



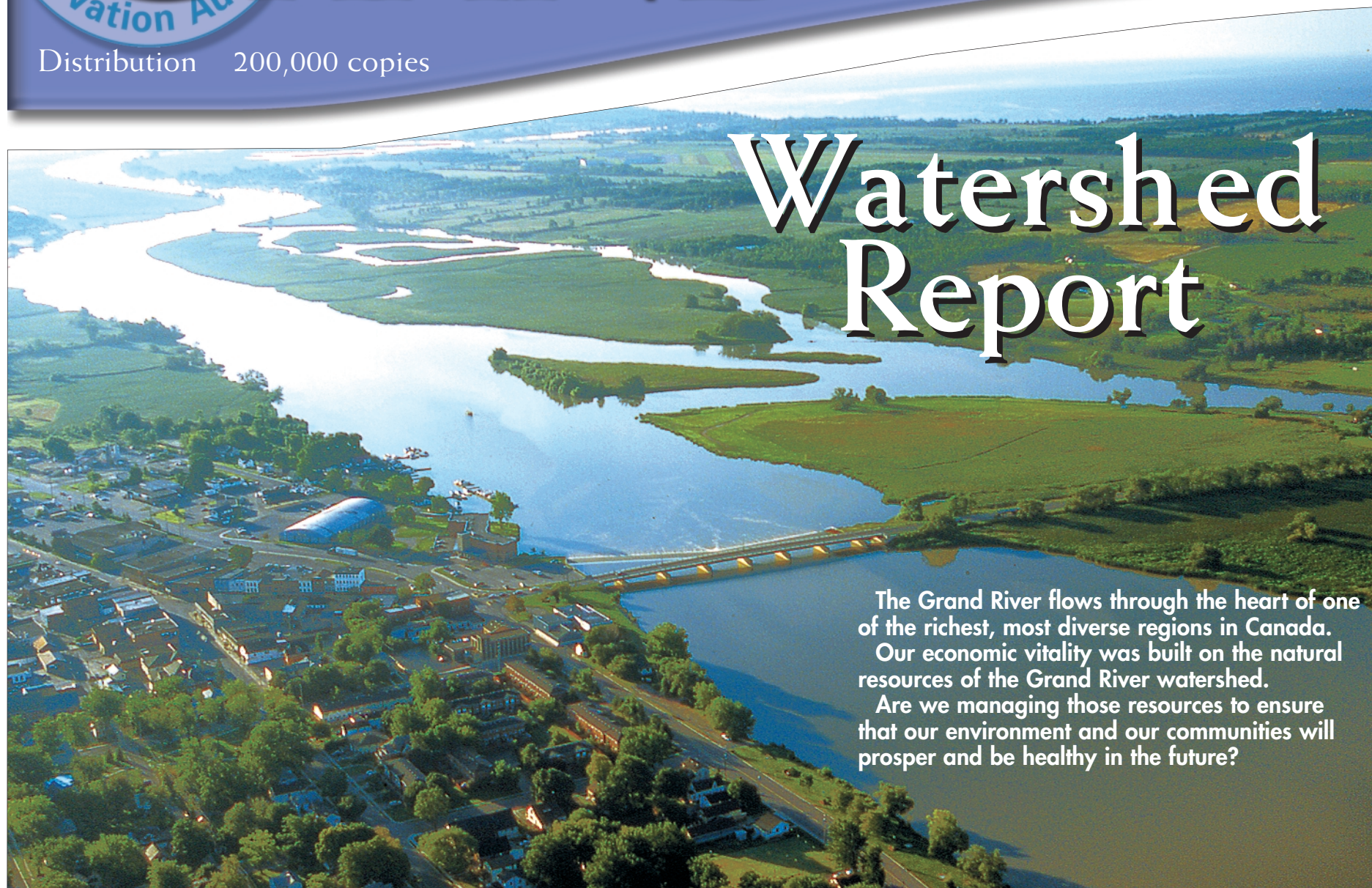
The

GRAND

GRAND RIVER
CONSERVATION
AUTHORITY
2003 FALL REPORT

Distribution 200,000 copies

Watershed Report



The Grand River flows through the heart of one of the richest, most diverse regions in Canada. Our economic vitality was built on the natural resources of the Grand River watershed.

Are we managing those resources to ensure that our environment and our communities will prosper and be healthy in the future?

The Grand River through Dunnville as it nears the end of its journey to Lake Erie. This photo was taken by Waterloo photographer Carl Hiebert from his ultralight plane as he shot pictures for his new book, *The Grand River – An Aerial Journey*. See more about the book on Page 16.

Along the Grand

Water quality



A great deal of progress has been made in improving water quality in the Grand River system, but more remains to be done.

Pages 4-7

Water quantity



Water quantity issues take many forms. How do we use water? What has been done to reduce flood damages? How do we cope with drought?

