

CREDIT RIVER WATER management STRATEGY

Update



**MAKING IT
WORK**

May 2007

acknowledgements



Region of Peel
Region of Halton
County of Dufferin
County of Wellington
Town of Caledon
City of Brampton
City of Mississauga
Town of Halton Hills
Town of Oakville
Township of Amaranth
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table of contents

Chapter 1	Introduction: Updating the Credit River Water Management Strategy	1
	A Snapshot of the Credit	2
	About this Report	3
Chapter 2	What Was Done	4
	Purpose of the Update	
	How It was Done	
	Goal, Principles and Objectives	5
	Exploring Options for the Future	6
Chapter 3	Key Findings of the Study	9
	Our Long-Term Health Depends on the Health of the Credit	
	The Health of the Credit is Already at Risk	10
	Current Planning and Development Practices are Not Sustainable	12
	We Can Continue Growing if We Change Our Planning and Water Management Practices	13
	There is a Limit to Growth	15
Chapter 4	Making it Work	16
	Recommendations	
	Working Together	17

INTRODUCTION

Updating the Credit River Water Management strategy

Of all the resources that we have on earth, fresh water is perhaps the most important. It is a resource that is critical to life itself. We need clean, fresh water for drinking, washing, irrigation, agriculture, and industry. We need access to fresh water for our communities, our economy and our environment. Fifty

years ago, we might have taken water for granted, but in this post-Walkerton time with the threat of climate change looming, it is imperative that we are wise stewards of our fresh water resources.

The Making it Work: Credit River Water Management Strategy Update is a plan of action that is designed to ensure that we have “abundant, clean and safe water” in the Credit River watershed, now and into the future. The Credit River Water Management Strategy Update (CRWMSU) was developed through a consultative process led by Credit Valley Conservation (CVCA) in partnership with municipalities, provincial agencies, educators and non-governmental organizations.

The CRWMSU builds upon the original Credit River Water Management Strategy (CRWMS), which was completed in the early 1990s. Phase 1 of the original CRWMS, completed in 1990, concentrated on issues related to flooding and erosion. Phase 2, completed in 1992, dealt with issues related to water quality and natural resources.

Much has changed in the Credit River watershed in the 14 years since the original CRWMS was developed. A significant amount of urban growth has taken place in the watershed and urbanization continues to take place at a rapid pace. Through scientific studies and comprehensive monitoring, we have gained a much better understanding of how the Credit watershed functions and the condition of its resources including

its surface water, groundwater, natural areas, fisheries and wildlife. Detailed subwatershed planning has been carried out in most of the Credit’s tributaries, and CVC has developed a number of important watershed-wide strategies including a Water Quality Strategy, a Groundwater Strategy, Fisheries Management Plan, Greenland Securement Strategy and a Natural Heritage Plan for the Credit. Within the last five years, the government of Ontario has passed a number of tough new laws aimed at protecting water resources in the province. These new laws have changed the context for the protection of water resources, especially in southern Ontario.

Key New Documents & Regulations

- United Nations Framework Convention on Climate Change, 2006.
- *Clean Water Act*, 2006
- *Amendment Act*, 2005
- New Provincial Policy Statement under the *Planning Act*, 2005
- *Greenbelt Act*, 2005
- Growth Plan for the Greater Toronto Horseshoe, 2005
- *Places to Grow Act*, 2004
- *Drinking Water Source Protection Act*, 2004
- *Safe Drinking Water Act*, 2002
- *Nutrient Management Act*, 2002
- Spills Bill (Environmental Enforcement Statute Law
- *Oak Ridges Moraine Act*, 2001

Strategy: A long-term plan of action to achieve a particular goal.

With all these changes, the time is indeed right for updating the CRWMSU to ensure that the Credit's water resources are protected in the future. The 2006 version of the CRWMSU builds on and integrates the considerable work that has been carried out by CVC and its partners in the watershed. The aim of the CRWMSU is to protect the features and the functions of the Credit River watershed. It will inform decisions about growth in the context of ensuring that there will be "abundant safe and clean water" over the long term. The CRWMSU will help decision makers answer key questions such as: How much can we grow and how should growth take place?

The theme of this report, and the major thrust of the CRWMSU is the need to "shift gears" in order to protect the health of the Credit River Watershed over the long term. In this context, "shifting gears" means changing how we plan our communities and changing how we deal with stormwater to ensure a sustainable Credit River. This report describes how we can do that together.

Figure 1
Physiology of the Credit River Watershed



A Snapshot of the Credit

If there is one adjective to describe the Credit River, it might be "diverse". The river begins in tiny streams that bubble up from the gravelly uplands of the headwaters. From these headwater streams, the Credit meanders 99 kilometres to the highly urbanized shoreline of Lake Ontario, on the way passing through natural areas, farms and rural estates, heritage villages and new suburbs, industrial areas and long-established residential zones.

A series of headwater moraines, outwash and buried bedrock plains and valleys intermingle the Oak Ridges Moraine and the Niagara Escarpment to give rise to a complex groundwater and surface water system. About a third of the 1,000 square kilometre watershed is covered by an extensive greenlands system made up of forests, valleylands, wetlands and meadows. Within this greenland system can be found 49 Environmentally Significant Areas – areas in which there are important landforms or habitats or that serve important hydrological functions – and 11 Potential Environmentally Significant Areas. The greenland system supports a rich variety of plant and wildlife communities, and the aquatic habitats in the watershed support one of the finest coldwater fisheries in Ontario.

The Credit River watershed is also an important home for people. Some 28% of the total Credit River watershed is classified as urban and about 650,000 people live within the watershed, with most of them (87%) living in the lower third of the watershed. The Credit is part of the Greater Toronto Area, which for a decade has been one of North America's fastest growing areas.

The incredible diversity of the Credit River watershed is linked to its physiography (the shape and elevation of the land and the soils through which it flows). It is naturally divided into three distinct zones – the Upper, Middle and Lower Watersheds (see Figure 1). The Upper Watershed lies above the Niagara Escarpment and has soils that are more coarse-grained and permeable than elsewhere in the watershed. Because of the elevation and the soils, there is significant infiltration of water into the ground and the groundwater provides a significant amount of the baseflow of streams.

