Anglers Association and the Mississauga Bassmasters. In the lower watershed, the Credit River Anglers Association has recently embarked upon an extensive tree planting initiative. The Mississauga Bassmasters have been successful in implementing a number of small-scale projects in ponds, lakes and wetlands throughout the watershed.

Guiding principles for the *Rehabilitation* issue

These guiding principles were the same as the guiding principles for the *Habitat* and *Species Mix and Partitioning* issues.

Guiding principles for the *Habitat* issue.

1. Protect and/or improve water quantity.
2. Protect and/or improve water quality.
3. Protect and/or improve direct and indirect physical habitats.
4. Protect and/or improve sustainable productivity/diversity with an ecosystem approach.

Guiding principles for the *Species Mix and Partitioning* issue.

1. Enhance self-sustaining populations with consideration for their value as indicator species (i.e. sensitivity) and their adaptability (in order of priority):
2. Native species (*e.g.*, brook trout, redbreast dace),
3. Investigate feasibility of restoring Atlantic salmon,
4. Naturalized species (*e.g.*, brown trout and rainbow trout).
5. Integration with the Fish Community Objectives for Lake Ontario.
6. Improving fishing opportunities through fish stocking and transfers.

ISSUES, STRATEGIES AND TACTICS

Approximately 100 aquatic habitat rehabilitation projects are proposed or ongoing in the Credit River watershed. In addition, there is an equal number of opportunities annually where permitted in-stream alterations attempt a “net gain” or improvement in fish habitat, and there is growing demand for the naturalization of all remaining stream corridors, recharge areas and other potential wildlife habitats.

With over 93% of the watershed privately owned, there is a large potential for rehabilitation projects on those lands. A CVC Stewardship Strategy (CVC 1999) has been developed to help landowners develop management strategies and actions on their property, and provide funding opportunities to help implement them for the betterment of the Credit River, its tributaries, and the watershed as a whole. The MNR

also provides financial and technical assistance, equipment and materials to individuals and community groups for fish and wildlife enhancement projects under the Community Fisheries and Wildlife Involvement Program (CFWIP).

While several of the active NGOs in the watershed are coordinating their efforts for similar initiatives, such as the *Upper Credit Rehabilitation Strategy* (CVC et al. 1999), there is a sense that rehabilitation projects in the watershed are implemented on a piecemeal basis. Traditionally, projects are implemented when opportunities arise without consideration from a watershed-wide perspective of priority.

Many of the strategies and tactics identified in this category relate to improving and enhancing the efforts by the NGOs to implement rehabilitation projects in the watershed. One of the primary strategies to improve rehabilitation efforts is to prioritize projects on a watershed-wide basis. A *Fisheries Rehabilitation Strategy* will be created as a companion document to the CRFMP to help guide groups, including NGOs, CVC and MNR as to where and how they should be directing their efforts and resources. The strategy will also improve the communication of ideas, create partnerships, provide a directory of resources (including funding sources, materials, partnerships, permitting requirements), and will suggest methods of monitoring completed projects.

There is a need to improve communication and cross-promotion of volunteer activities in order to increase participation rates. A newsletter or website listing all NGOs or groups requiring volunteers, needs to be created. This is also an excellent way of staying informed about activities in the watershed, and for learning from other peoples' experiences on the river.

4.6 Public Access and Fishing Opportunities

Access to the Credit River and other water bodies, whether for private or public interests, is in high demand. The experiences related to water and associated natural areas include recreational trail uses, angling, boating, picnicking, swimming, and nature appreciation. A balance often has to be achieved with what is often seen as competing uses, particularly those with private ownership around water, since water and fish are considered to be community resources.

There are many publicly owned areas within the watershed that provide access to the river and other waterbodies, providing many fishing opportunities (Figure 16).

In the lower watershed there are several parks. Parks such as Lake Aquitaine, a stormwater management pond, provide ideal urban fishing opportunities. Other large parks are concentrated along the valley and connected by the Culham Trail throughout Mississauga, with Erindale Park being the most popular for fishing. There is interest in extending a trail beyond Meadowvale Conservation Area and Park into Brampton as development occurs, using Churchville and Eldorado Parks as nodal areas. A trail

beyond to the headwaters in Orangeville as part of a Credit Valley Trail is currently under study.

The middle watershed has the greatest potential for improved access. A small but popular access area to the main river is available in Norval. At the confluence with Silver Creek, there is an Ecology Park being developed that will connect to a large holding of valleylands upstream throughout Hungry Hollow in Georgetown. Similar parkettes along the main river can be found in Inglewood, Terra Cotta, Glen Williams and at most road right-of-ways. At the headwaters of the Black Creek branch lies Fairy Lake where municipal access is provided. Although the largest public tracts of natural areas are associated with the Niagara Escarpment (e.g., Limehouse, Silver Creek and Terra Cotta Conservation Areas, and the Forks of the Credit Provincial Park) and linked by the Bruce Trail, there is limited access to the main river until Inglewood. Access by canoe from small parks and road crossings does occur mostly in the spring when water conditions are best.

Significant parts of the upper Credit River watershed are accessible and provide high quality recreational opportunities. These areas include Ken Whillans Resource Management Area, the TUC special agreement waters, the Forks of the Credit Provincial Park and Conservation Authority Lands along the West Credit River downstream of Belfountain. North of County Road 24 is the Charles Sauriol Conservation Area and the MNR Grange property. The Island Lake Conservation Area at the headwaters in Orangeville is also a very popular angler destination. Major trailways include: Caledon Rail Trail; Elora Cataract Trailway; and the Bruce Trail with its many sidetrails.

“Car counts” on opening day of trout season (Figure 16) confirms the popularity for anglers with the area from Inglewood to Alton. Of particular interest are the number of small creeks fished throughout all the tributary systems in the middle and upper Credit, particularly Black and Shaw’s Creek and the West Credit. These reports relate to roadside crossings abutting private lands, some of which remain unposted.

Surveys including estimates of angler effort and point of origin were collected for the MNR Special Harvest Regulations Study located in the middle and upper Credit River. Data gaps exist over other seasons and areas, especially for warmwater fisheries and along Lake Ontario. Some visitor data is available for analysis from Conservation Areas, including a few winter ice creeks at Island Lake Conservation Area.

“Opening day” car count data are not included from Erindale Park and other access points throughout Mississauga due to the mix of non-anglers present. Erindale Park is open year round (effectively having no opening day). Attempts to count anglers in a few years resulted in poor numbers attributed to weather patterns that reduced upstream migration or resulted in early return migrations before opening season. Relatively little angling occurs in the lower river in the summer, in contrast to the fall, when the lower river can be crowded with salmon anglers.

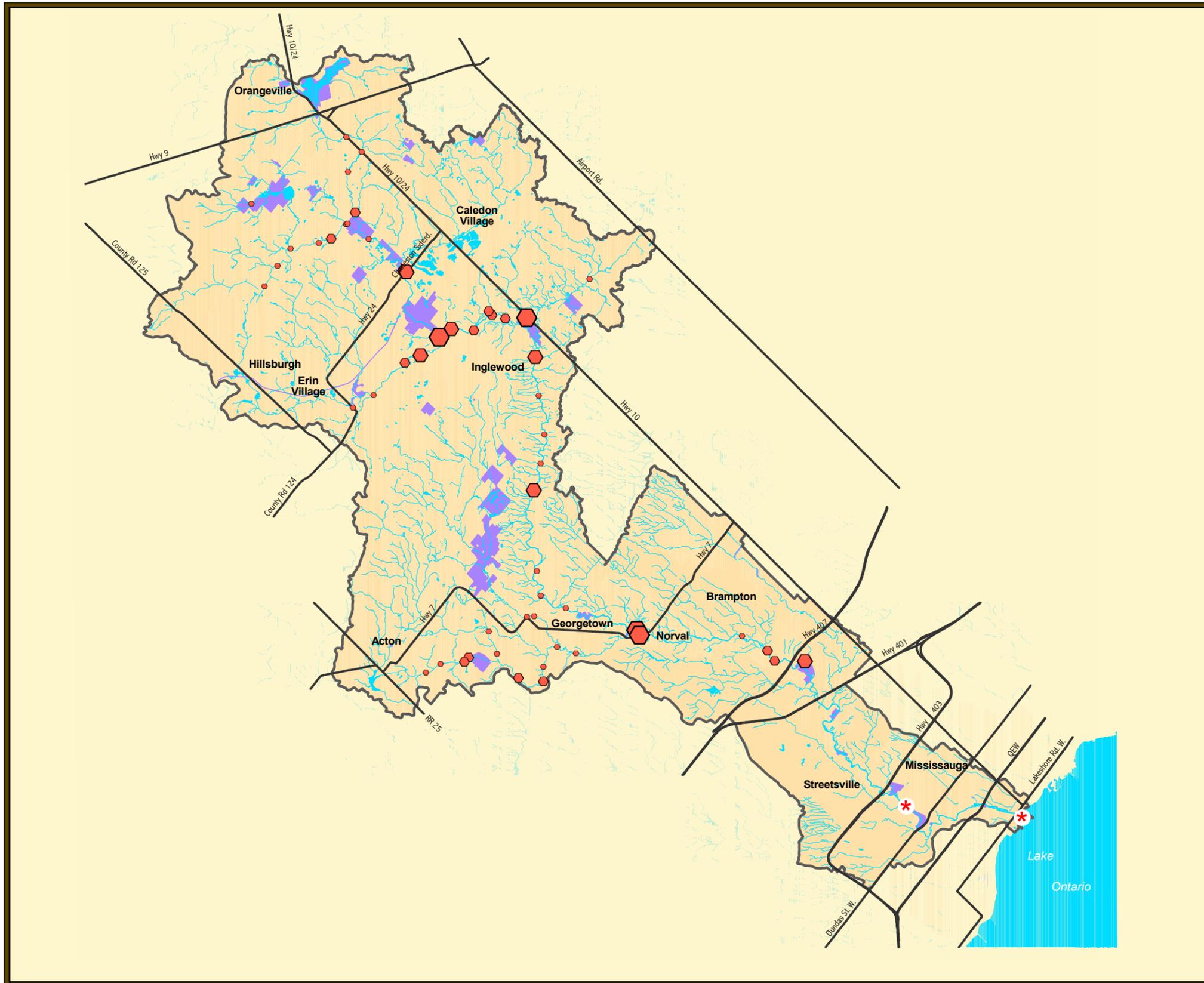


Figure 16. Access points and trout season opening weekend creel surveys along the Credit River.

- Angling Pressure**
- Low (1 - 9 anglers/hour)
 - ⬡ Medium (10 - 19 anglers/hour)
 - ⬡ High (20 - 31 anglers/hour)
 - ⬡ Very high (32 - 38 anglers/hour)
- CVC and MNR properties
- Transportation Network**
- Highway
- Drainage Network**
- Lakes and ponds
 - Rivers and streams
- Credit River watershed boundary

Data derived from 1996 and 1997 field seasons.

Note *:
A great deal of fishing pressure occurs in the lower Credit River, particularly at Port Credit and Erindale Park. Due to the survey design, this effort could not be quantified.

↑ N
1:250,000



Guiding principles for the *Public Access and Fishing Opportunities* issue

1. Improve access to the river for fishing and related nature appreciation.
2. Improve education and awareness of fish and fish habitat.
3. Minimize landowner conflicts resulting from trespassing and vandalism.
4. Improve fishing opportunities.

ISSUES, STRATEGIES AND TACTICS

According to public perception, access to fisheries resources is limited. However, many people are surprised to learn about the number of public access areas currently found in the Credit watershed. Over the last few years, a Credit River Fisheries brochure and fact sheet series detailing access points and angling opportunities has been extremely popular with the angling public, along with a continued demand for other related information and updating. Fisheries information has also been provided through signage in the lower river about migratory fish, and Wild Trout kiosks including a bulletin board in several locations in the upper Credit. A limited number of signs are posted at watershed pond and lakes. Through the promotion of current access locations and underutilized species such as carp, fishing opportunities will be increased.

Several opportunities for increasing fishing opportunities through fish species management exist in the Credit River watershed. The fish community currently found in the Credit River from Streetsville to Norval does not offer a summer resident fishery, lacks a top predator for ecological functions, and lacks in urban angling opportunities. Two potential solutions have been identified: to study the feasibility of allowing rainbow trout upstream into the middle river, thereby increasing their wild population; and the reintroduction of smallmouth bass between the Streetsville Dam and the Norval Dam.