Pages 8-12

Land resources



The health of our water is closely connected to the way we use the land. Reforestation efforts have helped return some natural balance to the watershed.

Pages 13-15

THE GRAND
RIVER
- A Canadian
Heritage River

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A Message FROM THE CHAIRMAN AND THE CAO



From the time of European settlement until today, the Grand River watershed has become one of the richest, most productive and most heavily developed regions of the country.

In the 1800s our ancestors put in a tremendous effort to clear and drain the land to make it suitable for agriculture. Soon, settlements grew up along the rivers and creeks, drawn there by all that they offered: water, transportation and power.

Over the years, that solid agricultural base became the foundation for the dramatic growth of Kitchener, Waterloo, Guelph, Cambridge, Brantford and the many surrounding towns and villages.

But as the agricultural and urban communities grew and prospered, there were severe disruptions to the natural ecosystem. Groundwater systems were disrupted and wells went dry. Native species of trees, plants, animals, birds and fish were pushed into remote corners of the watershed or eliminated altogether.

The natural rise and fall in water levels became more pronounced, with rivers overtopping their banks more frequently in the spring, and drying up in the summer. At their worst, floods and droughts threatened the future growth and well-being of the communities along the river.

By the 1930s many people in the Grand River watershed realized that things needed to change. People began to realize that they had to take a look at their watershed and take action.

They banded together to create what became the Grand River Conservation Authority. They built dams, planted trees, preserved environmentally sensitive land and took other steps to protect their communities from flood and drought.

They set in motion a process that continues to unfold today, as the people of the Grand River watershed continue to work to restore some balance to the natural system.

This brings us to this document, our first Watershed Report to the people of the Grand River valley.

It is our attempt to provide watershed residents with some information about the state of the watershed and answer some important questions.

Are we making progress in our efforts to revitalize the river? Are we cleaning up the water? Are we protecting the forests? Are we restoring natural habitats? Are we making our communities safer? Are we making our communities healthier?

In this report we want to establish some benchmarks and measure how far we have progressed in certain areas. Because of the incredible complexity of the natural system, we have decided to focus on three

key areas of concern in this first edition: water quality, water quantity and land resources.

We hope to give the people of the Grand River a better understanding of what some of the issues are in each of those areas, what steps have been taken to deal with them, and what issues lie ahead.

This report does not address every issue of concern in the Grand River watershed. Our goal this year is to focus on a selected number of key indicators of watershed health. In coming years we will be branching out into other areas of study and analysis to provide a more complete picture.

By understanding where we have been and where we are today, we can collectively map out a plan of where we need to go in the future to protect the natural system of this watershed.

For all of the changes that have taken place in the Grand River watershed since the 1930s, there is one fact that remains the same: it was a partnership of watershed municipalities that got things going then, and it is a partnership that keeps things moving today.

The Grand River Conservation Authority is a partnership of the 38 municipalities of the watershed. The municipalities appoint the GRCA's board of directors and contribute a significant amount of money toward our water quality, flood protection and other programs.

Part of the GRCA's responsibility as a watershed agency is to collect and analyze information so that municipalities, businesses, residents and other levels of government can make informed decisions about the watershed and its resources.

This document is our first attempt to take some of that data and present it to you, the people of the watershed.

We hope you find it useful and informative. If you have any suggestions and comments, we'd like to hear them so we can make next year's Watershed Report even more useful and more informative.



Peter Krause
Peter Krause
Chairman



Paul Emerson
Paul Emerson
Chief Administrative
Officer

The Salamander Foundation

The GRCA and Grand River Conservation Foundation wish to thank the Salamander Foundation for their generous donation which assisted in printing The Grand – Watershed Report.

The municipality where you live appoints a representative to the Grand River Conservation Authority (GRCA) board to oversee the budget and activities of the Conservation Authority. These appointed members, who have often been elected in your municipality, speak on your behalf at the GRCA.

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The Watershed Report: measuring progress in revitalizing the Grand

It has been said that you can never step into the same river twice. As you put one foot in, and then the second, the waters pass you by, the river changes forever.

That's certainly true of the Grand River. Over the years, it has undergone remarkable transformations. It was a pristine waterway 200 years ago, but declined to become an "open sewer" just 75 years ago.

During the past two generations the Grand has gone through a remarkable rebirth, once again becoming a river worthy of its name.

It required the concerted effort of the people of the Grand, exercising their will through local government and agencies such as the GRCA, to bring about the changes.

The Grand of today is certainly not the river it was in the 1930s. Nor is it the river it was in the 1830s.

The question is: What kind of river will it be in 2030 and beyond?

The Grand River watershed faces tremendous pressures.

Almost all of the watershed has been put to use. About 93 per cent of the watershed is rural and most of that is intensively farmed.

The other seven per cent is urban area, made up of burgeoning cities and thriving towns, with growth rates among the highest in the province.