The Middle Watershed includes the Niagara Escarpment Area and the Oak Ridges Moraine between Inglewood and Norval. This area is characterized by steep slopes, extensive outcroppings of bedrock, and thin soils. Forest cover in this zone tends to slow runoff and increase infiltration of water into the ground. In the Middle Watershed, the Credit flows through a narrow, steep-walled valley and is fed by small spring-fed creeks and tributaries that originate in wetland complexes.

The Lower Watershed is relatively flat and slopes gently southward to Lake Ontario. Soils in the Lower Watershed are less permeable and therefore more runoff takes place here than in the Upper and Middle Watersheds

About this Report

This report – Making it Work: Credit River Water Management Strategy Update – has been prepared by CVC in concert with member municipalities as an overview of the updated Credit River Water Management Strategy. While it includes a brief description of the process used to update the Strategy, this report places more emphasis on the findings of the study, and the implications of those findings than on the methodology used. Those interested in the detailed process used to develop the Strategy should consult the technical document, The Credit River Water Management Strategy Update (2007), which will be available through the Credit Valley Conservation in June of 2007.

Credit Facts

- The Credit River flows 99 kilometres from the headwaters (where it begins) to Lake Ontario.
- The Credit River drains an area of about 1,000 square kilometres.
- The Credit River watershed contains over 1,500 kilometres of tributaries, streams and creeks.
- While only about 21% of the watershed is urbanized, development pressure is intense and the Credit River watershed is one of the most rapidly urbanizing parts of Canada.
- About 650,000 people live in the Credit River Watershed, and most of them (87%) live in the lower third of the watershed.
- An extensive greenlands system covers about a third of the watershed, providing natural areas for wildlife, conservation and recreation.
- The Credit River Watershed includes portions of two unique and important landforms -- the world famous Niagara Escarpment and the Oak Ridges Moraine.
- The Credit River Watershed contains 49 Environmentally Significant Areas.
- CVC owns and/or manages 52 properties, 10 Conservation Areas, 4 Forest Conservation Areas and 2 Operational Conservation Areas that offer staffed facilities.
- The Credit's natural areas are home to 48 species of mammals, 31 species of amphibians and reptiles, 244 species of birds, 75 species of fish and 1,255 species of plants.
- The Credit contains the most diverse coldwater fishery in Ontario and is one of the best recreational fishing rivers in Ontario.

chapter 2

What was done?

Purpose of the Update

The overall purpose of the CRWMSU is to ensure that there will be “abundant, clean and safe water” in the Credit River watershed, now and into the future. The Update was undertaken to assess the impacts of past and future land use development and climate change

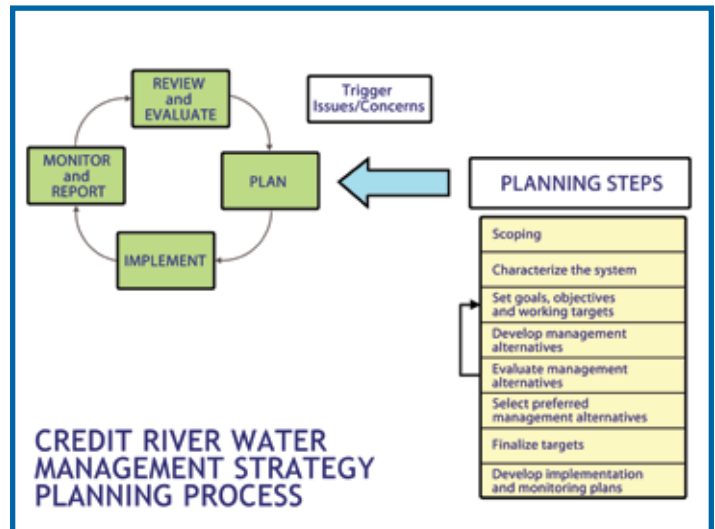
scenarios on the water resources of the Credit, and to develop a strategy to minimize or avoid negative environmental impacts in the future.

How It was Done?

In order to ensure that management decisions are achieving the measurable goals over time, it is important to utilize the principles of Adaptive Environmental Management (AEM). Adaptive Environmental Management can be defined as an approach to environmental management aimed at improving understanding of the ecosystems being managed, the institutions charged with their management, and the coupling of the two (Gunderson et al 1995). This concept is particularly suitable for the Credit River Water Management Strategy Update as well as subwatershed planning since it recognizes that ecosystems are, by their nature, complex and in a state of constant evolution. We therefore start by learning about the functional relationships between key environmental features, develop predictions on the response of these features as to management interventions, and recognize the uncertainty that underlies resource management issues (see Figure 2).

The planning process began with characterizing the system – developing a good understanding of the resources that are present in the Credit Watershed, their condition and how they function.

Figure 2 - CRWMS Planning Process



Next goals, principles, objectives and working targets were set. A number of possible management alternatives were identified, and then evaluated to see what impact they would have on the natural environment in the Credit River watershed. Once this evaluation was done, a preferred management alternative was selected. More detail on these steps is provided in the following sections.

The CRWMSU Study was led by CVC and depended greatly on advice provided by Technical and Steering Committees throughout the process. Input on Goals, Principles and Objectives was obtained through a public workshop and a Watershed Partners Forum that included politicians, senior municipal staff and interest groups. The process of updating the CRWMS built on and integrated extensive knowledge about the Credit River watershed that has been gained since 1992.

2

This knowledge includes:

- Subwatershed studies that have been completed or are underway in 17 of the 20 subwatersheds that drain directly into the Credit River;
- Comprehensive monitoring data collected through the Integrated Watershed Monitoring Program;
- The Credit River Water Quality Strategy that evaluated potential impacts on water quality from future land use development and climate change scenarios;
- The Credit River Water Budget Study that is quantifying how water enters, moves through and leaves the watershed;
- The Credit River Flow Management Study that examined the ability of stormwater management systems to provide flood protection under various development scenarios;
- The Credit River Fisheries Management Plan that is designed to protect and rehabilitate the Credit's aquatic ecosystems;
- The Credit Watershed Natural Heritage Strategy that coordinates the collection and analysis of natural heritage data; and
- Greenlands Securement Strategy that identifies lands of conservation importance that can be secured to help protect the Credit's terrestrial, aquatic and groundwater systems.