The production of rainbow trout in the 20 km of mixed water habitat from Norval to Inglewood could significantly increase the total angling opportunities for southern Ontario. However, it is strongly recommended that expanded fisheries in the middle watershed be prepared with plans for educating landowners and anglers about trespassing and navigable waters legislation. This may become an issue due to the lack of public access to the river in this area. On the lower Credit, a fish sanctuary was created above Burnhamthorpe Road after the 70s heyday of stocked Pacific salmon. The sanctuary was not created for conservation reasons, but to control the tremendous amount of trespassing and concerns for illegal fishing that resulted from the new fishing opportunity.

The reintroduction of a naturally reproducing smallmouth bass population above Streetsville would create a summer resident fishery in the lower Credit (i.e. Norval to Port Credit). Smallmouth bass distribution is now limited by the Streetsville dam. Other

popular warmwater sport fish such as largemouth bass, catfish, sunfish and perch do not thrive as well in high gradient rivers such as the Credit.

Smallmouth bass are very popular with a wide range of anglers and has great appeal as a natural attraction for visitors. Public access above Streetsville dam is extensive and well managed.

Rehabilitating habitats, and stocking new species where appropriate can also improve fishing opportunities. This makes better use of waters that are already accessible for angling, will help address a fast growing demand that is occurring with urbanization, and will help to improve coldwater opportunities within the Greater Toronto Area.

Stocking, particularly in partnership with private operations, should be expanded in isolated ponds and lakes. Several pits and quarries also offer an exciting future of new species (e.g., walleye and lake trout) and fishing opportunities. With the increase in stormwater management facilities, there is a high potential to create urban angling opportunities, such as those achieved at Lake Aquitaine in Mississauga.

Whereas fishing opportunities have the potential to increase, it may be difficult to substantially increase public access points to the Credit River. Public access is limited by the high percentage of private land ownership in the watershed (i.e. 93%). However, there is a need to identify the extent of publicly navigable or wadable waters along the Credit River, particularly upstream of Norval. Where feasible, agencies can identify and prioritize new areas for acquisition, conservation easements or other private landowner agreements similar to those by the Bruce Trail Association or TUC. Other public fishing opportunities may be developed in the lower Credit River, for example at Port Credit, along the Lake Ontario shoreline and upstream to Streetsville.

There are potential negative impacts related to increased access including, additional harvest, trail impacts, litter, trespassing and parking. These issues must be monitored and managed.

4.7 Other Issues

Due to the broad range of issues identified, not all of the issues fit neatly into the six previous category issues. This category deals with these “other” subjects such as climate change and economic concerns.

ISSUES, STRATEGIES AND TACTICS

While the topics found in this category are quite different from one another, the one common theme among the majority of the issues, was the need for further study or monitoring. Some of the areas for further study included:

- socio-economic analysis to value benefits of the fisheries of the Credit River;
- expanded monitoring of the sportfish contaminant levels by MOE;

- continued monitoring of the potential impacts of global warming; and
- inventorying the ponds of the Credit to gain a better understanding of their cumulative impacts.

The fisheries resources of the Credit provide for tourism and other local economic benefits. However, there is no understanding of the extent that the fisheries resource provides these benefits. Anglers may travel across town, across the province, or even across the country to enjoy the benefits of the Credit River. There is a strong need to understand the socio-economic value and significance of the fisheries resources of the Credit.

New stormwater management ponds, resulting from development may provide additional fishing opportunities, therefore it is important to monitor the contaminants levels in sportfish from these ponds. Currently, MOE conducts annual sportfish contaminant readings from one location (Streetsville Dam) for four species of fish (coho salmon, chinook salmon, rainbow trout and brown trout), but these are all migratory fish so these fish reflect the contaminant levels of Lake Ontario. With the number of species in the Credit expanding (e.g., black crappie in Fairy Lake, northern pike in Island Lake and most of the upper Credit), and the use of some stormwater ponds for urban angling opportunities, MOE needs to address these other locations and species in their monitoring program.

Concerns were raised for the misidentification and killing of brook lamprey. The killing of the native brook lamprey is based on the misidentification and confusion with parasitic sea lamprey. An annual chemical lampricide, i.e. TFM, is used to kill the sea lamprey larvae in the Credit. No harm comes to the brook lamprey that is found much further upstream. Education materials describing how to identify these two species of lamprey and their ranges is essential.

During the fall spawning run of chinook salmon, thousands of fish move up the Credit to spawn. Due to the sheer numbers of fish that are running during this period, and the life cycle of the fish ending once they have spawned, there can be thousands of carcasses. The public needs to understand that although the fish leave a trail of carcasses in and along the river, the life cycle of the fish cannot be changed. Concerns were raised that these fish need to be studied to determine the potential contaminant and nutrient loading effects of all these salmon decaying in the river system.

5.0 PLAN IMPLEMENTATION

The development of the fisheries management plan in section 4 produced approximately 140 management strategies and over 350 associated tactics (Appendix A – separate document). While all of the strategies and tactics are considered valid methods of managing the fish of the Credit River, this section focuses on the means for implementing the high priority and best bet initiatives.

5.1 Getting Organized

Priority initiatives were determined by ranking the **strategies** based on the following criteria:

- Does the strategy support the goals and objectives, guiding principles and vision outlined in this fisheries management plan?
- Does the strategy have agency support? Does a willing lead agency exist? Is the strategy part of an agency(s) core business? Is the strategy a continuation of an existing program?
- Will the strategy have the support of NGOs, landowners and the general public? Those strategies with a high or medium-high ranking were considered priority.

The **tactics** associated with the priority strategies were then evaluated for feasibility based on the following criteria:

- What is the cost of implementing the tactic?
- Is the tactic technically feasible? Is the tactic scientifically supported (biologically, physically, etc.), or is further research required?
- Are there legal issues associated with the tactic, i.e. existing policy and/or legislation, property ownership issues?
- Is there a time constraint associated with implementing the tactic (i.e. short vs. long term, such as operation and maintenance)?

Tactics that were determined feasible under these criteria were considered priority.

The priority strategies and tactics were compiled into an implementation table, to help focus efforts on these priorities (Table 12). Further details are also provided on agency roles, cost level and estimated time to completion.

Agency role outlines the lead agency(s) responsible for ensuring the implementation of a tactic, and lists the potential partners who may participate in implementation. Although specific lead agency(s) and potential partner(s) are listed, those groups or organizations that are not identified for each tactic are encouraged to participate as opportunities arise.

Cost to implement each tactic was estimated based on the following three categories:

- High (H) – Lots of new money required. Significant financial constraint.
- Medium (M) – Some new money required. Somewhat of a financial constraint.
- Low (L) – No new money required.

Table 12. Priority strategies and tactics for implementation and agency roles.

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	IMNR	MOE	CVC	Municipalities	NGOs	Others		
HABITAT (Water Quantity)														
1.a) 1.1. Need better permit management and monitoring of private and municipal wells and surface withdrawals.														
Encourage the MOE to continue the moratorium on new water taking permits until a water budget is complete.	X						P		L					
Develop a water budget for the Credit watershed defining minimum baseflows to be maintained or other flow targets.					X		P	L	L				H	0-5 yrs
Update water-taking policy and guidelines based on a water budget and require a public process (EA, EBR) for all water-taking policy and permits.	X						P	L	P					
Inventory water-taking permits and seasonal water-taking patterns.					X			P	L				L	0-5 yrs
Audit and enforce existing water-taking.	X							L	P				H	0-5 yrs

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Develop and support mechanisms that improve MOE participation and action e.g., lobbying, MOU, legal agreement, delegation of authority.				X			L		P	P	P	Public (L)	L	0-5 yrs
1.a) 1.2. Promote the storage of seasonal surplus water for use during low flow periods.														
MOE to require storage facilities, e.g., ponds, where feasible as condition of water-taking permits.	X							L	P				L	0-5 yrs
1.a) 2.1. Protect groundwater recharge.														
Promote more infiltration in the watershed through innovative stormwater techniques.	X					P	P	P	L	L			L	0-5 yrs
Improve recharge areas including depressional storage and forested areas.		X					P		L	P			M	New ongoing
1.a) 3.1. Encourage water conservation by water-taking permit holders.														
Develop economic incentives to conserve water (e.g., water bill for water-taking, surcharge on summer water-takings, etc.).	X							L	P	L			L	0-10 yrs

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Request water conservation program with water-taking applications or renewals.	X							L			P		L	0-5 yrs
HABITAT (Water Quality)														
1.b) 1.1. Monitor and enforce sediment controls during construction and maintenance.														
Improve enforcement of Section 36 of the <i>Fisheries Act</i> . See also 4.a) 1. – 4.a) 2.	X					P	L		P				M	0-5 yrs
Municipalities to adopt or more effectively implement Topsoil Preservation by-laws.	X								P	L			M	0-5 yrs
Review and update CVC Sediment Control Guidelines (e.g., increase buffer widths during construction phase, 'staged' stripping of developing lands).	X						P	P	L	P			L	0-10 yrs
1.b) 2.1. Ensure assimilative capacity studies are carried out for sewage treatment plants.														
Detailed assimilative capacity studies should be done, with results used to set discharge rates.					X			P	L	P			H	0-5 yrs

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
1.b) 3.1. Promote other stormwater techniques such as infiltration, swales and ditches (vs. curb and gutter), and foundation drains separate from stormwater.														
Support and conduct research and update 'Stormwater Management Planning & Design Manual'.					X	P	P	L	P	P			M	0-10 yrs
Ensure new technologies (e.g., baseflow splitters) become part of the development standards.	X								L	L				
HABITAT (Physical Habitat)														
1.c) 1.2. Stronger enforcement, publicity of illegal alterations, destruction, or contamination of fish habitat.														
Lobby federal government to increase funding for enforcement.				X							L		L	0-5 yrs
Publicize reporting and evidence collection procedures.				X			L		P				L	0-5 yrs
Identify the most appropriate agencies and legislation for enforcement.	X					L	P	P	P			DOE (P)		
Publicize the roles of the agencies and their responsibilities.				X		P	L		P					

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Publicize violations and fines to media.				X			L						L	Ongoing
1.c) 1.3. Ensure no net loss and encourage net gain of fish habitat.														
More consistent application and enforcement of the <i>Fisheries Act</i> and policy.	X					L	P		P				M	0-5 yrs
1.c) 1.4. Protect the fish habitat potential as determined by the fish community classification mapping exercise.														
Protect the fish habitat potential when applying the <i>Fisheries Act</i> .	X					L			L				L	0-5 yrs
1.c) 2.1. Protect and rehabilitate functional buffers for fish and wildlife purposes.														
Educate landowners on the value of buffers and investigate incentives to protect or increase width.				X			P		L	P		OMAFRA (P)	M	0-5 yrs
1.c) 3.1. Support and encourage wetlands protection.														
Continue to inventory and update wetland evaluations.					X		L		P	P		Developer (P)	M	Ongoing
Continue to protect wetlands through the planning process.	X						P		L	L		MMAH (P)	L	Ongoing

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Continue to provide educational materials about wetlands to the general public and municipalities.				X		P	P	P	P	P	P		L	Ongoing
1.c) 4.1. Need to ensure the functions (hydrograph, water quality) of swales and intermittent tributaries are better understood and replicated.														
Encourage and assist research into the function of swales and intermittent tributaries to fish habitat.					X	L	P		P	P		Academic Institutions (P)	M	0-5 yrs
1.c) 5.1. Remove or reduce the impacts (e.g., fishways, bottom draws) of dams and ponds not required for fish species partitioning.														
Inventory and characterize dams and ponds in the watershed and identify management issues.					X		L		L				M	0-5 yrs
Inform landowner of liability issues and discuss feasibility of fish habitat improvements.				X			L		P				L	0-10 yrs
Prioritize and prescribe management options for the dams and ponds in the 'Rehabilitation Strategy'.					X		L		L				M	0-10 yrs

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Implement management options in cooperation with landowner.		X					L		P		P	Landowner (P)	H	New Ongoing
HABITAT (Planning & Monitoring)														
1d) 1.1. Protect natural heritage features as identified in the Natural Heritage Policy Statements.														
Identify natural heritage features (i.e. valleys, recharge/discharge areas and wildlife corridors and habitats).					X		P		L	P		MMAH (P)	H	0-5 yrs
Protect natural heritage features in Official Plans.	X								P	L		MMAH (P)	L	Ongoing
1.d) 2.1. Develop subwatershed plans.														
Continue promoting the benefits of subwatershed plans to municipalities and the public.				X					L				L	Ongoing
Complete subwatershed plans with priority to expanding urban growth centers (e.g., Georgetown).					X		P		L	L			H	0-10 yrs
1.d) 3.1. Develop guidelines in concert with planners.														
Revise and update timing windows and buffer width guidelines for the Credit River.	X					P	L		L				L	0-5 yrs

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Incorporate guidelines into Official Plans and Subwatershed Plans.	X								P	L			L	Ongoing
1.d) 4.1. Improve fish habitat data management and long-term monitoring.														
Better organize, share and analyze data. Finish FCR data entry into a CVC/DFO database and complete MNR NRVIS database.					X	L	L		L				M	0-5 yrs
Identify data gaps, prioritize and collect data using standard methodologies (e.g., MNR Stream Assessment Protocol).					X	L	L		L				M	Ongoing
Review, revise and endorse CVC Monitoring Program. Identify, prioritize and assign monitoring duties and implement.					X		P	P	L				M	0-5 yrs
1.d) 5.1. Collect salmonid spawning data.														
Prioritize spawning surveys where previously not inventoried.					X	P	L		L		P		L	0-5 yrs
Implement and continue spawning surveys.					X	P	L		L		P		M	Ongoing
SPECIES MIX & PARTITIONING														
2.1.1. Continue sea lamprey control program.														