The population is expected to grow by 37 per cent – about 300,000 people – over the next 20 years, along with their associated industry and commerce. That's the equivalent of a new city the size of Cambridge, Guelph and Brantford combined.

Agricultural practices are growing more intensive as farmers work harder to maximize what they can produce on a limited amount of land to meet the needs of an expanding population in a global marketplace.

As great as these pressures are, though, the people of the Grand River watershed have

shown they understand that growth comes with a responsibility to protect the environment.

They have enthusiastically supported reforestation projects. Their municipalities have enacted bylaws to protect woodlands and wetlands. Farmers and businesses have adopted water protection and water conservation programs. Environmental groups, universities, scientists, citizens – all of them have applied themselves to changing the Grand River for the better.

This report is intended to document some of those changes, and to give watershed residents a reference point they can use to follow issues as they unfold over the coming years.

The Grand River watershed is an incredibly diverse region and it would be impossible to describe completely all of the issues facing it in a publication this size.

So in this issue of the report we are addressing three broad themes. Then, within each theme, attention is focussed on a group of key issues that provide some indication of the health of the watershed. The goal is to provide a broad overview of some of the factors responsible for the state of the watershed.

Water quality issues

The steady improvement in water quality over the past 75 years is one of the success stories of the Grand River watershed. While there remains much to be done, the advances in water quality have made the river system a more hospitable place for all creatures, from insects to birds, from fish to people.

The Watershed Report addresses several key indicators relating to water quality:

- the presence of nutrients, such as phosphorus and nitrates, in surface water, and steps being taken to reduce their presence.
- dissolved oxygen levels at various locations throughout the watershed
- the growing issues relating to the presence of chlorides, mostly from road salt, in our surface and groundwater
- the presence of sport fish and insects as indicators of water quality.

Other work is being done to better understand the impact of the presence of heavy metals, biological contaminants and other pollutants. As understanding of these issues grows, they will be highlighted in future watershed reports.

Water quantity issues

Water supply, flooding, droughts – all of these issues relating to water quantity

have been a focus of municipal and GRCA endeavours for decades.

Water supply: Most people in the Grand River watershed depend on the river and the region's groundwater system for their drinking water. To highlight some of the issues relating to water supply the watershed report examines:

- who is using water and how much
- how does our water use compare to water use in Canada and around the world
- what kind of water conservation efforts are in place and how are they working
- the potential impact of growth on important water source areas such as moraines

Flooding: Over the years, floods have caused millions of dollars in damages throughout the Grand River watershed. Dikes and dams have been built to control flooding, and land use restrictions have been imposed in floodplains to limit damages.

To explain flooding issues, the watershed report outlines:

- the factors which contribute to flooding
- the location and function of flood control structures and the impact they have had on reducing damages
- the potential for future flood damages

Drought: The Grand River watershed has lived through several drought cycles in the past century – the 1930s, the 1960s and the latest, which began about 1997.

The watershed report examines water shortage issues by explaining:

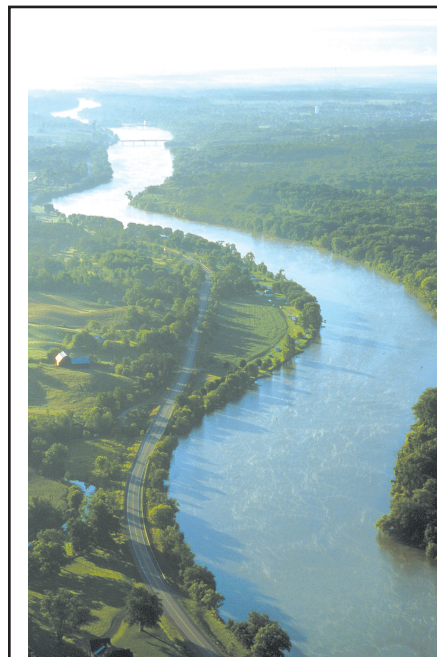
- how flows are augmented by the GRCA's reservoir network
- the level of drought conditions in different areas of the watershed in 2002
- conservation efforts in place to share available water during drought periods

Land resource issues

Water quality is intimately connected to the quality of land resources. Forests and wetlands help moderate floods, raise water quality and provide an incredibly rich and diverse habitat.

In the report, land resource issues are addressed by looking at:

- how forest cover has changed over the years and the extent of forest cover today
- the presence of "big block" tracts of forest and their significance as a habitat
- the importance of "riparian vegetation," which is vegetation along the banks of a river or stream
- the number of at-risk species in the watershed, which is an indicator of the overall state of forest, wetland and other types of habitat



Watershed facts

- The Grand River is the longest river in southern Ontario. It is about 298 kilometres long, from Dundalk in the north to Lake Erie in the south.
- The Grand River watershed takes in about 6,800 square kilometres.
- Major tributaries of the Grand include the Nith River, Speed River and Conestogo River.
- About 93 per cent of the land is rural, and most of that is farmed.
- About seven per cent of the land is urban.
- The population of the watershed is more than 800,000 and is expected to grow by 37 per cent – 300,000 people – over the next 20 years.
- The watershed takes in all or part of 38 municipalities and two First Nation territories.
- A network of reservoirs operated by the GRCA ensure minimum flows in the Grand and several tributaries even during drought.
- The watershed is part of two forest zones, the Great Lakes (or Alleghenian) in the northern half and the Carolinian in the southern half
- The Grand River system was declared a Canadian Heritage River in 1994.