Goal, Principles and Objectives

With input from the Technical and Steering Committees, Watershed Partners and the public; a goal, principles and objectives were developed for the CRWMSU. The overall goal for the Strategy is:

CRWMS GOAL: To ensure abundant, safe, clean water for environmentally, socially and economically healthy communities within the Credit River Watershed.



A series of principles were also developed. The principles are provided below:

1. Recognize that the responsibility for the health of water and natural resources is shared by everyone. Successful water management within the Credit River watershed can only be achieved through active and sustained partnerships with all levels of government, agencies, groups and individuals.
2. Apply a long-term approach to ensure a sustainable and environmentally healthy river for current and future generations.
3. Maintain a watershed scale perspective and consider the implications of our cumulative actions, as well as external factors, on the watershed as a whole.
4. Protect, enhance and restore natural systems as a priority within the urban environment and throughout the watershed.
5. Take a preventative, proactive and integrative approach based on the principles of adaptive management. Where there is uncertainty, risk or irreversibility, use caution and err on the side of protecting the environment.
6. Pursue reasonable, practical approaches to water and natural resources management based on sound science, creativity and innovation for effective solutions.
7. Recognize that healthy communities require a sustainable balance between economic, social, natural and human uses in the watershed.
8. Promote ecologically sustainable lifestyles and behaviours through sustainable urban design approaches.

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The objectives that were developed are broad in scope, and deal with communications and education; water quantity; water quality; natural communities; and social values. The objectives were used to develop more specific targets, such as targets

for water quality and river flows. These targets were used in the CRWMSU study to evaluate management alternatives and will be used in the future to evaluate the effectiveness of management actions and the progress being made to achieve the overall watershed goal, principles and objectives. Refer to Table 1.

Table 1: CRWMSU Objectives

Communications and Education	
1	Demonstrate and promote awareness of the linkages between healthy water, healthy lifestyles and the economic viability of rural and urban land uses.
2	Promote the wise use of surface and ground waters having regard to both human and ecological needs.
3	Promote the need for environmental stewardship and better understanding of the importance of natural features and functions of the Credit River watershed.
Water Quantity	
4	Preserve and re-establish the natural hydrologic cycle.
5	Maintain, enhance or restore natural stream processes to achieve a balance of flow and sediment transport.
6	Manage stream flow to reduce erosion impacts on habitats and property.
7	Minimize risk to human life and property due to flooding.
8	Maintain groundwater levels and baseflows (groundwater discharge to streams) to sustain watershed functions, human uses and climatological change.
Water Quality	
9	Maintain or enhance water and sediment quality to achieve ecological integrity.
10	Protect drinking water sources.
11	Protect groundwater quality to support watershed functions.
12	Reduce toxics through pollution prevention.
13	Improve water quality in rivers and Lake Ontario for body contact recreation.
14	Improve water aesthetics including odour, turbidity and clarity.
Natural Communities	
15	Protect, restore or enhance the integrity of the watershed ecosystem, through an integrated network of natural areas, habitats and connecting links.
16	Protect, restore or enhance native terrestrial and aquatic plant and animal species, community diversity and productivity.
17	Promote integrated resource management of the aquatic and terrestrial systems and areas within the watershed for plant, animal and human uses.
Social Values	
18	Research, identify and promote the social benefits of the watershed system (recreational, educational, cultural, psychological, tourism, economic).

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Exploring Options for the Future

The process of exploring future options began with the proposition that urbanization will be the key stressor (factor that causes stress) on the watershed in the future. From this, three possible future scenarios were developed. The first of these assumed that 20% of the watershed would become urbanized – up from the existing 15% – reflecting the targets in current Official Plans. The second scenario assumed a further 5% of the watershed becomes

urbanized to a total of 25% of the land base. The third scenario assumed 55% urbanization.

These future land use scenarios as well as two climate change scenarios were then modelled to look at what the impacts they would have on water quality, flows, erosion and groundwater.

Scenario	% Urbanization	Description
Existing Conditions	15%	Based on the most recent data (2002)
Future Scenario 1	20%	In accordance with the current Official Plans
Future Scenario 2	25%	5% more than current Official Plans
Future Scenario 3	55%	Full watershed build out

NOTE: The study area for the Credit River Water Management Strategy Update includes those subwatersheds that drain directly into the Credit River. Those watersheds that drain directly into Lake Ontario were not included in the surface water modelling exercise (but were considered in the groundwater modelling exercise).

For any of these future scenarios, there could be many outcomes, depending on how we act. The impacts on the watershed at 20% urbanization will be different, for example, if we manage stormwater aggressively than if we do very little. To identify potential future conditions (or management alternatives) for the CRWMSU study, a Watershed Partners Workshop was held in June 2003. Management alternatives were defined as a set of stormwater measures that, once implemented, will protect, enhance or restore environmental conditions. The Watershed Partners identified three possible management alternatives for lands undergoing development – “Business as Usual”, “Technology and Economy Driven”, and “Ecotopia” (explained in Table 3). A “Do Nothing” scenario was also included in the study as a worst-case scenario.

Table 3: Four Management Alternatives for Urbanizing Areas

Management Alternative	Description
Do Nothing	Using no stormwater Best Management Practices in developing areas
Business as Usual	Continuing with current stormwater Best Management Practices
Technology and Economy Driven	Overcoming existing technical and economic barriers that limit use of stormwater
Ecotopia	Using greater consideration of the environment in land use planning

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These management alternatives were evaluated in a two-step process.

Step 1 of the evaluation modelled what would happen in the watershed when Best Management Practices associated with the various management alternatives were used in urbanizing areas (areas undergoing development). The results of this analysis showed that significant degradation of the Credit River watershed would take place if the “Do Nothing” or “Business as Usual” management

alternatives were selected. Some degradation of the watershed would take place if either the “Technology and Economy Driven” or the “Ecotopia” management alternatives were selected. Because a fundamental principle of the study was that future conditions in the watershed should not be allowed to deteriorate below existing conditions, it was agreed that having more rigorous controls in urbanizing areas alone would not protect the health of the watershed over time. Accordingly, the study then examined what could be achieved outside of the urbanizing areas (i.e., in existing urban and rural areas).