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Monitor, review and improve the efficiency of the Streetsville Dam and applications of TFM to control sea lamprey.			X			L	P						L	Ongoing
2.2.1. If experimental Atlantic salmon restoration program indicates rehabilitation is feasible, formulate detailed management plan.														
Discuss optional management strategies (e.g., barrier management) that are consistent with the Credit River and Lake Ontario Fisheries Management Plans with public input and with Credit River Implementation Committee.			X				L				P	Public (P) Implement. Committee (P)	M	0-5 yrs
2.3.1. Re-introduce smallmouth bass above Streetsville Dam to the Norval Dam.														
Conduct habitat assessment and investigate Credit River transfers, transfers from other systems and aquaculture sources, and ensure Norval Dam is an effective barrier to upstream movement.					X		L		P		P		M	0-5 yrs
If the habitat assessment deems it feasible, re-introduce smallmouth bass above Streetsville Dam.			X				L				P		M	0-5 yrs

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
2.4.1. Reduce pike populations and escapement from Island Lake.														
Promote angler harvest of pike through signage, media releases, derbies, cash incentives and contests.				X			P		L		P		L	Ongoing
Monitor for migration of pike over dam. If necessary, investigate a barrier over length of entire dam.			X				L		L		P		M	0-5 yrs
Allow others to collect and transfer pike to other areas.			X				L		P				L	Ongoing
2.5.1. Stock young hatchery rainbow trout upstream of Norval Dam (see Table 6).														
Continue to stock rainbow trout at levels and locations consistent with the Lake Ontario Fish Community Objectives. In the future, if rainbow trout are given access above Norval Dam, stocking is to be determined by the level of natural reproduction and the Lake Ontario Fish Community Objectives.			X				L				P		L	Ongoing

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
2.5.2 Allow rainbow trout access above Norval dam and up to some point below confluence of the East Credit River if an effective barrier is constructed, and if it does not prevent the overwintering migration of brown trout. Protection of existing brook and brown trout fishery. If not feasible, refer to strategy 2.5.3 in Appendix A (separate document).														
Determine the brown and brook trout wintering range and migration timing with electrofishing or telemetry studies.					X		L		P		P		M	0-5 yrs
Undertake barrier design study and EA (i.e. type, efficiency, operation, location).			X			P	L		P		P		H	0-5 yrs
Fund, build new barrier and manage the Norval Dam to improve rainbow trout and Atlantic salmon passage upstream.			X				L				P		H	0-10 yrs
Monitor efficiency of the new barrier and Stewarttown Dam. If rainbows access above either barrier take appropriate action.					X		L				P		L	New ongoing

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Monitor rainbow trout reproduction success below the barriers and, if can be improved, investigate rehabilitative options.					X		L				P		L	New ongoing
2.6.1. Clarify fishery management options for lower Black/Silver Creek.														
Investigate co-management of trout (e.g., stocking levels and locations) with different species, i.e. brook trout, brown trout, Atlantic salmon.					X		L		P		P		M	0-5 yrs
2.7.1. Stop Pacific Salmon at Streetsville Dam to ensure egg collection.														
Manage the dam and fishway so that Pacific salmon and sea lamprey do not get above Streetsville Dam.			X			P	L						L	Ongoing
Clarify regulations to deal with Pacific salmon passing Streetsville Dam.			X				L						L	0-5 yrs
Monitor effectiveness of the barrier.					X		L				P		L	New ongoing
EDUCATION														
3.1.1. Centralize, share and coordinate information distribution.														

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Consider a newsletter / webpage to improve communication with NGOs and highlight important points for the general public.				X			P		L		P		M	0-5 yrs
Provide a copy of brochures, factsheets and fisheries management plan to libraries, school boards, and post on website.				X			L		L				L	0-5 yrs
3.2.1. Improve the distribution of habitat protection and rehabilitation educational materials and relate messages to their (non-angling) values, e.g., economic benefits for corporations.														
Develop a Citizen's Guide and deliver to priority areas. Coordinate with other similar initiatives, e.g., Region of Halton.				X					L	L			M	New ongoing
3.2.2. Educate developers, front-line workers, landowners, municipalities, agencies and NGO's on the impacts of watercourse and wetlands alterations and the existence and purpose of the permitting process.														

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Ensure developers, front-line workers, landowners, municipalities, agencies and NGOs are educated on harmful alteration or destruction to fish habitat (i.e. <i>Fisheries Act</i> /BMP's / guidelines / manuals, seminars, 'What is Fish Habitat' video).				X		L	L		L	P			M	New ongoing
3.3.1. Improve distribution of, and update signage, maps, and education/regulations materials.														
Create signs with public access maps, fishing regulations (include penalties), fish identification (e.g., Atlantic salmon, brook/sea lamprey), hotline numbers, and Guide to Eating Ontario Sportfish. Add this information to Conservation Areas and Wild Trout signs.				X			L		L		P		M	0-5 yrs
Provide brochures and factsheets to tackle shops, municipalities, tourist outlets, libraries, MNR offices and NGOs.				X			L		L				L	0-5 yrs
Continue promotion of access points at the fishing shows.				X			L		L				L	Ongoing

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Mail a copy of the fishing regulations summary with each fishing license.				X			L						M	New ongoing
ENFORCEMENT & REGULATIONS														
4.b) 1.1. Increase awareness of existing fishing regulations and publicize violations.														
Better distribution of regulations summary, e.g., mail with all licences, distribute at Conservation Areas and discuss partnership with beer/liquor stores.				X			L		P		P		M	New ongoing
Summarize fisheries regulations specific to the Credit River. Modify and update existing 'Fisheries of the Credit River' brochure and factsheets, which may include the summarized regulations and distribute them.				X			L		L		P		L	0-5 yrs
Report violations of the fishing regulations to the media.				X			L						L	Ongoing
Make the regulations easier to understand (e.g., Atlantic salmon regulations, rainbow trout in Mullet Creek, Pacific Salmon above Streetsville) including translation for ethnic groups and the use of international symbols.				X			L					Public (P)	M	0-5 yrs

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
4.b) 2.1. Create programs that will improve enforcement.														
Improve and better publicize MNR / Crimestoppers (Report a Poacher) 'hotline' number(s), e.g., on Wild Trout signs, for 24-hour contact with officers (including cellular telephone numbers).			X	X			L				P		L	0-5 yrs
Expand and improve Riverwatch and Riverkeeper programs that promote ethical fishing practices, regulations awareness and improves working relations with the Conservation Officer and local police.			X				L				P		M	Ongoing
Publicize reporting and evidence collection procedures for fisheries violations.				X			L		P				L	0-5 yrs
Increase patrols through monitoring / enforcement partnerships and/or additional Deputy Conservation Officers. Review roles of Deputy Conservation Officers.			X				L						H	New ongoing
REHABILITATION														
5.1.1. Identify, prioritize and design rehabilitation projects watershed-wide.														

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Identify all potential rehabilitation sites.					X		L		L		P		L	0-5 yrs
Develop criteria for prioritizing rehabilitation projects, i.e. decision matrix, through a workshop and/or subwatershed plans. Utilize existing and potential fish habitat maps, TU strategy and CVC criteria to create a watershed-wide 'Rehabilitation Strategy'.		X					L		L		P		L	0-5 yrs
Direct rehabilitation efforts to the most limiting factors to fish production. Consider stream type and natural limitations. Utilize an adaptive management approach with monitoring.		X				P	L		L		P		H	New ongoing
Train and provide scientific guidance / protocols to NGOs and others to collect data, design and monitor projects.				X			L		L		P		M	0-5 yrs
5.1.2. Implement and monitor rehabilitation projects watershed and subwatershed-wide.														

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Publish a list of stream rehabilitation references and include it in the 'Rehabilitation Strategy'. Provide fact sheets and up-to-date manuals such as CFWIP and Natural Channel Design.				X			L		L				L	0-5 yrs
Adopt standard assessment / monitoring methodology of rehabilitation projects and apply lessons learned through a monitoring working group.		X			X		L		L		P		L	New ongoing
5.2.1. Maintain and improve volunteer interest and participation.														
Identify potential volunteer groups (e.g., schools, Guides, Scouts, Lions Club etc.) located in the watershed via their head offices.			X				L		L				L	0-5 yrs
Solicit input from NGO members on preferred project types.			X				L		L		P		L	Ongoing
Make phone calls to individuals for workdays.			X								L		L	Ongoing
Coordinate and provide centralized pool of available volunteers and projects, e.g., keep updated calendar of events on website.			X				L		L		P		L	Ongoing

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Better advanced distribution of workday calendars and cross promotion between NGOs (e.g., Wild Trout Signs, CVC website, outdoor magazines, community newspapers, cable tv, Credit River Stewardship newsletter). Also consider providing an annual report to volunteers and media of volunteer workdays to aid in promotion and fundraising.			X				P		L		L		L	Ongoing
Provide an educational component to each workday.		X					L		L		L			Ongoing
Provide incentives to NGO members for participating in workdays (e.g., portion of membership fee returned for participation in workdays, pins, posters, draw prizes, awards, crests, volunteer discount cards).				X			P		P		L			Ongoing
5.3.1. Provide more stewardship information to landowners/NGOs.														
Prepare a coordinated / streamlined MNR and CVC Stewardship Program.		X					L		L			MOE (P) OMAFRA (P)	M	0-5 yrs

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
	Implement MNR/CVC Stewardship Programs.				X			L		L		P		
Produce and distribute stewardship documents (e.g., Citizen's guide, pond manual) and other related factsheets.				X		P	P		P	P			M	0-5 yrs
Provide educational seminars for landowners and NGOs.				X			L		L		P		L	Ongoing
Catalogue demonstration sites and promote in the Ontario Streams Rehabilitation Manual.				X			P		P		P	Ontario Streams (L)	L	New ongoing
Provide incentives to improve landowner participation, e.g., tax rebates, funding, recognition, signage and awards.		X					L		L	P		OMAFRA (L)	H	New ongoing
5.3.2. Improve communication of ideas / partnerships with government, NGOs and public.														
Maintain existing level of communication between groups through the Implementation Committee.				X		P	L		L	P	P		L	New ongoing
5.3.3. Provide better access to funding programs and equipment.														

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Publish potential funding sources, e.g., CFWIP, Great Lakes 2000, Canada Trust, corporate sponsors, etc. in the 'Rehabilitation Strategy'.				X			L		L				L	0-5 yrs
Identify and publish sources of equipment.				X			L		L				L	0-5 yrs
PUBLIC ACCESS AND FISHING OPPORTUNITIES														
6.1.1. Improve information and distribution of existing access points.														
Update 'Fisheries of the Credit' brochure and factsheets and identify new areas requiring factsheets (e.g., parkettes), include parking and private fee-for-fishing opportunities. Also update website and hotlinks.				X			P		L		P		L	Ongoing
6.1.2. Introduction or expansion of species range for new opportunities.														