The Grand on the web

Here are some web sites which provide more information on the issues discussed in this report:

- GRCA: www.grandriver.ca
- Conservation Ontario: www.conservation-ontario.on.ca
- Canadian Heritage Rivers System: www.chrs.ca
- Carolinian Canada: www.carolinian.org
- Wetlands Research Centre: www.fes.uwaterloo.ca/research/wetlands/
- Guelph Water Management Group: www.uoguelph.ca/gwmg/



Water quality: the Grand has come a long way

We expect a lot from the Grand River system.

We expect it to be a source of drinking water for our rapidly expanding population. More than 800,000 residents of the watershed depend on the river and the watershed's rich groundwater sources for their drinking water.

We expect it to be a place where we can put our waste. The river system receives the outflow of 26 sewage treatment plants and the runoff from fields, lawns, streets and highways.

We expect it to provide a home for all manner of creatures — fish, birds, plants and insects.

And we expect it to be a place where we can enjoy a pleasant Sunday walk, a stimulating kayak paddle or a day's fishing.

All of these activities — human and natural — have an impact on the quality of the water in the rivers and the groundwater system. A river system has an ability to accommodate

these activities — up to a certain point. But beyond that point, water quality starts to drop, with serious consequences for all of the inhabitants of a watershed — human and other.

When water quality declines, communities such as Waterloo Region, Brantford and Ohsweken that rely on the Grand for all or part of their water supply have to put more effort — and more money — into treating their drinking water. The river becomes a less inviting place for the people who enjoy using it for recreation. And last, but not least, as water quality drops, so does the quality of the habitat for the hundreds of species that live in or near the water.

Water quality issues go deeper, too. High levels of nutrients, chloride and other contaminants can also affect the quality of groundwater. That's a particularly important issue in the Grand River watershed because more than 600,000 people — 80 per cent of the watershed's residents — get their drink-



A healthier habitat

Decades of effort have improved water quality in the Grand River system, making it a better habitat for fish, such as this golden redbreasted sunfish found near Brantford.

ing water from wells, either through municipal systems (such as Guelph, Cambridge and Grand Valley) or from private wells.

Given the importance of surface and groundwater to the health and economic vitality of the watershed, it is no wonder that the people of the Grand River have taken a keen interest in protecting water quality.

There were times, in the past, when the demands on the river system exceeded its ability to cope. In the 1930s and 1940s the river was accurately described as an "open sewer," especially in summer when flows were

low and what little water there was in the Grand consisted mostly of the outflow from sewage treatment plants.

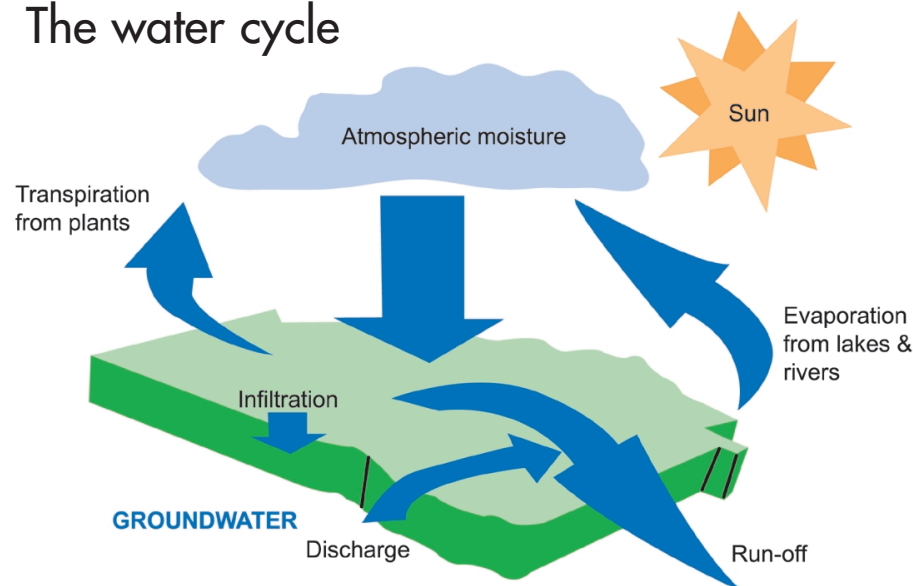
Since then, though, the communities of the Grand River watershed have invested a lot of effort and money to revive the river system.