Step 2 modelled what the effects on the watershed would be if, in addition to Step 1 controls, varying degrees of management action were taken in the watershed’s existing urban and rural areas. This could involve the use of such measures as downspout disconnection, and the use of landscaped (or grassy) swales in urban areas and conservation tillage and improved nutrient management in agricultural areas.

- The management alternatives were then evaluated against a suite of criteria that included cost, ability to implement, social impacts and natural environment (the ability to meet the objectives and targets set for the watershed). The study team recommended acceptance of the management alternative that best met the evaluation criteria. This was the “Ecotopia” alternative, with a moderate level of restoration in existing urban and rural areas.

The elements of the recommended management alternative and what it will achieve are addressed in Chapter Three.

Figure 3: Step 1 Evaluation

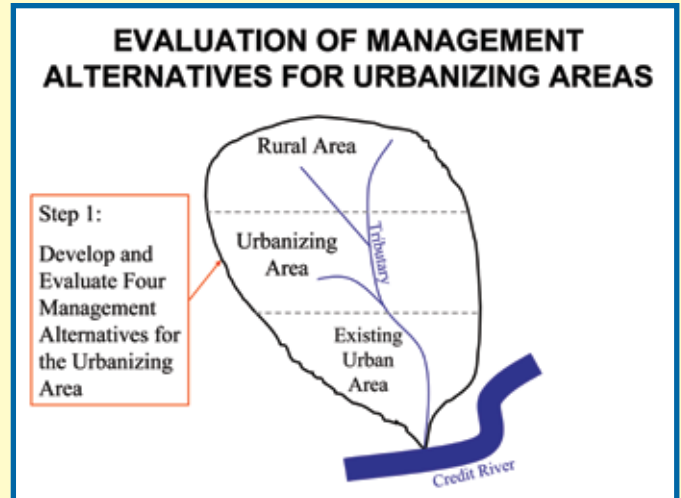
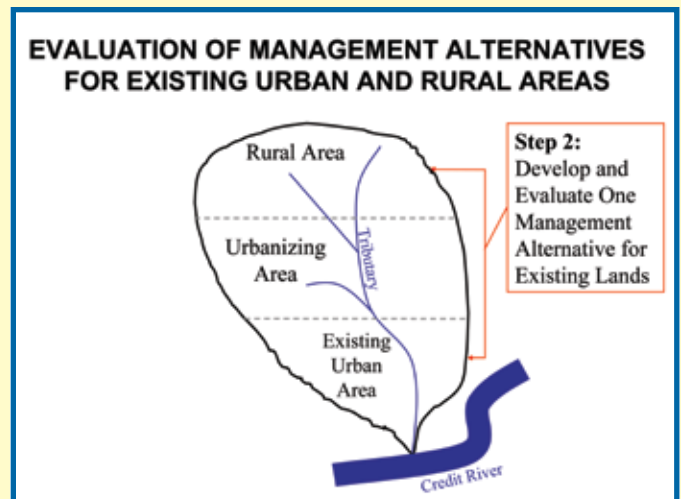


Figure 4: Step 2 Evaluation



chapter 3

Key findings of the study

Our Long-Term Health Depends on the Health of the Credit River Watershed

The first key finding of the CRWMSU study is that there is a direct link between public well-being and the health of the Credit River watershed. This is in part because our communities and

economies are supported by functions provided by the watershed.

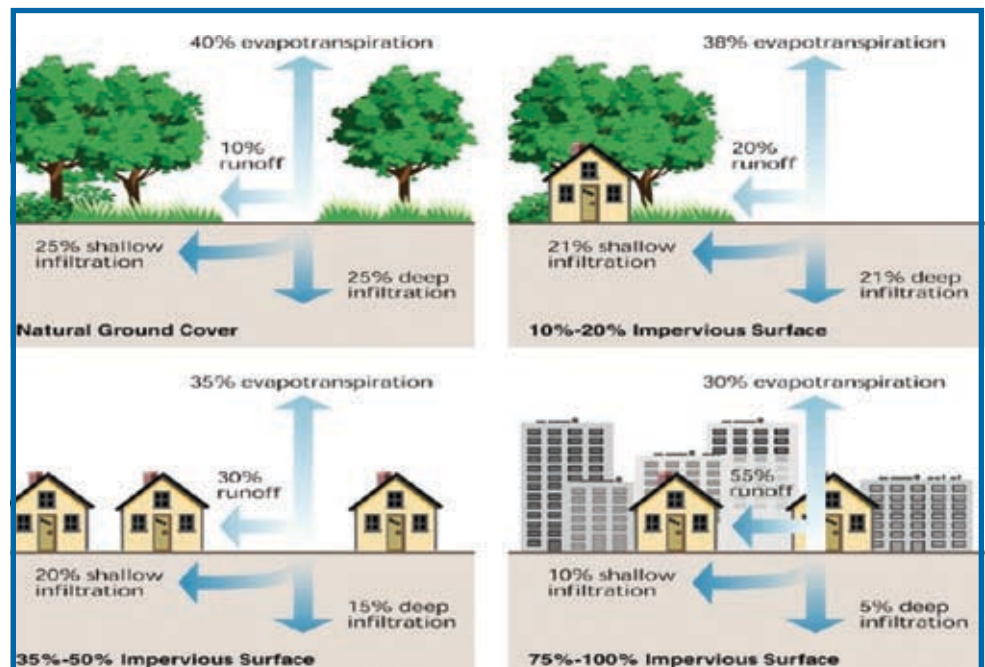
A healthy watershed provides us with much of value including:

- Abundant, clean drinking water;
- Clean air;
- A mosaic of connected habitats that support wildlife;
- Wetlands, streams and ponds that support diverse fish communities;
- Natural flowing rivers and streams; and
- A variety of recreational spaces and places for people

However, when watersheds are urbanized, the hydrologic cycle (how water moves in the landscape) is dramatically altered. As illustrated in Figure 5, urbanization results in a situation where:

- Less water is infiltrated into the ground (because of the amount of impervious surface present);
- Less water is evaporated (because of loss of vegetation); and
- More water runs off as stormwater, which eventually is discharged into our streams, rivers and lakes.