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Identify waters and species suitable (habitat assessments) for introduction, e.g., non-migratory rainbow trout, brown trout, smallmouth bass and Atlantic salmon upstream of Streetsville, black crappie in Lake Aquitaine, walleye, bass and lake trout in Caledon Pits, and panfish in stormwater ponds. Stock accordingly. See also 2.5.1.1.-2.5.5.1 and 2.9.1.1a) – 2.9.1.4.			X		X		L		P		P	Landowner (P)	M	New ongoing
6.2.1. Increase urban angling opportunities.														
Identify and promote existing fishing opportunities in urban areas.			X	X			L		L	P			L	New ongoing
Rehabilitate fish habitat in urban areas to improve fishing opportunities.		X					L		L	P	P		H	Ongoing
Identify appropriate locations for stocking and stock appropriate species, e.g., smallmouth bass above Streetsville dam and sunfish, perch, catfish and bass in some stormwater ponds.			X				L		P	P	P		M	New ongoing

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Continue to promote youth fishing programs such as MNR Fishways, Bassmasters - Youth Angling Club, OFAH school program, FON youth programs, municipal summer camps, Take a Kid Fishing Week, and Urban Fishing Festival.				X			L		P		P		L	Ongoing
6.4.1. Educate public regarding the <i>Trespass to Property Act</i> .														
Publish information on <i>Trespass to Property Act</i> , <i>Public Lands Act</i> and <i>Navigable Waters Protection Act</i> .				X			L						L	0-5 yrs
Work with landowners to control trespassing, e.g., signage.			X				P		P		P	Landowner (P)	M	New ongoing
6.5.1. Improve parking facilities.														
Identify locations where additional (e.g., Port Credit) or safer parking facilities (e.g., Forks of the Credit shoulder parking), boat ramp (e.g., ILCA) and washroom facilities are needed.					X		P		P	P	L		L	0-5 yrs
Discuss with Ontario Parks, the possibility of re-opening the Forks of the Credit Provincial Park parking lots on Dominion St. Identify corporate sponsor, if necessary.			X				L				P		L	Ongoing

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Purchase or develop available land as parking facilities, e.g., Mississauga Road and Elora-Cataract Trailway. Discuss other options in Cataract with MNR, Town of Caledon.			X				P		P	P	L		H	0-10 yrs
OTHER ISSUES														
7.1.1. Stay aware of climate warming trends and predictions, and monitor trends.														
Monitor international literature, attend workshops etc. and incorporate latest studies.					X	P	L	P	P			DOE (P)	L	Ongoing
Develop a partnership to model climate change in the Credit River and consider management options consistent with climatic predictions, e.g., reduce water-takings.					X	P	P	P	L			DOE (P) Academic Institutions (P)	H	0-10 yrs
Review, revise and implement CVC Monitoring Program.					X		P	P	L				L	Ongoing
7.2.1. Better incorporate, model and understand all of the interactive components of an ecosystem.														

STRATEGIES AND TACTICS	THEMES					AGENCY ROLE L=Lead P=Partner							COST LEVEL	TIME
	Habitat Protection	Habitat Enhancement	Fisheries Management	Communications	Monitoring and Future Studies	DFO	MNR	MOE	CVC	Municipalities	NGOs	Others		
Better identify natural areas, recharge areas, and physiographic features requiring protection. Update wetland evaluations and Ecological Land Classification mapping.					X		L		L	P			H	Ongoing
7.3.1. Utilize more information regarding tourism and economic benefits in managing the fishery.														
Initiate a socio-economic review / study (creel and other data) of the values of the Credit River fishery and identify opportunities for improvement.					X		L		L	P		TEDA (P) Academic Institutions (P)	M	0- 10 yrs
Investigate catch and release for biological reasons, increasing fishing opportunities and as potentially improving economic benefits.					X		L							

A more accurate estimate of cost of each tactic becomes quite complex when considering materials, equipment, labour, staff resources etc. Budgets for each tactic, if required, will be completed as the tactics are to be implemented.

An estimated **time** to complete each tactic was based on four categories:

- Ongoing – projects that are in progress and will continue through the life of the Plan.
- 0-5 years – projects that will be complete within 5 years.
- 0-10 years – projects that will be complete within 10 years.
- New Ongoing – Projects that will begin as soon as possible and will continue through the life of the Plan.

It is important to note that this Plan is a living document, and as such will be constantly revised and updated by the Implementation Committee (refer to section 5.2.3 for a discussion of the Implementation Committee). As new ideas are identified or priorities change, the issues, strategies and tactics can be deleted, added, or moved from the implementation tables to reflect the current objectives.

In order to organize implementation, the priority tactics are grouped into some common themes including: Habitat Protection, Habitat Enhancement, Fisheries Management, Communications, Monitoring and Future Studies. These common themes helped to organize the discussion of the priority initiatives in the following sections.

5.1.1 Habitat Protection

Given the pace of urban expansion in the watershed in recent years and the anticipated future trend, land use change is a major threat to the Credit River fishery. Many of the tactics in this section are related to the protection of the watershed from the effects of land use change. Protection is achieved through a variety of legislation including the *Planning Act*, *Fisheries Act*, *Conservation Authorities Act*, etc. (Figure 14).

The *Planning Act* governs the land use planning process. MMAH is responsible for administering the Act, while municipalities are the lead agency responsible for implementing the Act, although many other public sector agencies are involved either in a commenting capacity or in the administration of related legislation. The following discussion is organized by subheadings that relate to the various pieces of legislation.

Land Use Planning

An effective method of protecting habitat is through the creation and implementation of policy and legislation. Once policy or legislation has been incorporated into Official Plans or supported by zoning by-laws, developers are obligated to comply. Currently, many recommendations outlined in the fisheries management plan and subwatershed plans are not recognized in most of the Official Plans in the Credit River watershed. All municipalities in the watershed need to review the CRFMP so they will cooperate to implement the Plan through their Official Plans, and subsequently in the review of development applications

Wetlands play an important role in terms of hydrological function (i.e. recharge, discharge, baseflow, flood control), fish and wildlife habitat contribution, water quality improvement and recreational and tourism opportunities. To date, it is estimated that over 68% of southern Ontario's original wetlands have been lost (Snell 1987). This incredible loss highlights the importance of protecting the remaining wetlands in the region.

As identified in the *Provincial Policy Statement* (1997), municipalities are responsible for protecting Provincially Significant Wetlands. While this protection has been reasonably effective, there is a lack of protection of the "other" unevaluated or locally significant wetlands. These "other" wetlands are also important to protect in terms of their inherent value as rare features in southern Ontario. The CVC and the municipalities have tried and should continue to try to protect all wetlands that meet evaluation criteria (size and distance), through policies, official plans and/or zoning by-laws.

Technical guidelines such as construction timing windows and buffer widths are used as methods of protecting fish habitat as development occurs (Table 13 and Figure 17). Timing windows refer to the time period when in-stream works (to bankfull), are allowed with the required permits from MNR, CVC and DFO and municipalities. Timing windows help to protect sensitive life stages of fish (e.g., smothering eggs with silt) while natural buffers control nutrients, sediment, and provide shading, etc.

The approach taken in the CRFMP was to protect the sensitive downstream fish communities (Table 13). For example where small warmwater tributaries drains into coldwater habitats, the more restrictive coldwater timing window applies to the warmwater tributary. This principle was used throughout, except for two locations. The first exception occurs at the transition zone in the main Credit River from mixed cool / cold to large warmwater, in the Huttonville area. This exception accommodates a earlier in-stream construction window upstream in the watershed (before July 1st). This was the point at which the fish community changed and it was anticipated that this particular zone was less sensitive, due to the lack of top predators between Huttonville and Streetsville. If top predator populations are established in this reach these timing guidelines may need to be revisited.

The second timing window exception occurs below the confluence of the West Credit River with the main Credit River. This exception was required to protect the redbreasted dace known to occur in the main Credit River from the Forks to Cheltenham. The more restrictive spring timing window was extended upstream to the escarpment to provide protection from the more permissive coldwater timing window upstream.

Exceptions or further restrictions to the recommended timing windows can also occur on a case-by-case basis but must be approved by MNR.

Vegetative buffers provide many ecological functions including: temperature regulation through shading; woody cover; natural food production (leaf litter and invertebrates); nutrient and sediment control; reduce pollution; erosion control; flood retention; and

Table 13. Construction timing windows for inwater works and recommended natural buffer widths.

Fish Community	In-Stream Construction Timing Window	Minimum Buffer Width^b Greatest of meander belt, or:	Justification
Coldwater	June 1 – September 15	30m	Protection of fall spawning species
Coldwater draining to large warmwater	July 1 – September 15	30m	Protection of fall spawning species and warmwater species in Island Lake
Large warmwater draining to coldwater	July 1 – September 15	30m	Protection of warmwater spawners in Island Lake and downstream fall spawning species
Mixed Water – Cool/Cold	June 15 – September 15	30m	Protection of fall and spring spawning species
Mixed Water – Cool/Cold	June 15 – March 31	30m	Protection of spring spawning species only
Mixed Water – Cool/Cold draining to large warmwater	July 1 – September 15	30m	Fairy Lake
Mixed Water – Cool/Warm That Drain into Coldwater	June 15 – September 15	30m	Draining into coldwater; fall spawning
Mixed Water – Cool/Warm That Drain to Large Warmwater	July 1 – March 31	15m	Protection of large warmwater top predators.
Small Warmwater – Draining into Coldwater	June 1 – September 15	30m	Protection of fall spawners
Small Warmwater – Draining into Cool/Cold Water	June 15 – September 15	30m	Protection of fall and spring spawners

Fish Community	In-Stream Construction Timing Window	Minimum Buffer Width^b Greatest of meander belt, or:	Justification
Small Warmwater – Draining into Large Warmwater or Cool/Warmwater	July 1 – March 31	15m	Protection of large warmwater top predators.
Large Warmwater*	July 1 – March 31	15m	Protection of large warmwater top predators.
Redside Dace Habitat**	July 1 – March 31	30m	Protection of redside dace spawning.

*During the period when in-water works are permitted, migratory fish passage must be maintained.

**Redside dace are known to occur in Fletchers Creek, Huttonville Creek, Springbrook Creek, tributaries of Caledon Creek and Rogers Creek. Historical records indicate that redside dace were found in Black Creek, Silver Creek, Credit River and its tributaries near Cheltenham. Further fisheries inventories would be required to confirm the presence or absence of redside dace within these watercourses, before allowing a broader construction in-water timing window.

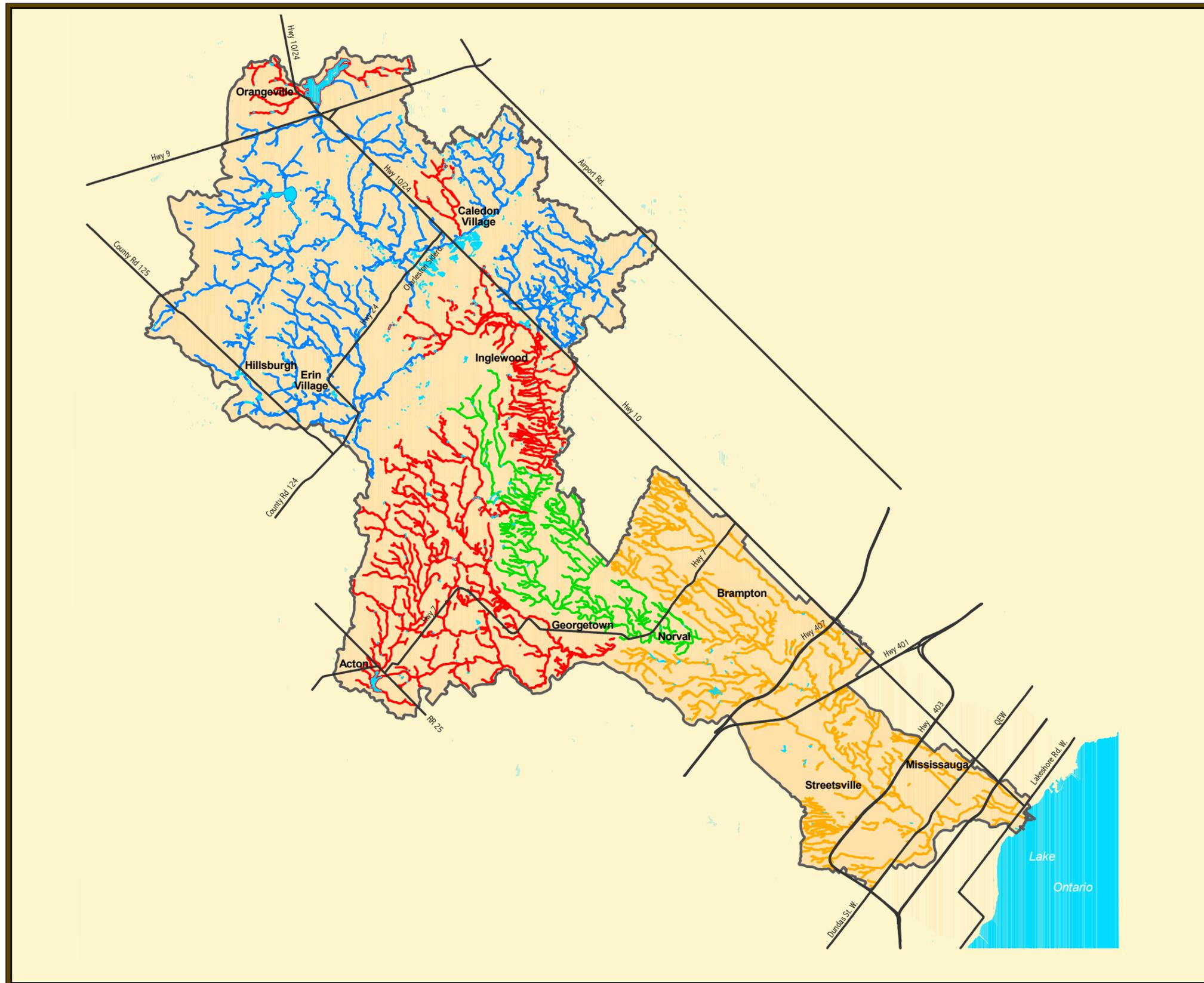


Figure 17. Construction timing windows during which in-water works are allowed.