Millions have been spent on new and better sewage treatment plants. Farmers have adopted new techniques to lessen the impact of their operations on the environment. Changes in the way storm sewer systems are designed have reduced the impact of urban

Water quality facts

- ❑ More than 600,000 watershed residents get their water from wells, either from municipal systems or private wells.
- ❑ There are 26 sewage treatment plants handling the sewage of 680,000 people
- ❑ All sewage receives what is known as "secondary" treatment, which lessens the impact of the effluent by 95 per cent. About 19 per cent of the sewage gets a higher degree, or "tertiary," level of treatment.
- ❑ Agriculture is a major industry in the watershed, with more than 75 per cent of the land in production.
- ❑ More than 825 projects worth than \$8 million have been completed under the Rural Water Quality Program which is designed to help farmers improve water quality.
- ❑ Under the Rural Water Quality Program 115 fences have been built along 55 kilometres of watercourse, keeping 4,000 livestock out of streams and rivers.
- ❑ The GRCA maintains seven automated water quality monitoring stations which measure dissolved oxygen levels, pH level, temperature and conductivity. The GRCA and the Ontario Ministry of the Environment do water quality sampling at 28 sites throughout the watershed.
- ❑ The presence of certain species of fish is an indication of rising water quality. Various species, such as bass, that were missing from large parts of the watershed a few decades ago, are staging a comeback.
- ❑ Sixty per cent of the classified streams in the watershed are coldwater or mixed.

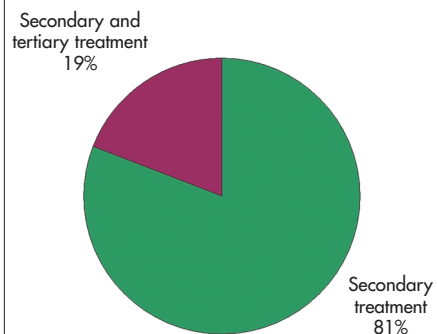
The water cycle



Falling rain and melting snow help to restore water levels to surface and groundwater systems. But the runoff can also carry pollutants with it, which can have an impact on river water and groundwater quality.



Level of sewage treatment



runoff. The construction of a network of dams and reservoirs, such as Guelph Lake, Belwood Lake, Luther Lake and Conestogo Lake, allows water to be added to the river during dry months to maintain minimum flows, which helps deal with pollutants.

But the pressures of growth — urban and rural — continue to put the Grand River system under stress and the battle to hold, if not improve, water quality is a constant one. At present, the watershed's sewage treatment plants serve about 680,000 people but by 2021 that number is predicted to rise to 900,000.

There are two key, long-standing water quality issues in the Grand River system. The two issues are interconnected — high nutrient levels and low levels of dissolved oxygen.

Nutrients are chemicals such as phosphorus, ammonia and nitrate. When these nutrients get into the water, they act as fertilizers for algae and other plant life. If the nutrient levels are too high, excessive plant growth can result in low oxygen levels in a river, leaving fish fighting to breathe. In the worst cases, low oxygen can result in the death of life in the stream.

The landscape of the Grand River water-

shed is naturally rich in nutrients, particularly the till plains of the northern and western sides of the watershed, and the clay soils of the southern section. However, intensive rural and urban land use has contributed substantially to the nutrient content of the rivers, streams and groundwater.

Agriculture is a major industry in the watershed and more than 75 per cent of the watershed land is used for agricultural production.

As melting snow and rainwater drain off the land, nutrients from cattle manure or fertilizers are washed into rivers and streams. Some pollutants also get into the groundwater system and over time nitrates can build up in aquifers.

Rural septic tanks, particularly if they are faulty, can also contribute nutrients to groundwater and eventually to surface water systems.

Better treatment means better water

Municipal wastewater treatment plants are another significant source of nutrients. There was a time when sewage treatment plants did little actual treatment beyond screening and settling the waste, a process known as "primary" treatment.

Over the last few decades, however, most plants have been upgraded and now provide higher levels of treatment, which have resulted in a significant improvement in water quality. In fact, treatment standards are generally higher in the Grand River watershed than other places in Ontario because the effluent is being placed into relatively small watercourses.

Today, all watershed sewage plants provide what is known as "secondary treatment," which means that the sewage has been treated to reduce the impact on the receiving stream by about 95 per cent.