Figure 5: The Impact of Conventional Urbanization on the Hydrologic Cycle



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The greater the amount of urbanization in a watershed – the greater the percentage of impervious surface (paved surfaces) – the greater these effects are.

Imperviousness leads to a cascade of effects as shown in Table 4. Rivers in highly urbanized areas are sometimes referred to as “peaky” because they have too little flow under dry conditions, and too much flow (high volumes and high peak flows) when it rains. This leads to problems with flooding, erosion, water quality, channel widening, streambed alteration and loss of fish habitat.

The Health of the Credit River Watershed is Already at Risk

The second key finding from the CRWMSU study is that the health of the Credit River Watershed is already at risk. CVC created its Integrated Watershed Monitoring Program (IWMP) in 1999 as a means of checking on the health of the Credit River watershed. With over 150 monitoring stations, the comprehensive program provides up-to-date information on the status of the Credit’s rivers and streams, surface water quality, groundwater, fisheries and terrestrial systems. The most recent results of this monitoring and analysis of trends are provided in the 2005 CVC Watershed Report Card.

Table 4: Ecosystem Responses to Urbanization

Results of Increased Imperviousness	Resulting Impacts				
	Flooding	Habitat Loss	Erosion	Channel Widening	Streambed Alteration
Increased Flow Volume	✓	✓	✓	✓	✓
Increased Peak Flow	✓	✓	✓	✓	✓
Increased Peak Duration	✓	✓	✓	✓	✓
Increased Stream Temperature		✓			
Decreased Base Flow		✓			
Sediment Loading Changes	✓	✓	✓	✓	✓

Adapted from US EPA

Keeping the Credit River watershed healthy has many social, economic and environmental benefits. A healthy watershed will reduce the risks to people, structures and infrastructure from flooding. A healthy watershed saves us money over the long term, as it is more expensive to try and undo environmental impacts after the fact than to prevent them from happening in the first place. A healthy watershed will protect sources of drinking water over the long term, and preserve habitats, wildlife, recreational opportunities and environmental functions for the benefit of future generations.

The results of watershed monitoring are presented in Table 5. These results show quite clearly that the health of the watershed declines as one moves from the largely rural Upper Watershed to the highly urbanized Lower Watershed. The Lower Watershed is characterized by a moderately to highly altered flow regime, moderately to highly unstable tributaries, poor to fair water quality, poor baseflows, and except for the Main Credit degraded fish habitat. These conditions are directly related to the impacts of urbanization, in particular the large extent of impervious surfaces (paved surfaces) that is typical of modern cities.

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Table 5: Current Environmental Conditions in the Credit River Watershed

Watershed Functions	Upper Watershed	Middle Watershed	Lower Watershed
Hydrology and Flooding	<ul style="list-style-type: none"> ● Generally natural hydrology with good baseflows and moderate peak flows ● Few flood damage centres 	<ul style="list-style-type: none"> ● Generally natural hydrology with moderate to good baseflows and moderate peak flows ● Contains one third of flood damage centres 	<ul style="list-style-type: none"> ● Hydrologic regime is moderately to highly altered with poor to fair baseflow and moderate to high peak flows ● Contains most of the watershed's flood damage centres
Erosion and Stream Stability	<ul style="list-style-type: none"> ● Relatively stable ● Some tributaries unstable because of agriculture and urbanization 	<ul style="list-style-type: none"> ● Relatively stable ● In urban areas, streams unstable because of relatively steep gradient 	<ul style="list-style-type: none"> ● Moderately to highly unstable because of urbanization
Water Quality	<ul style="list-style-type: none"> ● Water quality generally good ● Main influence is Water Pollution Control Plant and Island Lake Reservoir ● Total phosphorus levels above PWQO 	<ul style="list-style-type: none"> ● Water quality generally good ● Main influence is urban and rural land uses ● Moderate nutrient levels 	<ul style="list-style-type: none"> ● Water quality is poor to fair ● Main influence is urbanization ● Moderate to high nutrient levels
Groundwater	<ul style="list-style-type: none"> ● Baseflows generally good and representative of natural conditions ● Some tributaries susceptible to interference from water takings 	<ul style="list-style-type: none"> ● Baseflows generally good and representative of natural conditions ● Baseflows in many tributaries susceptible to interference from water withdrawals 	<ul style="list-style-type: none"> ● Baseflows are generally poor, representative of urban conditions ● Urbanization has reduced natural infiltration rates, which has lowered water tables and reduced discharge to streams
Fisheries	<ul style="list-style-type: none"> ● Warm water fishery upstream of Melville due to warming from Island Lake ● Main Credit south of Melville and tributaries provide fair quality coldwater fish habitat 	<ul style="list-style-type: none"> ● Good to excellent quality coldwater fish habitat ● High quality brown and rainbow trout fishery ● Focus of efforts to re-establish Atlantic salmon 	<ul style="list-style-type: none"> ● Main Credit provide fair quality coldwater fish habitat and good quality warmwater fish habitat ● Tributaries generally only provide degraded warmwater fish habitat ● This portion supports a migratory coldwater fishery that includes Chinook salmon, rainbow trout and brown trout
Terrestrial Resources	<ul style="list-style-type: none"> ● 17% forested; this helps sustain groundwater ● 9.5% wetlands 	<ul style="list-style-type: none"> ● 26% forested ● 7.5% wetland ● Large areas of relatively undisturbed valley systems ● Highest biodiversity found here 	<ul style="list-style-type: none"> ● 7% forested ● Less than 1% wetlands ● Many natural features have been lost or seriously degraded due to urban development

3

Figure 6 (see page 13) shows graphically how healthy the Credit and its tributaries are now. The definitions used are:

- **Impaired:** High levels of nutrients, metals, and suspended sediment; substrate, flow regime and animal populations may be degraded.
- **Moderately Impaired:** Some sediment and nutrient problems, some channel form and flow problems, some degraded animal populations.
- **Unimpaired:** Healthy flow, temperature regime, channel form, substrate and animal populations.