Timing Window

- ↘ June 1 - September 15
- ↘ June 15 - September 15
- ↘ July 1 - September 15
- ↘ July 1 - March 31

Transportation Network

- Highway

Drainage Network

- Lakes and ponds

- Credit River watershed boundary



1:250,000



wildlife habitat/corridors. If natural buffers are not maintained this may result in a harmful alteration of fish habitat.

Buffer widths will be applied where there is permanent or seasonal fish habitat on-site. This buffer zone must be maintained in a natural state. This may be best achieved if lot lines do not encroach on the buffer. If buffer guidelines cannot be maintained, the proponent must demonstrate “no net loss” of the functional contributions to fish habitat. Where reddsides are found, at least the minimum buffer width is essential.

It is anticipated that more detailed discussion on these and other protection guidelines will be included in the CRFMP *Planner’s Guide* companion document.

Stormwater management is regulated by the *Ontario Water Resources Act*, which is administered by the MOE. The Municipalities and CVC review development proposals and their proposed stormwater management practices, utilizing the *Stormwater Management Planning and Design Manual* (MOE 1999). This manual provides “technical and procedural guidance for the planning, design, and review of stormwater management practices”. This manual was created to guide stormwater management solutions, and to provide flexibility in allowing the use of new and innovative designs. The CRFMP recognizes this ongoing evolution of stormwater management techniques, and encourages the municipalities and CVC promote these ideas when reviewing development proposals.

Water-taking

The top priority identified by the participants in the CRFMP planning process deals with improving the management and monitoring of water withdrawals within the watershed. Under the *Ontario Water Resources Act*, MOE is the agency responsible for tactics recommended in this category. Two tactics suggest that MOE can improve their role in managing water taking through a water budget. In the meantime, MOE is encouraged to continue the use of moratoriums on new water taking permits until a water budget is complete.

All of the tactics identified are not currently in progress, and the majority would require some additional funds to implement.

Sediment Control

The addition of sediment to a river system through erosion is a natural process. However, the accelerated erosion caused by human activity is viewed as harmful to aquatic life. Numerous agencies including the MNR, DFO, DOE, CVC, MOE and Municipalities, help to ensure sedimentation does not occur (Table 14).

Even with all these agencies involved, sedimentation problems continue to plague the watershed. These problems can be attributed to:

- a lack of willingness to control sediment;

- the use of incorrect sediment control measures;
- lack of maintenance of sediment controls;
- lack of sufficient buffers; and / or
- large areas being stripped and laying bare over successive year.

In order to improve the effectiveness of sediment control, there is a need for increased enforcement and a review of technical guidelines.

Table 14. Legislation relevant to sedimentation.

Statute	Section(s)	Area of Regulation	Agency
Fisheries Act	Section 35(1)	Prohibits harmful alteration, disruption, or destruction of fish habitat	Fisheries and Oceans Canada
Fisheries Act	Section 36(3)	Prohibits deposition of deleterious substance into water frequented by fish	Environment Canada
Fisheries Act	Section 36 (3)	Prohibits deposition of deleterious substance into water frequented by fish	Ontario Ministry of Natural Resources
Fisheries Act	Section 36 (3)	Prohibits deposition of deleterious substance into water frequented by fish	Ontario Ministry of the Environment
Ontario Water Resources Act	Section 30(1)	Prohibits discharge into waters of substance that may impair water quality	Ontario Ministry of the Environment
Topsoil Preservation By-Law		Regulations regarding the removal of topsoil.	Municipalities
Fill By-Law		Regulation regarding the placement of fill.	Municipalities

Adapted from “Fish Habitat in Ontario Compliance Protocol: Federal and Provincial Roles and Responsibilities” (DFO *et al.* 2000).

Fish Habitat

The *Fisheries Act* is recognized as a powerful piece of environmental legislation. Concerns have been raised about the implementation of the Act. DFO and their commenting partners, in particular MNR and CVC, need more consistent application and enforcement of the *Fisheries Act* and its policy to ensure protection of fish and fish habitat.

Planning Guidelines

In order to facilitate the implementation of tactics that relate to planning, a CRFMP companion document titled *Planner's Guide* will be produced. The purpose of the guide is to provide information such as construction timing windows for in-stream works, buffer

widths and references to other guidelines (e.g., *Provincial Policy Statement – Implementation Guidelines*, sediment and erosion control guidelines for the protection of natural features contributing to fish habitat (MNR 1993)). The guide will also recommend actions that can be taken to improve fish habitat protection. Some of these techniques include baseflow splitters, bottom draws, cooling trenches, and the use of open ditches versus curb and gutter. The target audience of the *Planner's Guide* is primarily agency staff, municipal staff and developers.

5.1.2 Habitat Enhancement

Fishing clubs, individuals, municipalities, MNR and CVC have a long history of undertaking fisheries enhancement projects in the Credit River watershed. The priority recommendations outlined in this Plan propose to build on that history by providing better information and support to make these initiatives even more effective.

Some of the key enhancement tactics centre on the delivery of stewardship services by resource management agencies. Historically, MNR and CVC have been involved in varying ways in the delivery of stewardship services in a loosely coordinated way. The Plan is recommending that the two agencies prepare and implement a joint, coordinated and streamlined Stewardship Program. This should be completed as soon as is practical. Further priority tactics identify specific projects to enhance groundwater recharge and urban fishing opportunities.

Rehabilitation

A main recommendation identified in the CRFMP is the need for a watershed-wide approach to rehabilitation. A companion document to the CRFMP called the *Fisheries Rehabilitation Strategy* will be prepared to facilitate the implementation of the habitat enhancement tactics. The *Rehabilitation Strategy* will be a result of CVC, MNR, NGOs and members of the academic community focussing rehabilitation efforts on the limiting factors affecting fish populations in the watershed and developing a reference document to guide future activities.

The *Rehabilitation Strategy* will also:

- Identify and rank the limiting factors on a watershed-wide scale;
- Provide scientific protocols to design projects, collect data and monitor rehabilitation;
- Help groups to design workplans; and
- List available reference manuals, tools, factsheets, etc.

Ultimately, the *Fisheries Rehabilitation Strategy* will provide a listing of rehabilitation projects in priority sequence to help coordinate efforts from an agency and NGO perspective at a watershed scale. Identification of rehabilitation projects will continue with data collection and monitoring activities.

Communication was identified as another key component of ensuring the rehabilitation initiatives are the most effective. The continued distribution of the stewardship workday

calendar, communication among the NGOs via newsletters or the website, and the development of a *Citizen's Guide* for people living in or near natural areas, will help to improve awareness and create a sense of need to improve and protect natural areas.

Dam Mitigation and Removal

The CRFMP takes advantage of some of the existing dams as opportunities to partition various fish species. Many other barriers to fish passage exist on the Credit River. Dams have many known negative environmental impacts. Some of the dams that are not used for fish management have been identified for mitigation or removal. Dams identified to date, with known negative impacts include:

- Melville Dams
- Alton Dams
- Erin Dams
- Cedar Falls
- Hillsburgh Dams
- East Credit Dam
- Belfountain Dams
- Sawmill Creek
- Orpen Lake
- Mary Fix

5.1.3 Fisheries Management

MNR is legislated to manage the stocking and transfer of fish, barriers to fish passage, fish ladders and fishing regulations. All of the priority tactics falling under the theme of Fisheries Management identify MNR as the lead agency responsible for implementation. Partnered leads have been identified for a couple of the tactics due to ownership and federal responsibility for the control of sea lamprey.

Increased angling opportunities, access and enforcement were identified as the key issues. Access issues are a concern from a social perspective, and therefore require another agency or group to lead the implementation.

5.1.3.1 Barrier Management

One of the main tools used to partition fish species from potentially competing with each other is through barrier management. MNR has the primary responsibility of managing fish barriers and fish passage. The key barriers used to either stop or pass fish in the Credit River include Streetsville dam, Norval dam, Stewarttown dam, Niagara Escarpment (e.g., Cataract falls), and the Belfountain dam. Other barriers not used for fisheries management purposes represent habitat enhancement opportunities (section 5.1.2).

Under certain flow conditions, all of the barriers in the Credit River watershed may not be efficient at stopping or passing various species of fish. Therefore, initially, a hydraulic

analysis of the efficiency of the barriers will be undertaken to provide a risk analysis or to determine their effectiveness at passing fish. This work will be undertaken in conjunction with DFO. Also, monitoring of these barriers is imperative to ensuring their efficiency.

The **Streetsville Dam** will continue to be used to stop the upstream migration of chinook and coho salmon in the fall. Rainbow trout and brown trout will be allowed above the Streetsville dam in the fall (approximately October 10-December 15), by selectively passing them at the fishway. In the spring, the Streetsville fishway will be opened (approximately March 15 - beginning of May) to allow the free passage of migrating rainbow trout. In addition, Streetsville Dam will continue to be used to stop migratory sea lamprey from moving upstream. Minimally, a 40cm jump in the fishway is adequate to stop sea lamprey (pers comm. Tom McCauly, DFO - Sea Lamprey Control 2000). In co-operation with DFO, the Streetsville Dam will be modified further to reduce the potential for sea lamprey passing over the dam. These modifications will also help to make the dam a more effective barrier to Pacific salmon. In 2000, the Streetsville Dam will also be assessed to determine if the fishway can be used to pass smallmouth bass, while stopping sea lamprey which migrate at approximately the same time of year. Partnerships with local interest groups will continue to be a very important component of the day-to-day operation of the Streetsville fishway.

The **Norval dam** will continue to be used to stop the upstream migration of rainbow trout and brown trout, until a feasibility study is conducted to determine optional sites for a new barrier, or the Norval dam fails. If a new barrier is built, modifications will be required at the Norval dam to allow the upstream migration of rainbow trout in the fall and spring and Atlantic salmon in the fall. This includes improvements or replacement of the existing denile fishway. If, in the future, the Norval dam fails and there is no new upstream barrier, migratory fish will be stopped at the Streetsville dam and the issue of any Pacific salmon and trout passing the Streetsville dam will have to be addressed.

The **Stewarttown dam** needs to be assessed to ensure rainbow trout do not get above the dam, it may need to be retrofitted to pass Atlantic salmon. Brook trout populations above the Stewarttown dam must be protected.

The Plan identified that there are opportunities for increased production in the middle part of the river and that rainbow trout could take advantage of this section of river. Therefore, this Plan recommends a full environmental feasibility assessment be undertaken to determine the feasibility of a **new barrier** to partition migrating rainbow trout from the upper river resident brook and brown trout areas. The CRFMP has also identified that the barrier should be downstream of the confluence of the East Credit River with the main Credit River, and that the study needs to consider the overwintering brown trout populations. Atlantic salmon must be able to pass the new barrier to Cataract. The new barrier will require an Environmental Assessment.

Dam construction is subject to the Environmental Assessment (EA) Act for Small Scale MNR projects. This new barrier is anticipated to be a "B" category EA project because it

is a dam intended to improve fisheries habitat / management and has a cost greater than \$50 000. Therefore, the Field Environmental Planning Procedure must be followed. The six step planning process is outlined in Figure 18. Public consultation is an integral part of the process.

The historical **electric barrier** near Inglewood will be removed in 2000, because it is too far upstream to be used to partition rainbow trout from the East Credit River, it did not prove to be an effective barrier, and because of the liability issues associated with the barrier located in a public area.

The Niagara Escarpment at **Cataract** will continue to be managed as a natural barrier to the upstream migration of all species of fish.