Some sewage treatment

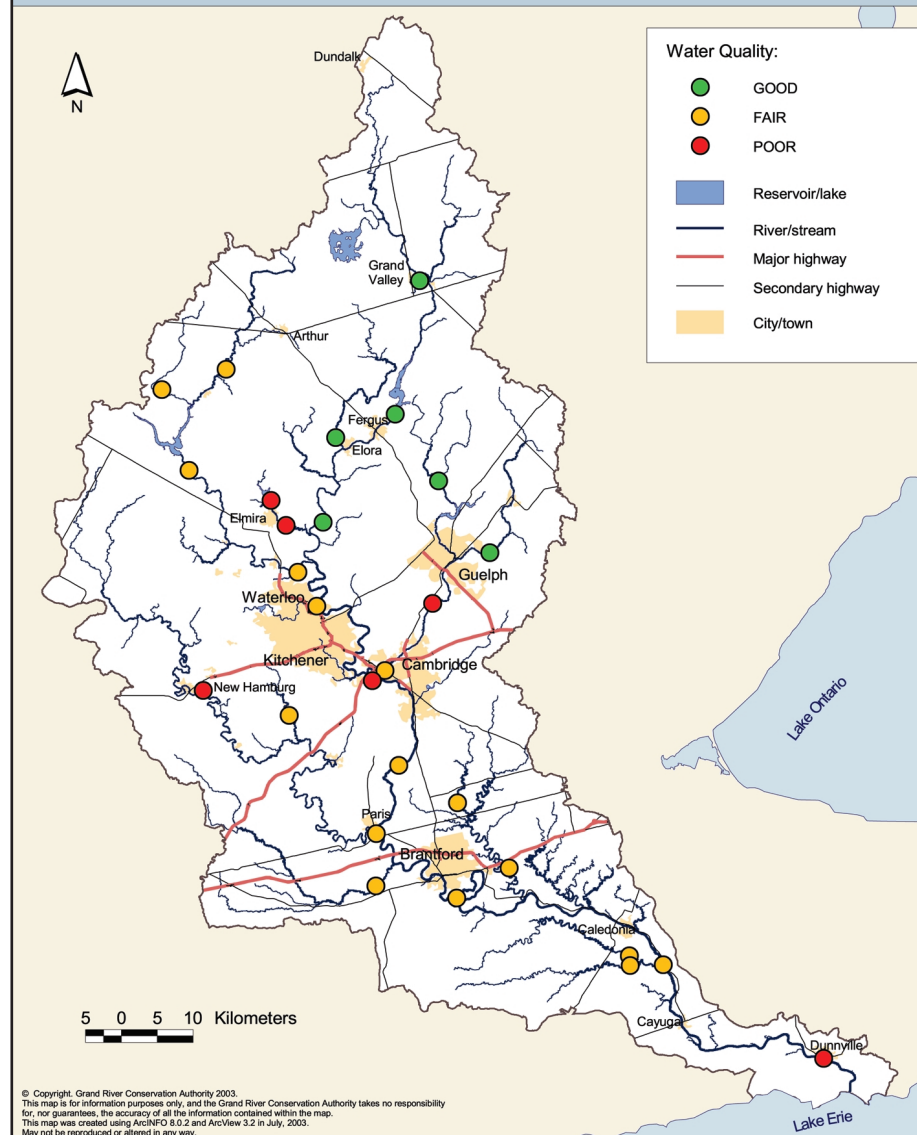
plants have a third, or "tertiary," level of treatment, which goes even further to cut down the amount of nutrients and other pollutants making their way into the rivers. About 19 per cent of the urban population is served by sewage plants offering tertiary treatment.

But even though the sewage plants of today remove most of the nutrients from the wastewater they treat, the cumulative impact of the outflow from 26 plants, treating the sewage of about 680,000 people, is still significant.

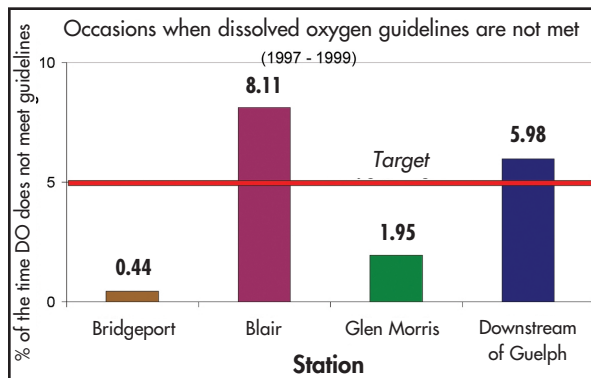
Runoff from urban areas — lawns, streets, parks and parking lots — is also a source of nutrients from lawn fertilizers, suspended sediments and chloride (road salt). The fertilizers we apply to our lawns, and the droppings from birds and pets

The Grand River
Watershed
Report

Water Quality at Various Locations (1999 - 2002)



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Meeting a target

Fish require a minimum level of dissolved oxygen in order to breathe and survive. The target for dissolved oxygen is to make sure it does not drop below four milligrams of oxygen in each litre of water more than five per cent of the time during the summer months. The target was missed about eight per cent of the time at Blair, downstream of Kitchener, and about six per cent of the time at Wellington Road 32, downstream of Guelph on the Speed River

Water quality and nutrients

Water quality is affected by nutrient levels. In the Grand River watershed, the impact of nutrients is less in the headwater areas so the water is rated "good." However, as you go downstream, through farmland and past urban areas, nutrient levels rise and water quality declines. Water quality is rated "fair" in most places, but falls into the "poor" category in areas of intensive agriculture and downstream of urban areas.