Current Planning and Development Practices are Not Sustainable in the Long Term

The third key finding from the CRWMSU study is that current planning and development practices are not sustainable over the long term if watershed goals are to be realized. Figure 7 (see page 14) illustrates what would happen in the watershed if we continued “Business as Usual” in terms of stormwater management in developing years. As can be seen, if we did this, by the time the watershed was 25% urbanized, there would be no subwatersheds that are unimpaired or slightly impaired. The “healthiest” subwatersheds would be moderately impaired, and most of the subwatersheds would be impaired or seriously impaired.

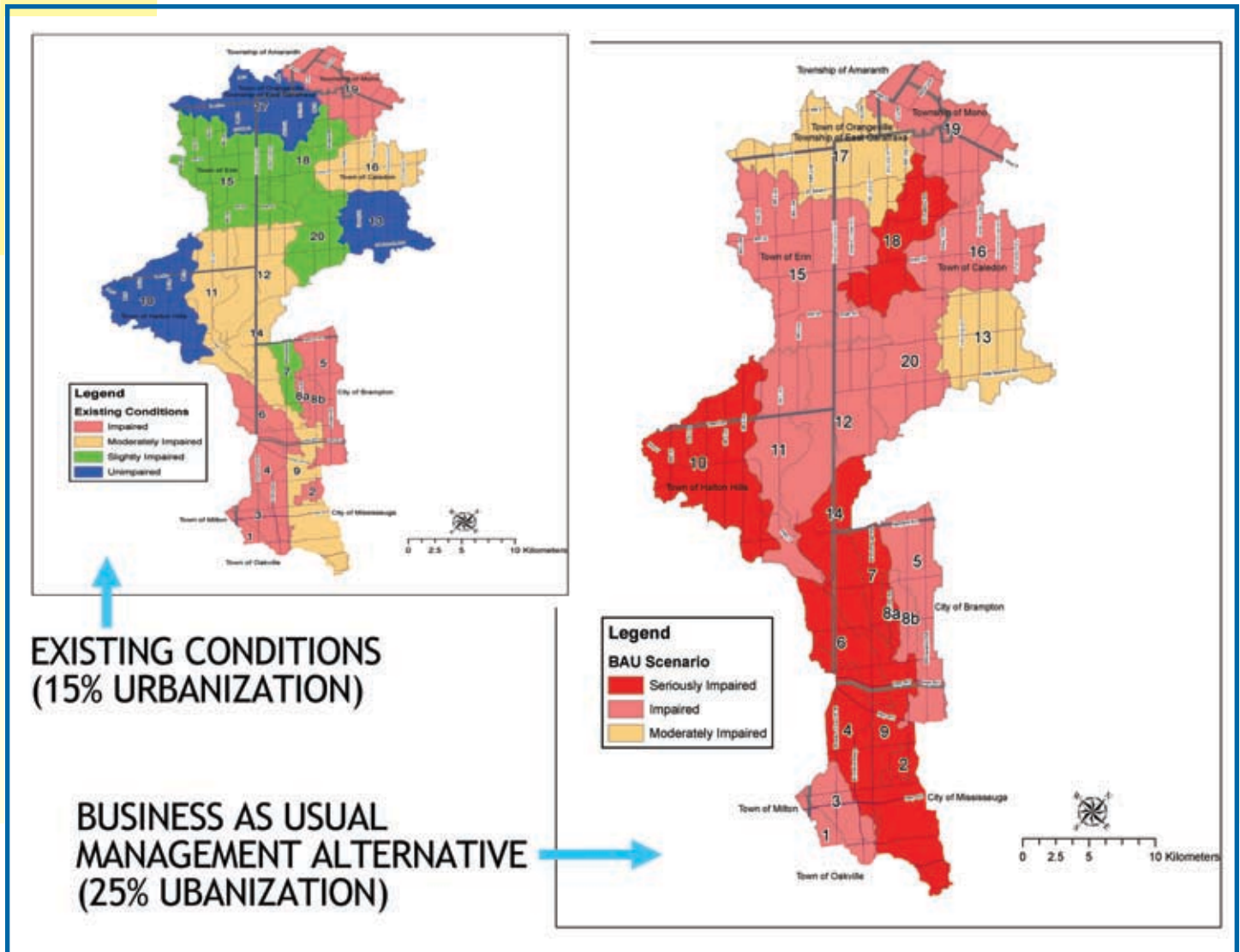


Figure 6: Draft River Zonation Map for the Credit River Watershed



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Figure 7: Effects of Continuing Current Planning and Development Practices



The CRWMSU study demonstrates that we are not dealing with a hypothetical future problem, but one that is real and already with us. The health of the Credit River watershed is already being compromised by the impacts of urbanization. We cannot afford to wait, but must act now to protect the integrity of the watershed.

3

We Can Continue Growing if We Change Our Planning and Water Management Practices

The fourth key finding of the CRWMSU study is that we can continue to grow, but only if we change how we do business in the watershed. The authors of the study noted that:

“To prevent deterioration in environmental conditions over the long term and achieve the watershed goal and objectives, an immediate strategic shift in current land use practices is needed.”

The recommended approach in the CRWMSU is two-pronged, and involves:

1. Taking a more aggressive approach to stormwater management and stream restoration in developing areas; and
2. Placing more emphasis on stormwater management throughout the watershed (i.e., incorporate sustainable practices in areas where land use is not changing).

The Proposed Approach in Development Areas

In areas where development is taking place, this will mean using a broad suite of stormwater management techniques to aggressively manage stormwater. This includes measures for controlling stormwater at source, in the conveyance system and at the end-of-pipe, along with restoration of streams that may already be degraded. Examples of these are provided in Table 6.

In addition to aggressive management of stormwater, the CRWMSU encourages the use of an integrated approach for development that:

- Is founded on a systems approach;
- Regards the environmental context of the site within the larger landscape;
- Recognizes the interrelated functions that contribute to the sustainability of natural heritage features and systems; and
- Has regard for the features, functions and systems that are situated beyond the limits of the site.