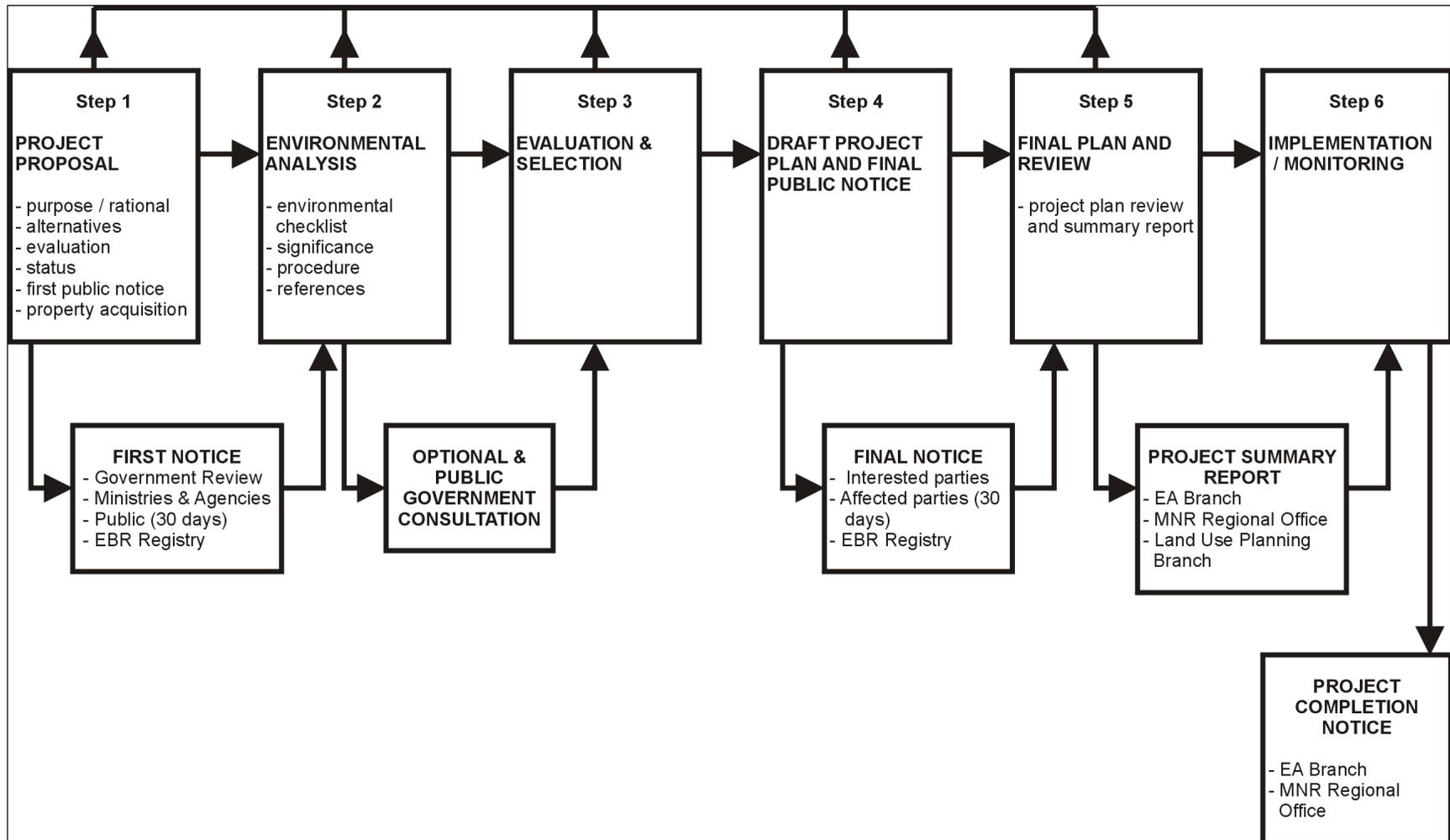
The Niagara Escarpment at **Belfountain** will continue to be managed as the partition between brown trout and brook trout populations. However, it has been accepted that Atlantic salmon historically may have had access above the Belfountain Dam into the West Credit River. Opportunities regarding access for Atlantic salmon above Belfountain Dam will be explored in conjunction with an assessment of rehabilitation options regarding the future of the dam and headpond now underway.

Modifications to the **Island Lake** south dam outlet structure, and the continued promotion of the pike derbies will be used as tools to reduce the number of northern pike leaving the reservoir and potentially impacting downstream fisheries.

The CRFMP supports the experimental re-introduction program for Atlantic salmon, a natural heritage species, in the Credit River. If the Atlantic salmon re-introduction program proves feasible, adult passage above Streetsville dam, Norval dam, the new barrier, Stewarttown dam and possibly Belfountain dam, will be assessed. Management of these ladders must consider the time of migration of other species. For example, Atlantic salmon may migrate up the river at the same time as Pacific salmon that must be stopped at the Streetsville dam. The implementation of this Plan will involve further public consultation with the CRFMP Implementation Committee and the provincial Atlantic salmon Steering Committee.

Special consideration is required for the protection of the Threatened reddsidedace. A recovery plan will be developed to help protect and enhance the reddsidedace population in the Credit River watershed.

Figure 18. Field environmental planning procedure.



Access

There is a demand to increase parking facilities along access points, particularly at the Cataract, Forks of the Credit Road, and Mississauga Road at the Elora-Cataract Trailway. A variety of issues (i.e. traffic, trespassing) and options (i.e. land acquisition, maintenance) require further assessment by MNR, Municipalities, CVC and NGOs. Existing and potential access points to the middle river will have to be assessed when salmonids are given access to these areas.

In concert with access is the issue of trespassing on private property throughout the watershed. It is recommended by the CRFMP to work with landowners to control trespassing on private property.

Stocking and Transfers

Stocking efforts have been identified as priority in order to significantly improve fishing opportunities through new and ongoing initiatives. These efforts include:

- 1) Continuing to stock rainbow trout in accordance with the Lake Ontario Fish Community Objectives (Stewart *et al.* 1998);
- 2) Reintroducing smallmouth bass above Streetsville Dam, if feasible; and
- 3) Investigating the feasibility of stocking stormwater ponds to increase urban fishing opportunities, and private ponds for fee-for-fishing opportunities.

Transferring northern pike out of the watershed, where appropriate will continue.

Fishing Regulations

One of the many responsibilities of the MNR is adjusting the existing fishing regulations, making recommendations to the federal government on new fishing regulations, and enforcing these regulations. Clarification of the regulations for Pacific salmon that pass over the Streetsville dam was identified as a priority.

Changes to the fishing regulations will be considered as the distribution of fish changes in the Credit River watershed. For example, fisheries regulations may be amended to allow for a fishing limit of Atlantic salmon above the QEW or, if rainbow trout are allowed above the Norval dam, the fishing regulations may be changed for the catch and possession limits above Norval.

Although none of the individual regulation changes were identified as a priority, the Implementation Committee may choose to bring them forward collectively for review and implementation.

5.1.4 Communications

Through the course of the development of the CRFMP, it has become very clear that better information exchange and communication among a wide range of groups and individuals is critical to the future of the Credit River fishery. The theme of communications and education was found to run through every issue, such as:

- Habitat – Educate landowners on the value of buffers and investigate incentives to protect or increase buffer widths.
- Species Mix & Partitioning – Promote angler harvest of pike in the upper watershed through signage, media releases, derbies, cash incentives and contests.
- Enforcement and Regulations – Better distribution of the *Recreational Fishing Regulations Summary*.
- Rehabilitation – Train and provide scientific guidance/protocols to NGOs and others to collect data, design projects and conduct monitoring.

Common topics about priority communication initiatives were quite evident. These included creating awareness, training groups or individuals, or promoting existing information through signs, brochures and press releases. Three companion documents will be prepared to help in communicating the tactics outlined in the CRFMP: *Fisheries Rehabilitation Strategy*, *Citizen's Guide*, and the *Planner's Guide*.

The *Fisheries Rehabilitation Strategy* will be developed by a small group of dedicated individuals including CVC, MNR, NGOs, and members of the academic community to provide a useful tool to those interested in conducting rehabilitation projects in the Credit River watershed. The strategy will prioritize projects watershed-wide, provide proper protocols for data collection and monitoring, help individuals plan their projects, and contain invaluable reference lists such as potential funding sources, access to tools, and stream rehabilitation documents.

One of the top requests from the public, from a communications perspective, is informing them how they can take an active role in protecting the resources of the Credit River watershed. A *Citizen's Guide* will provide information on such issues as lobbying the government, how to report a fisheries or habitat violation, education programs, etc. The guide will also help to foster an awareness of the creation of the CRFMP and the high quality fishery offered in the Credit River watershed.

The *Planner's Guide* will provide planners with the recommendations from the CRFMP to help guide them when reviewing a development application for potential impacts to the fisheries of the Credit River. The guide will also help to educate developers, landowners and other proponents of a land use development application on the guidelines under which their proposals are reviewed.

While these three documents provide an excellent start in implementing the priority communication initiatives, it is not comprehensive. Several other tactics identified as priority do not fall under these documents.

The *Recreational Fishing Regulations Summary*, produced annually by the MNR, need to be clarified and more readily available. Distribution of the regulations with the fishing license, or signage at access points was suggested to increase an anglers awareness of the rules associated with fishing an area. Constant reporting of fishing violations to the media is also suggested as a way of increasing awareness of the regulations and of enforcement.

The continued promotion of the fisheries resources offered by the Credit River watershed is highly recommended. A *Fisheries of the Credit River* brochure and the associated factsheets are very popular with first-time anglers and those anglers who aren't aware of all of the access points located in the watershed.

Many other tactics were identified, however the most important aspect of implementing the tactics is to coordinate efforts among all groups and agencies to achieve an effective, cost-efficient communications plan to fulfill the objectives outlined in the CRFMP. This includes getting the community to adopt the river, the fishery and this Plan for their future.

Whereas specific lead agencies have been identified for implementing priority tactics, the communication, or extension of information, is the responsibility of all groups, agencies and individuals. Communication will be an important aspect of all future implementation initiatives.

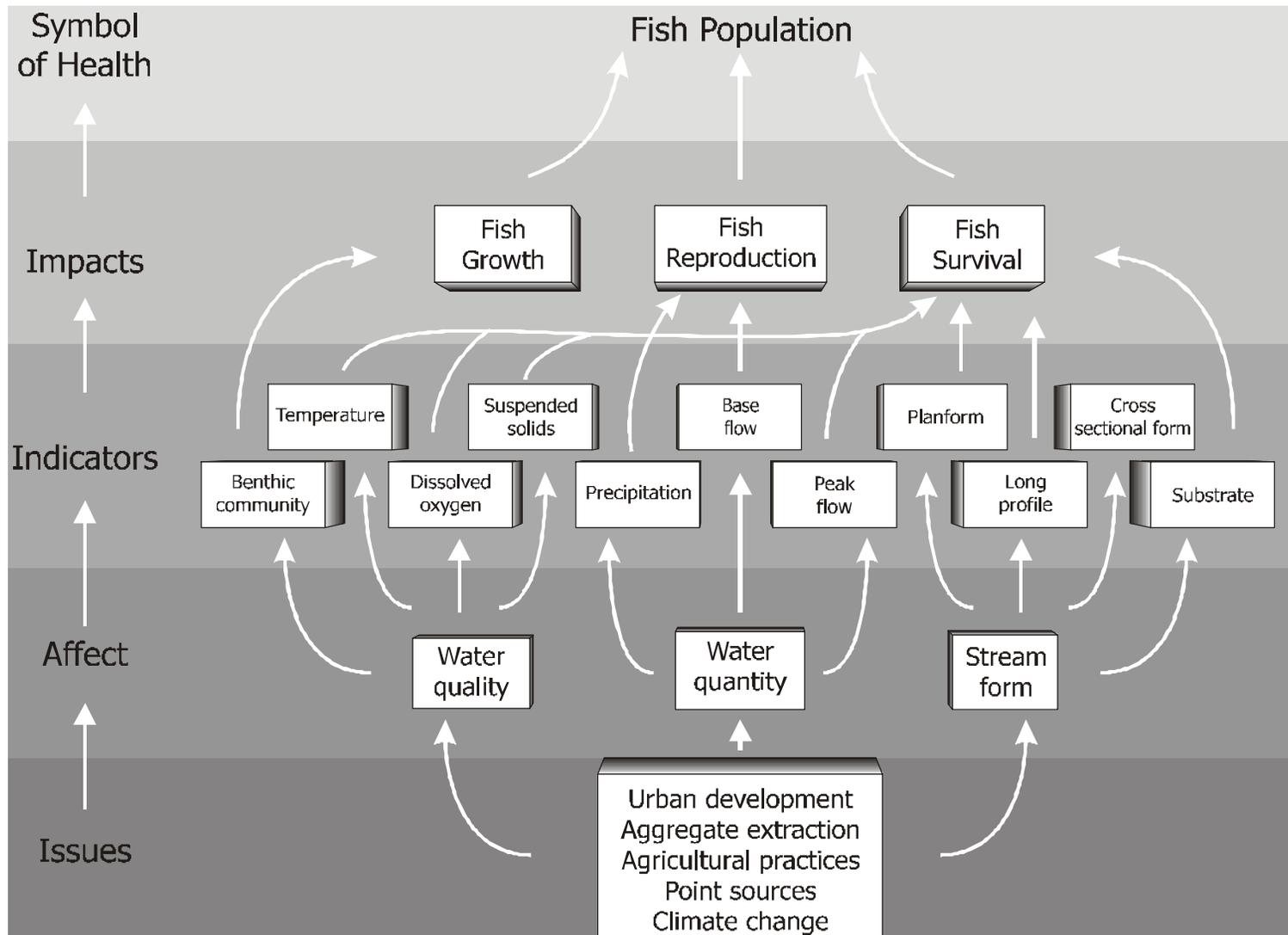
5.1.5 Monitoring and Future Studies

There are many priority strategies within the Plan where definitive decisions could not be made due to a lack of information, or uncertainties. As a result, there are several tactics that propose additional analysis or study. For example, global warming is likely to have a significant impact on the management of the fishery in the future, however more information is required to make definitive management decisions.