Areas where water quality is considered "poor" because of high nutrient levels are:

- ☐ the Grand River, downstream of Kitchener
- ☐ the Speed River, downstream of Guelph
- ☐ Canagagigue Creek
- ☐ the upper Nith River
- ☐ the Grand River at Dunnville

all contribute to nutrient levels in the river.

When these nutrients reach the rivers, streams and ponds of the watershed, they promote the growth of aquatic plants. Aquatic plants, such as algae, are the basic building blocks in the aquatic food chain, therefore a certain amount of these nutrients are required for a healthy, balanced ecosystem.

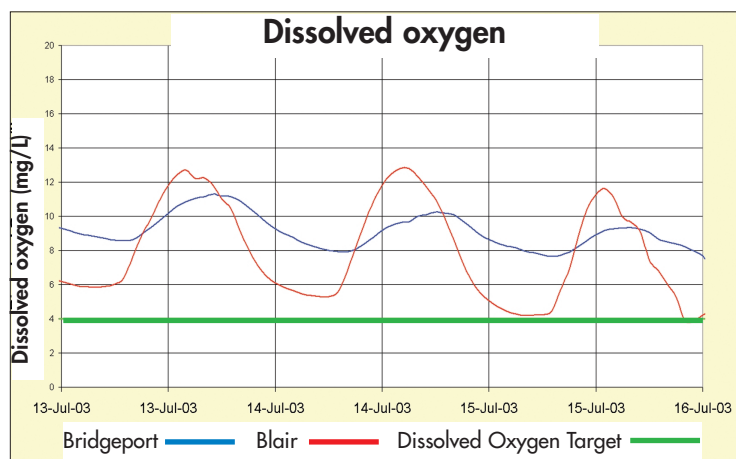
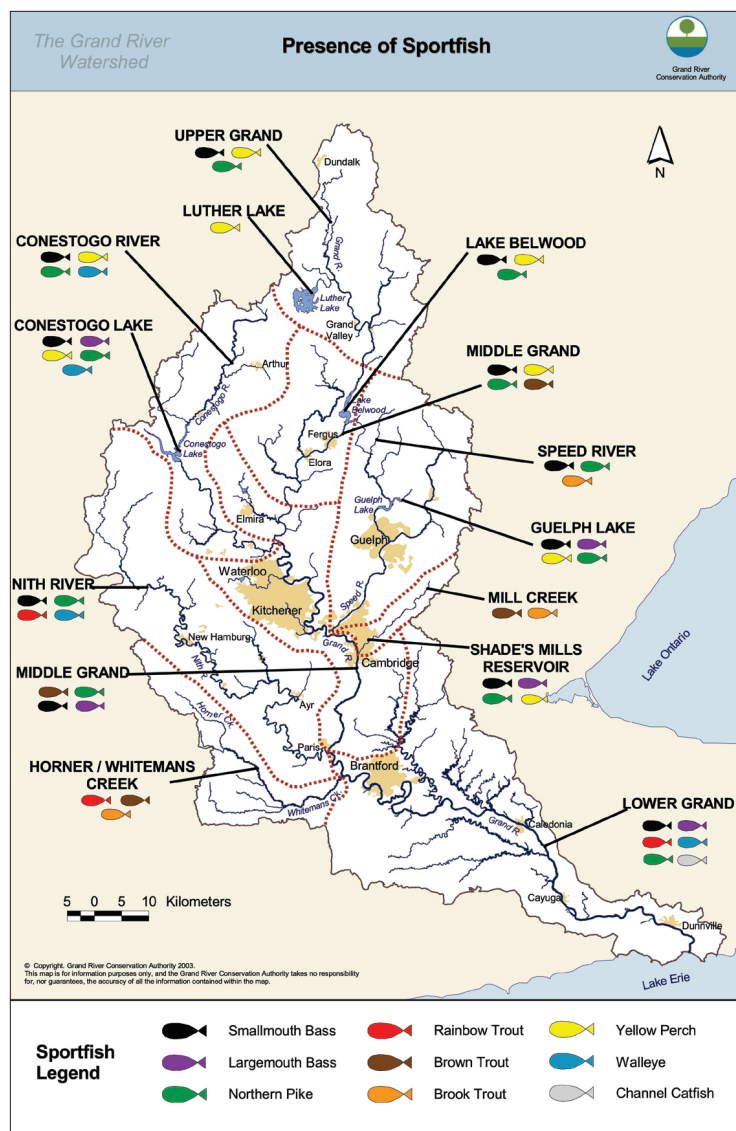
But too much of a good thing can be bad

for a river.