Table 6: Potential Best Management Practices for Development Areas

Category	Best Management Practices
Source Controls	Rooftop storage (“green roofs”)
	Parking lot storage
	Super pipe storage
	Reduced lot grading
	Downspouts led to ponding area
	Soakaway pits
	Infiltration trenches
Conveyance Controls	Rooftop grading
	Grassy swales
	Pervious pipe systems (“leaky pipes”)
	Pervious catch basins
	Vegetated filter strips
End-of-Pipe Controls	Stream/valley buffer strips
	Wet ponds
	Constructed Wetlands
	Hybrid ponds/wetlands
	Dry ponds
	Infiltration basins
	Filters

3

In practical terms, this change in how planning is done would preserve open space and work with the key features, functions and linkages of the natural resources. It would incorporate natural areas (such as forests and wetlands) into community designs and would protect their features and functions.

The Proposed Approach in Existing Urban and Rural Areas

In existing urban and rural areas, we need to place a greater emphasis on stormwater management. This can be challenging to accomplish in dense urban areas, but has been done in many cities across North America. The kinds of Best Management Practices that can be used are listed in Table 7.

What the Recommended Strategy will Achieve

The recommended management strategy contained in the CRWMSU integrates urban form (how we build our communities) and stormwater infrastructure (how we manage stormwater) to support the hydrologic function of the watershed. In areas where development will take place, this includes minimizing impervious cover by reducing the extent of roads and building footprints, and preserving natural areas. It includes use of a broad range of stormwater management practices to reduce stormwater runoff by treating it at source, infiltrating it into the ground, and ensuring that discharge into streams is clean and at a volume and rate that preserves stream function. The recommended strategy also includes measures designed to improve water quality, reduce erosion and protect fish and other aquatic species.

Table 7: Potential Best Management Practices in Urban and Rural Areas

Category	Examples
Source Controls (U)	Downspout disconnection, porous pavement, soakaway pits, biofilters on parking lots, rooftop storage
Conveyance Controls (U)	Porous storm sewer pipes, grassy swales
End-of-Pipe Controls (U)	Wet and dry stormwater ponds, constructed wetlands, underground water storage tanks, infiltration ponds
Structural (R)	Manure storage and handling facilities, feedlot runoff controls, outlet controls on tile drainage systems
Non-Structural (R)	Livestock fencing, buffer strips, conservation tillage, nutrient management
Rural Estate	Grassy swales, septic system repair/replacement, management of fertilizers and pesticides
Operations & Maintenance (U)	Reduced lawn maintenance, naturalized riparian plantings, water conservation
Stream Restoration	Measures to address erosion and flooding problems, naturalization of riparian zones
Fish Habitat Enhancement	Stream bank plantings, flow deflectors, habitat creation, boulder placements
Terrestrial Habitat Enhancement	Buffers adjacent to sensitive features, wetland restoration, reforestation, naturalization
Groundwater Protection	Septic tank replacement, infiltration facilities, nutrient management, grassy swales
WPCP Upgrades	Upgrading the Water Pollution Control Plants that discharge into the Credit
Aggregate Extraction	Measures to reduce impacts on ground and surface water, restoration plans, aggregate extraction standards
Landfill	Reviewing current practices at active and closed landfills in the watershed

U= Urban areas R= Rural areas

3

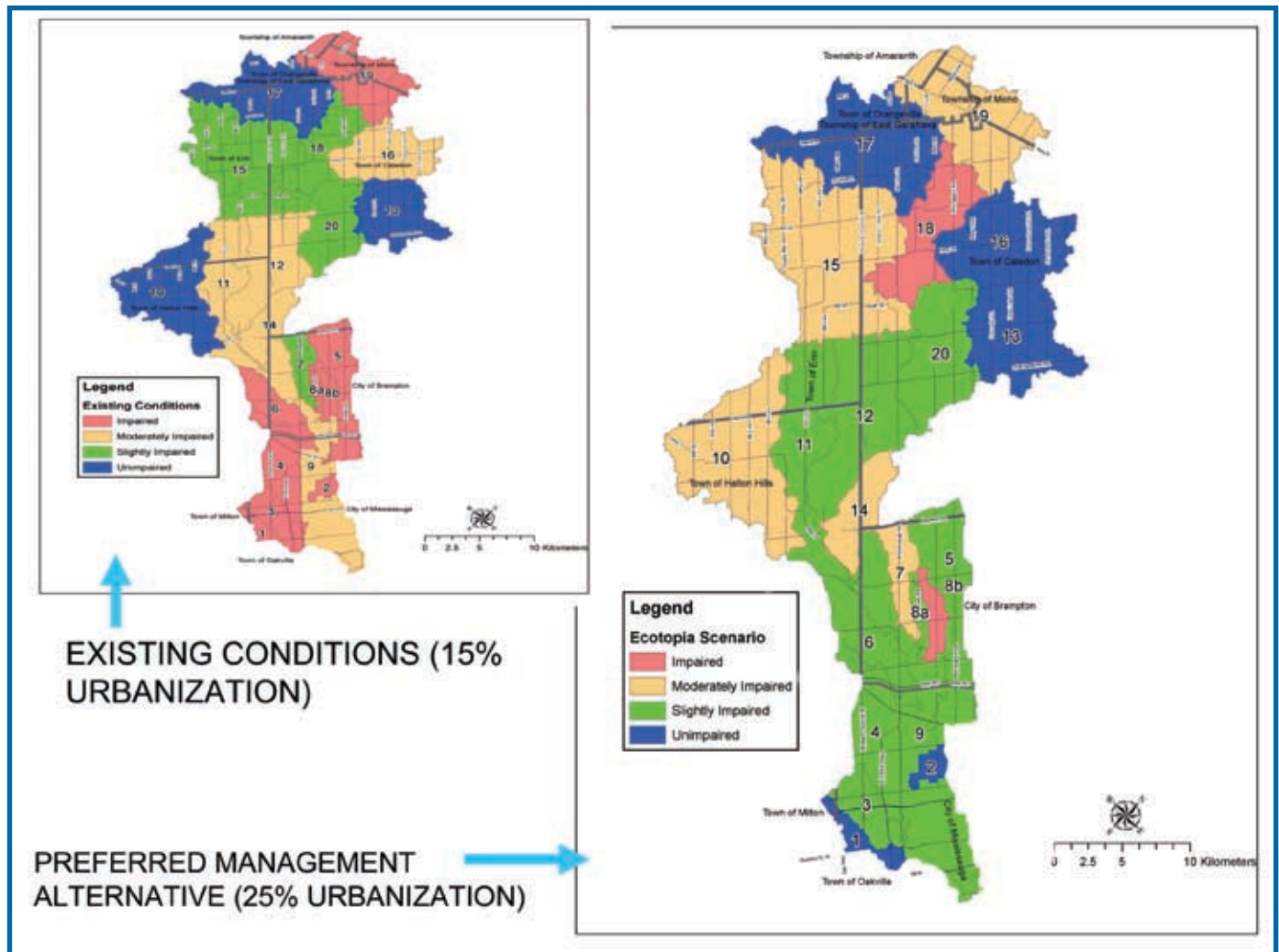
Figure 8 provides a graphic illustration of what can be achieved through implementation of the recommended CRWMSU. If implemented, the recommended management strategy for the CRWMSU will avoid further degradation of the watershed and in fact will result in:

- Improved water quality;
- Reduced flood risks;
- Improved habitats for fisheries and wildlife;
- Reduced potential for erosion; and
- Enhanced groundwater supply.

There is a Limit to Growth

The fifth key finding of the CRWMSU study – a very important one – is that there is a limit to growth if watershed goals are to be realized. Monitoring and model results show that it is not possible to offset impacts from land use change entirely. Furthermore, modelled predictions under climate extreme scenarios extenuate the deterioration of watershed conditions. There are limits to how much environmental features and functions within the watershed can “cope” with change. This important finding needs to be incorporated into long-term plans and policies in the watershed.

Figure 8: Effects of Applying Recommended Strategy



chapter 4

Making it work!

Recommendations

The key conclusion of the CRWMSU update study is that current development and stormwater management practices are not sustainable over the long term. We need to change how we do things if we want to continue to grow and maintain or enhance environmental conditions in the Credit River watershed. The key recommendations of the study are:

- **Principle:** CVC and its municipal partners should recognize rainwater, groundwater and snowmelt as valuable resources and should manage rain where it falls – on lots, roofs and streets – before it enters sewers and streams.
- **Targets:** CVC and its municipal partners should formally adopt the CRWMSU goal, principles, objectives and targets as a basis for future planning and operations.
- **Sustainable Management Practices:** CVC and its municipal partners should implement a broad suite of stormwater Sustainable Management Practices across the watershed using a full range of source, conveyance, end-of-pipe controls and restoration measures consistent with the CRMWS.
- **Policies and Standards:** CVC and its municipal partners should ensure that municipal planning and development policies, guidelines, standards and processes incorporate an integrated ecosystem approach.
- **Funding:** CVC and its municipal partners should initiate the necessary programs and policies to staff and finance the range of Sustainable Management Practices as recommended in the CRWMSU and determine appropriate program and funding requirements as part of the implementation process.
- **Administration:** CVC and its municipal partners should establish an appropriate administrative structure to guide the implementation of the CRWMSU (see Figure 9). This administrative structure will incorporate integrated stakeholder groups that will be tasked with reviewing existing policies and programs to recommend changes necessary for implementing the CRWMSU.



4

Working Together

Implementing the recommendations contained in the CRWMSU will require not only the involvement of CVC and its municipal partners, but also provincial agencies, non-governmental organizations, the development community and the public at large. To this end, an Implementation Committee will be formed with broad representation from stakeholders. This committee will be charged with ensuring that the Credit River Water Management Strategy Update is implemented, updated and revised as necessary.

A major step on the road to implementation of the CRWMSU was signing the Credit River Watershed Charter by watershed municipalities. This says:

"We recognize the importance of the Credit River and the significance of water to our local communities for present and future generations. Now therefore, as municipal partners, we encourage everyone to continue to work together to ensure sustainable practices are implemented across our watershed communities."

This is the first step to Making it Work for a Sustainable Credit.



Credit River Watershed Charter

WHEREAS the member municipalities that make up the Credit River Watershed and the Credit Valley Conservation, through the Credit River Water Management Strategy Update found that:

- Direct linkages exist between public well being and ecosystem health,
- Existing watershed conditions show some degradation in the environment,
- Growth can occur if we improve current planning and development practices and implement a sustainable management approach to new development and enhance existing land uses,
- Regardless of urban form and stormwater management alternatives applied, there is a limit to growth if the goals and objectives for watershed health are to be realized.

We recognize the importance of the Credit River and the significance of water to our local communities for present and future generations.

NOW THEREFORE, as municipal partners we encourage everyone to continue to work together to ensure sustainable practices are implemented across our watershed communities.

Patricia Mullin

Patricia Mullin
Chair
Credit Valley Conservation Authority

Emil Kolb

Emil Kolb
Regional Chair, Region of Peel

Joyce Savoline

Regional Chairperson, Joyce Savoline
Region of Halton

David McCallum

Mayor David McCallum
City of Mississauga

Marjyn Morrison

Mayor Marjyn Morrison
Town of Caledon

Rick Bonetto

Mayor Rick Bonetto
Town of Halton Hills

Drew Brown

Mayor Drew Brown
Town of Orangeville

J. Paul Leung

Mayor Paul Leung
Township of East Gwillimburgh

Keith Thompson

Mayor Keith Thompson
Town of Mono

Susan Fenell

Mayor Susan Fenell
City of Brampton

www.creditvalleycons.com

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CVC Staff
Aquafor Beech Limited
AquaResource Inc.
Ebnflo Environmental
J. Kinkead Consulting
Kidd Consulting



1255 Old Derry Road
Mississauga, Ontario, L5N 6R4
Phone: (905) 670-1615 or 1-800-668-5557
Fax: (905) 670-2210
Email: cvc@creditvalleycons.com
Web: www.creditvalleycons.com