Effective fisheries management requires an ongoing assessment of changes in fish habitat and associated watershed conditions so that adjustments can be made. The CVC has developed a Watershed Monitoring Program based on an “adaptive management approach” that allows for regular data collection and analysis to identify changes to the environment (Figure 19). The specific monitoring requirements outlined in the CRFMP and in subwatershed plans should be incorporated into the Credit River Integrated Monitoring Program.

The number one priority issue as identified in the CRFMP is the development of a water budget (refer to section 4.1.1). Based on the developed budget, approved water-takings must be monitored. This tactic has already been initiated by CVC, however MOE, due to their legislative responsibility, should assume responsibility for its completion.

Figure 19. Conceptual impact model for the Credit River.



From CVC 2000b

Within this group of priority tactics, research and development is the major focus. The studies recommended include subjects that have never been studied, such as a water budget specific to the Credit River, subwatershed plans or the function of swales and intermittent tributaries, to subjects that require constant research or updating, such as stormwater management techniques, and wetland evaluations.

Data collection, storage and analysis are another major focus. An up-to-date database, including fisheries and other natural features in the watershed is necessary to provide data for decision making when reviewing development applications. Implementation of the Credit River Integrated Monitoring Program (CVC 2000a) is an excellent way of monitoring these changes in habitat conditions and identifying potential problem areas. Feasibility studies regarding potential fish species introductions or barrier creation are also recommended.

A variety of lead agencies and potential partners have been identified for these tactics. The majority of the tactics are new action items and therefore will require additional money to support their implementation.

5.2 Coordination of Plan Implementation

5.2.1 Roles of Various Organizations & Agencies

In addition to the roles discussed in the previous sections, numerous tactics are targeted at specific agencies either as a result of specific legislative responsibilities (Figure 14 and Table 14) or the fact that they have the necessary expertise. Figure 20 shows the areas of jurisdiction for the various agencies and municipalities. These lead agencies are responsible for implementation of the tactic, but other agencies may be involved.

While the bulk of these tactics are directed at MNR and CVC, MOE, DFO, watershed municipalities and NGOs also have important roles to play.

Department of the Environment

DOE plays a role in implementing Section 36 of the *Fisheries Act*, which deals with the deposition of deleterious substances into watercourses.

Department of Fisheries and Oceans

DFO is responsible for the administration of the fisheries habitat provisions of the *Fisheries Act*. They are the lead agency responsibility for the identified need to improve enforcement of this section of the Act.

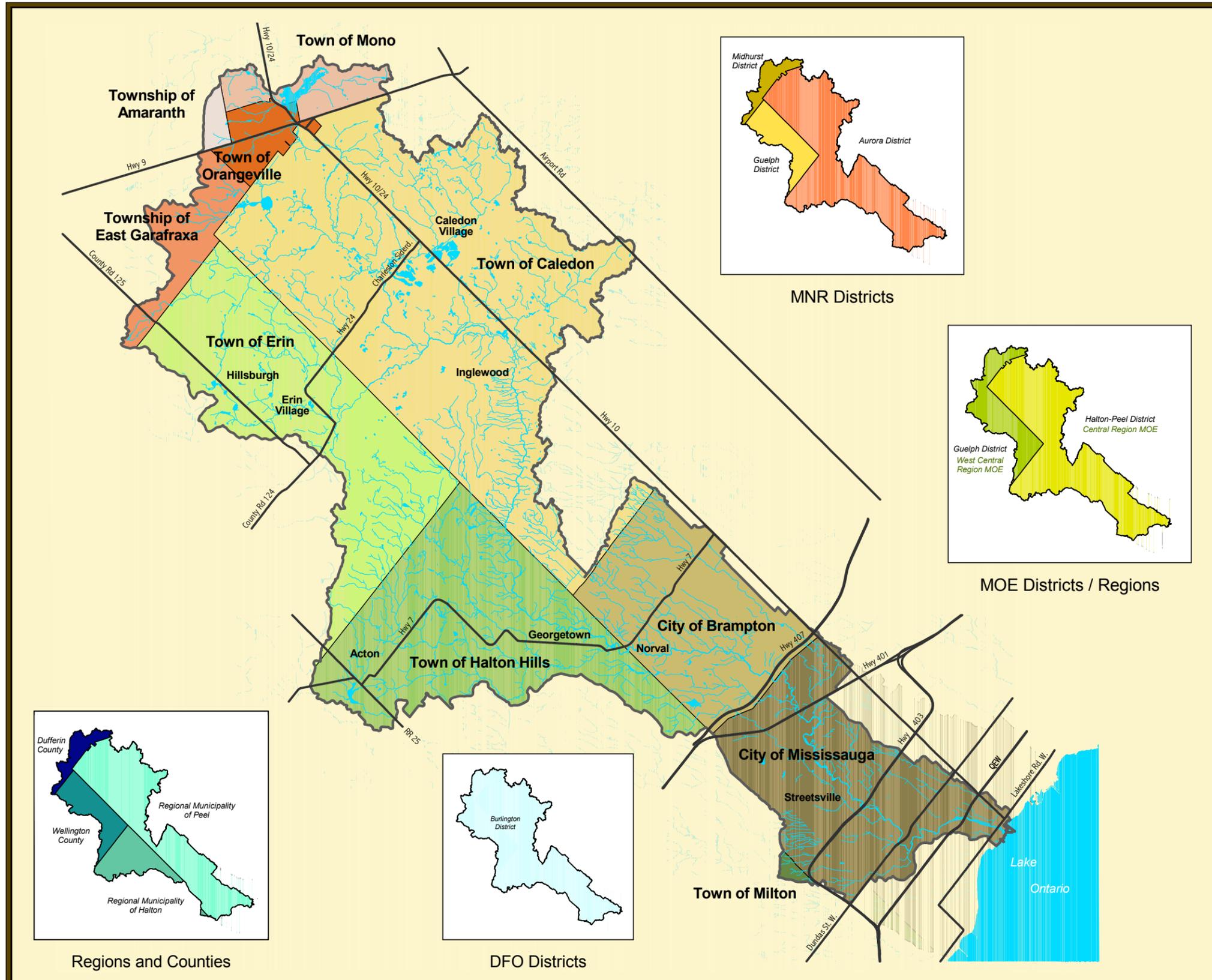


Figure 20. Agency and municipal areas of jurisdiction.

Municipality

- City of Brampton
- City of Mississauga
- Town of Caledon
- Town of Erin
- Town of Halton Hills
- Town of Milton
- Town of Orangeville
- Township of Amaranth
- Township of East Garafraxa
- Town of Mono

Transportation Network

- Highway

Drainage Network

- Lakes and ponds
- Rivers and streams

- Credit River watershed boundary



1:250,000



Credit Valley Conservation, 2000; Ministry of Natural Resources, 2000; Ministry of the Environment, 2000

Provincial Agencies

While regulatory powers that affect fish are distributed among many agencies, provincial agencies hold powers that affect fish and fish habitat, including MNR and MOE. The highest priority strategy in the Plan deals with improving the management and monitoring of water withdrawal in the watershed. Under the *Environmental Protection Act* and the *Ontario Water Resources Act*, MOE is the approving agency, responsible for regulating water takings in the province and its impacts to surface water, groundwater and the natural functions of the ecosystem. In addition, MOE also plays a role in implementing Section 36 of the *Fisheries Act*, which deals with the deposition of deleterious substances into watercourses.

The MNR has legislative responsibility for fisheries resource management in Ontario. MNR is the lead for, among other things, the tactics that deal with fishing regulations, proposed changes to special regulations, and the related enforcement tactics, as relayed in the *Fish and Wildlife Conservation Act*. For the same reason MNR is responsible for implementing the tactics under the species mix issue. MNR is also responsible for enforcement of Section 36 of the *Fisheries Act*, which deals with the deposition of deleterious substances into watercourses, as it relates to sediment.

Credit Valley Conservation

As the agency with jurisdiction over the whole of the Credit River watershed, CVC is in a somewhat key position when it comes to implementing the Plan. CVCs program activities range across the full spectrum of environmental management within the watershed, and have an ongoing working relationship with all of the public sector agencies involved in plan implementation. CVC is therefore well placed to ensure implementation of fisheries management is coordinated and linked to the broader environmental management of the river.

CVC has a signed agreement with DFO for the screening and mitigation of proposed habitat alterations and intends to assume the responsibility for negotiating compensation agreements (Level 3) in the future. Those proposals that still result in a “harmful, alteration, disruption or destruction of fish habitat” (*Fisheries Act*) are referred to DFO for authorization and compensation plans.

Municipalities

Municipalities have delegated responsibility for implementation of the *Planning Act*, including the *Provincial Policy Statement* (Province of Ontario 1997). In addition to being key participants in the implementation of land use planning strategies, municipalities are the lead agencies in the implementation and enforcement of topsoil bylaws, which are identified as priority tactics for water quality protection.

As owners of significant valley lands and providers of local parks and recreation services, municipalities could also be active participants in the strategies related to Public Access.

Non Governmental Organizations

The fishing clubs, conservation organizations and other interest groups that have participated in the development of this Plan are also important participants in its implementation. The NGO role tends to be focused on implementing strategies related to the issues of Rehabilitation and Education but they can play a strong supportive role across all of the priority tactics.

5.2.2 Funding

At times, successful implementation of this Plan will come down to money. The cost of implementing the various tactics ranges from no money to hundreds of thousands of dollars. Costs of plan implementation include both one time, or capital costs (e.g., new barrier) and annual or operating costs (e.g., monitoring). The implementation table (Table 12) provides an estimated cost of implementing the priority initiatives. While agency leads have been assigned to all priority tactics that does not necessarily mean that that agency has the responsibility to fund the initiative.

One of the initial priorities for the Implementation Committee will be to develop a funding strategy. This strategy will have to determine appropriate funding sources (agency, NGO, private, etc) for each initiative and a plan to secure the funding.

5.2.3 Implementation Committee

The successful implementation of the CRFMP will require the ongoing participation of many agencies, groups and individuals. An Implementation Committee is being proposed as a bridge between the development of the Plan and the implementation of its recommendations.

The purpose of the committee will be to oversee plan implementation, coordinating fundraising issues, facilitating plan implementation and coordination amongst the various groups, and adjusting priorities and updating the Plan as new information becomes available. The Implementation Committee will also be responsible for publicizing the success of the CRFMP and for maintaining a list of performance measures (refer to section 6.0). Committee representation should be similar to the Steering Committee and must include representation from agencies and NGOs that have a significant role in plan implementation.

6.0 MONITORING THE PLAN

A consistent message from the Steering Committee, Stakeholder workshops and public open houses was the need for accountability. People want to see the recommendations from this strategic Plan implemented, and they want the Plan's success or failure measured and communicated to the public.

The Monitoring and Measures Working Group was established in June 1999 to develop performance measures to monitor the implementation of the CRFMP, and to develop measures to evaluate the success of the Plan. A separate environmental monitoring plan has been developed to measure long-term changes in the aquatic system.

Potential measures were created and debated by the working group with the final set of recommended performance measures summarized in Table 15. Targets are described for each measure, for each major component of the Plan, e.g., Habitat, Species Mix and Partitioning, Education, etc. Both a temporal and a spatial scale are defined for the measure and its respective targets. In addition, the agency with lead responsibility for the measure is identified in the Table.

Definitions for each of the categories listed in Table 15 are:

Issue:

Category with similar concerns identified by the public.

Performance Measure:

A measurement that evaluates the effectiveness of implementing a tactic.

Temporal Scale:

Indicates the reporting frequency of the measures. Although the results will be publicized on a biennial basis, some of the measures will be evaluated less often due to the length of time required to detect a change.

Spatial Scale:

Indicates the scale at which the measure will be reported, i.e. by watershed or subwatershed.

Target:

Indicates the specific item to be measured.

Lead:

Agency with lead responsibility for implementing the tactic. If the tactic is measured as *low* or *poor* in performance, this agency has lead responsibility to address the issue.

The contributions of the Monitoring and Measures Working Group become part of an adaptive management strategy. Monitoring implementation of the CRFMP through performance measures will help identify when changes are needed to the CRFMP to ensure its goals and objectives are achieved. Once a tactic has been implemented, the performance measures will also need to be updated and changed. The Implementation Committee will be responsible for publicizing the results of the evaluation, and for maintaining the list of performance measures.

Communications of the performance measures to government agencies, NGOs, the public and industry in the watershed are part of the implementation of the Plan. Agencies and partners have to work together to collect the information needed to evaluate the success of the Plan and its implementation. The goal is to assemble all the information and to publicize a biennial Report Card with the assistance of corporate partners active in the watershed.

Table 15. Performance measures for the Credit River Fisheries Management Plan.

Performance Measures	Temporal/Spatial Scale	Target	Lead
1. HABITAT (water quantity, water quality, physical habitat, planning & monitoring)			
1.1 <u>Water Budget Study</u>	<ul style="list-style-type: none"> • 3-5 years for all components • By watershed 	<ul style="list-style-type: none"> • Water budget study 	MOE
1.1.1 Baseflow targets	<ul style="list-style-type: none"> • 1 year • By subwatershed 	<ul style="list-style-type: none"> • Minimum baseflows based on fisheries needs (e.g., Atlantic salmon habitat requirements; minimum flow; groundwater discharge; historical data; natural systems; hydrology) 	MOE
1.1.2 Allocation priorities	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • % of available water allocated; priority setting for uses of water 	MOE
1.1.3 Water-taking inventory	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • monitoring legal and illegal takings • charges laid & paid 	MOE
1.2 <u>Stormwater Management Study</u>	<ul style="list-style-type: none"> • 3 – 5 years • By watershed 	<ul style="list-style-type: none"> • by subwatershed (prioritize subwatersheds) • Inventory of facilities (e.g., volume vs. #; # or volume of retrofits; proper placement of facilities) 	Municipalities

Performance Measures	Temporal/Spatial Scale	Target	Lead
1.2.1 Hydrograph measures	<ul style="list-style-type: none"> • 1 year • By subwatershed 	<ul style="list-style-type: none"> • Flow stability • Water quality standards <ul style="list-style-type: none"> – <u>Temperature</u> – minimums <ul style="list-style-type: none"> – related to groundwater – <u>Contaminants</u> – suspended solids • Water quantity standards <ul style="list-style-type: none"> – Baseflows & stormflows 	MOE
1.2.2 Index of development	<ul style="list-style-type: none"> • 3 years • By subwatershed 	<ul style="list-style-type: none"> • Indicator of development pressures e.g., $\frac{\text{meanflow}}{\text{baseflow}} = \text{RATIO}$ • Population or % of $\frac{\text{watershed developed}}{\text{Hydrograph performance}} = \text{Index?}$ 	Academic institutions
<u>1.3 Fish Health & Consumption</u>	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • Annual & species dependant • Human health targets (including consumption guidelines) • Contaminant levels by species taken from: Forks, ILCA, Fairy Lake, County Rd 24, Lake Aquitaine, lower Credit and possibly other locations • Target = unrestricted consumption on the Credit River 	MOE

Performance Measures	Temporal/Spatial Scale	Target	Lead
<u>1.4 Natural Heritage Mapping</u>	<ul style="list-style-type: none"> • 1 – 3 years • By watershed 	<ul style="list-style-type: none"> • Produce maps of significant features related to fish habitat • Ecosystem targets: designate target features for protection and enhancement (e.g., significant corridors, woodlots, wetlands, recharge/discharge, wildlife, valleys) 	Municipalities
<u>1.5 Sediment Controls & Buffer Widths</u>	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • # and % of applications that meet development standards for sediment controls and buffer widths through 10 site visits annually 	CVC
<u>1.6 Subwatershed Plans</u>	<ul style="list-style-type: none"> • Official Plan timing to be considered for plans currently in place • 2 years • By subwatersheds 	<ul style="list-style-type: none"> • # of subwatershed plans consistent with CRFMP • Integration of CRFMP into development and implementation of watershed & subwatershed plans 	CVC
2. SPECIES MIX & PARTITIONING			
<u>2.1 Fish Barrier</u>	<ul style="list-style-type: none"> • 2 years – 7 years • By watershed 	<ul style="list-style-type: none"> • As outlined in the Credit River Fisheries Management Plan, located above the Norval dam and below confluence with the East Credit River 	MNR

Performance Measures	Temporal/Spatial Scale	Target	Lead
2.1.2 Barrier construction	<ul style="list-style-type: none"> • April 2000 – feasibility study • Fall 2000 – site selection • 2002 – site assessment & design (EA) • 2004 - fundraising • 2005 – construction • By watershed 	<ul style="list-style-type: none"> • Main Credit River 	MNR
2.1.2. Efficiency of barriers	<ul style="list-style-type: none"> • 2-3 years • By watershed 	<ul style="list-style-type: none"> • By dam: Streetsville, Norval, Stewarttown and new barrier • By fish species (e.g., # of species caught in a prescribed reach) 	MNR
<u>2.2 Stocking, Transfer & Naturalization Report</u>	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • By species • By location • By size: fry/fingerlings/yearlings 	MNR
3. Education			
<u>3.1 Private Landowner Contact</u>	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • Via: CFTIP, MFTIP, CVC, Environmental Farm Plan 	Multiple agencies
<u>3.2 Random Survey</u>	<ul style="list-style-type: none"> • 2 years • By watershed 	<ul style="list-style-type: none"> • Determine if people are becoming more educated: by age class • By topic 	CVC
<u>3.3 Educational Materials</u>	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • # distributed • # of signs erected • # of website hits 	CVC

Performance Measures	Temporal/Spatial Scale	Target	Lead
<u>3.4 Fishing Regulations</u>	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • Copies available in many places • Some place to sign on fishing license that acknowledges you have read, and understood the regulations 	MNR
4. ENFORCEMENT & REGULATIONS			
<u>4.1 Volunteer Patrols</u>	<ul style="list-style-type: none"> • 5 years • By watershed 	<ul style="list-style-type: none"> • MNR's Guardian program • CRAA's Streamwatch program 	MNR
<u>4.2 Media Release</u>	<ul style="list-style-type: none"> • 4 times a year • By watershed 	<ul style="list-style-type: none"> • News release by all agencies (MOE, MNR, DFO, CVC, Municipalities) on habitat and fisheries related violations on the Credit 	Multiple agencies
<u>4.3 MNR Patrols</u>	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • Days of effort tracked by MNR and coded to different activities & geographic locations (one of the key issues of the plan is to increase enforcement. Key enforcement leads to more compliance, which leads to a better fisheries) 	MNR
5. REHABILITATION (as related to habitat restoration)			
<u>5.1 Trees Planted</u>	<ul style="list-style-type: none"> • 10 years • By subwatershed 	<ul style="list-style-type: none"> • 90% of streambanks of all tributaries 	Multiple agencies

Performance Measures	Temporal/Spatial Scale	Target	Lead
<u>5.2 Dams/Barriers</u>	<ul style="list-style-type: none"> • 10 years • By watershed 	<ul style="list-style-type: none"> • # of dams/barriers removed and retrofitted • size of dams/barriers removed and retrofitted 	MNR
<u>5.3 Volunteer Participation</u>	<ul style="list-style-type: none"> • 1 year • By watershed 	<ul style="list-style-type: none"> • Volunteer hours by project and by priority 	Multiple agencies
<u>5.4 Rehabilitated Areas</u>	<ul style="list-style-type: none"> • 1 year • By subwatershed 	<ul style="list-style-type: none"> • Areas that are below potential that are brought up to potential (where feasible; Figure 11) • # of prioritized projects addressing limiting factors 	MNR & CVC
6. PUBLIC ACCESS & FISHING OPPORTUNITIES			
<u>6.1 Private Landowner agreements</u>	<ul style="list-style-type: none"> • 2 years • By watershed 	<ul style="list-style-type: none"> • Increase # or km of landowner agreements for public access or landowner permission for rehabilitation 	NGOs
<u>6.2 Public Access</u>	<ul style="list-style-type: none"> • 10 years • By watershed 	<ul style="list-style-type: none"> • km of accessible river (bed ownership). Look at land tenure. Map private vs. public ownership. • # of new parking spots/lots, access points/ramps (including those for physically challenged) 	MNR & CVC
<u>6.3 Angler Satisfaction</u>	<ul style="list-style-type: none"> • 2 years • By watershed 	<ul style="list-style-type: none"> • Angler satisfaction and effort survey (in river) 	MNR & CVC

Performance Measures	Temporal/Spatial Scale	Target	Lead
7. OTHER ISSUES			
<u>7.1 Socio-economics</u>	<ul style="list-style-type: none"> • 2-3 years • By watershed 	<ul style="list-style-type: none"> • Socio-economic study for the fisheries of the Credit River 	MNR & CVC
<u>7.2 Support for the CRFMP</u>	<ul style="list-style-type: none"> • 5 years • By watershed 	<ul style="list-style-type: none"> • Directly and in-kind support 	Multiple agencies

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9.0 ACRONYMS

CA	Conservation Area
CN	Canadian National Railway
CO	Conservation Officer
CP	Canadian Pacific Railway
CRAA	Credit River Anglers Association
CRFMP	Credit River Fisheries Management Plan
CVC	Credit Valley Conservation
DCO	Deputy Conservation Officer
DOE	Department of the Environment (Environment Canada)
DFO	Department of Fisheries and Oceans (Fisheries and Oceans Canada)
EA	Environmental Assessment
EBR	Environmental Bill of Rights
FIERCE	Fisheries Education and Regulations Certification course
HADD	Harmful Alteration, Disruption or Destruction of fish habitat
ILCA	Island Lake Conservation Area
IWFFC	Izaak Walton Fly Fishing Club
KWRMA	Ken Whillans Resource Management Area
MMAH	Ministry of Municipal Affairs and Housing
MNR	Ministry of Natural Resources
MOE	Ministry of the Environment
MOU	Memorandum of Understanding
MTO	Ministry of Transportation Ontario
NGO	Non-Government Organization
NRVIS	Natural Resource Values Information System
OBA	Ontario Bait Association
OFA	Ontario Federation of Agriculture
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
PWQO	Provincial Water Quality Objectives
SPOF II	Strategic Plan for Ontario's Fisheries II
TEDA	Tourism and Economic Development Agencies
TUC	Trout Unlimited Canada
VTE	Vulnerable, Threatened or Endangered species

10.0 GLOSSARY

Adaptive Environmental Management

An approach to environmental management which seeks to explicitly account for uncertainty about ecological processes and our interactions with them.

Exotic species

A species not native to Ontario.

Introduced species

A species relocated to an area where it does not occur naturally. Introductions can be deliberate or accidental and can include exotic species, naturalized species and native species which are stocked beyond their natural range.

Native species

A species indigenous to a particular region or area.

Naturalized species

An introduced species which is now self-sustaining.

Rehabilitation

The re-establishment, enhancement or creation of ecological form and function through the alteration of activities and physical features to enhance biological productivity and/or diversity that is sustainable.

TFM

A chemical used to control sea lamprey populations.

Vulnerable, Threatened and Endangered Species

Vulnerable

Any native species that, on the basis of the best available scientific evidence, is a species of special concern in Ontario, but is not a threatened or endangered species.

Threatened

Any native species that, on the basis of the best available scientific evidence, is at risk of becoming endangered throughout all or a significant portion of its Ontario range if the limiting factors are not reversed.

Endangered

Any native species that, on the basis of the best scientific evidence, is at risk of extinction or extirpation throughout all or a significant portion of its Ontario range if the limiting factors are not reversed.

Water Budget

A quantitative measure of all components of a water cycle including precipitation, evapotranspiration, runoff, stream flow, withdrawals, groundwater recharge, storage, travel times and discharge for a watershed.