A river can assimilate, or use up, a certain amount of these nutrients through natural biological processes. As water moves downstream, some of these chemicals will break down and dissipate.

The ability of a river to cope with pollutants is called its "assimilative capacity." When the demands on a river exceed its assimilative capacity, water quality drops and





Oxygen, plants and fish

This graph shows the rise and fall of oxygen levels over three days in the Grand River near Kitchener. Bridgeport is upstream of the Kitchener sewage treatment plant and Blair is downstream. The effluent contains nutrients such as phosphorus and nitrates, which act like fertilizers, encouraging plant and algae growth. Plants produce oxygen during the day, but consume it at night. High plant growth means lower oxygen levels. When oxygen levels get too low – below four milligrams per litre of water – fish can find it hard to find enough oxygen to survive.

affects all of the creatures, from insects to people, who depend on it.

A system, called the Water Quality Index, has been developed to rate water quality in relation to nutrient content. The GRCA and the provincial Ministry of Environment maintain a network of 28 water-sampling sites on the rivers and creeks of the Grand River system.

According to information gathered between 1999 and 2002, the headwaters of the Grand and its tributaries are rated “good,” using the Water Quality Index adopted by the Canadian Council of Ministers of the Environment.

However, as the waters move downstream, taking in rural and urban runoff and the outflow from sewage treatment plants, the water quality declines into the “fair” category.

Then, as it passes by the major cities, water quality falls into the “poor” category because of the presence of high levels of phosphorus and nitrogen and the frequency that water quality targets are missed.

Major upgrades to sewage treatment plants, such as those in Guelph in 2002 and Elmira, along with others planned for Waterloo Region, should address problems in some of these areas.

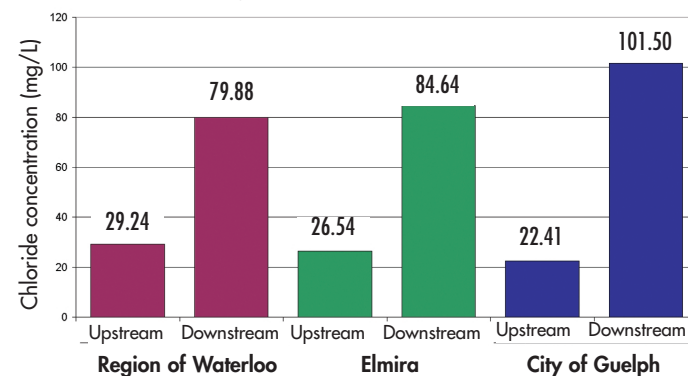
As would be expected, several of these areas also show low levels of dissolved oxygen, which can have a serious impact on many aquatic organisms, particularly fish.

The GRCA continuously monitors dissolved oxygen levels at seven locations in the watershed. Two locations — on the Grand downstream of Kitchener and on the Speed downstream of Guelph — exceed the objective most frequently. At Blair, the objective was missed about eight per cent of the time during 1997 and 1999. On the Speed, the objective was missed about six per cent of the time. That means that these two stretches of river can be stressful for aquatic life.

Many of the occurrences of low dissolved oxygen levels took place in very hot summers and during periods of low flow when the volume of pollutants in the river is more concentrated. When river flows are higher and temperatures are cooler, there were few instances of low oxygen levels.

The low water response program in Guelph, which aims to reduce water use in dry periods, also helps address this issue.

Average chloride concentrations



The amount of chloride (salt) tends to increase downstream of urban areas.

Going on a low-salt diet

An emerging issue in the Grand River watershed is the increase in chloride – salt – levels in the river and groundwater systems.

Some chloride is in the water naturally, but key sources of chloride are road salt and water softeners.

Chloride levels in the Grand River watershed are generally higher downstream of urban areas and they have been steadily increasing over the past 25 years.

Research by the Region of Waterloo also shows higher levels of salt in groundwater, which makes its way into some of the region's wells. There is evidence that it may take years, even decades, for salt spread on the

surface to show up in the wells, therefore, the higher concentrations of chloride today reflect activities that took place several years ago.

High concentrations of salt can affect the taste of water. However, Waterloo Region blends water from several wells, which serves to cut the concentration of the salt and eliminate taste problems.

Many municipalities are changing their procedures to reduce the amount of road salt they use.

And the federal government has declared road salt to be a toxic material, which means future regulations will also curtail its use.

Other water quality monitoring stations, including those at Bridgeport and Glen Morris, recorded relatively few violations of the objective.

Healthy fish in a healthy river

While much of the scientific investigation into water quality involves analysing water samples, another way to judge water quality is to look at the health of the creatures living in and near the water.

A healthy river will support many different types of organisms, from small insects to prize-winning game fish. Different species of fish and other aquatic life require different types of environments. Whether the water is warm or cool, murky or clear, will determine what

kind of organisms can survive in it.

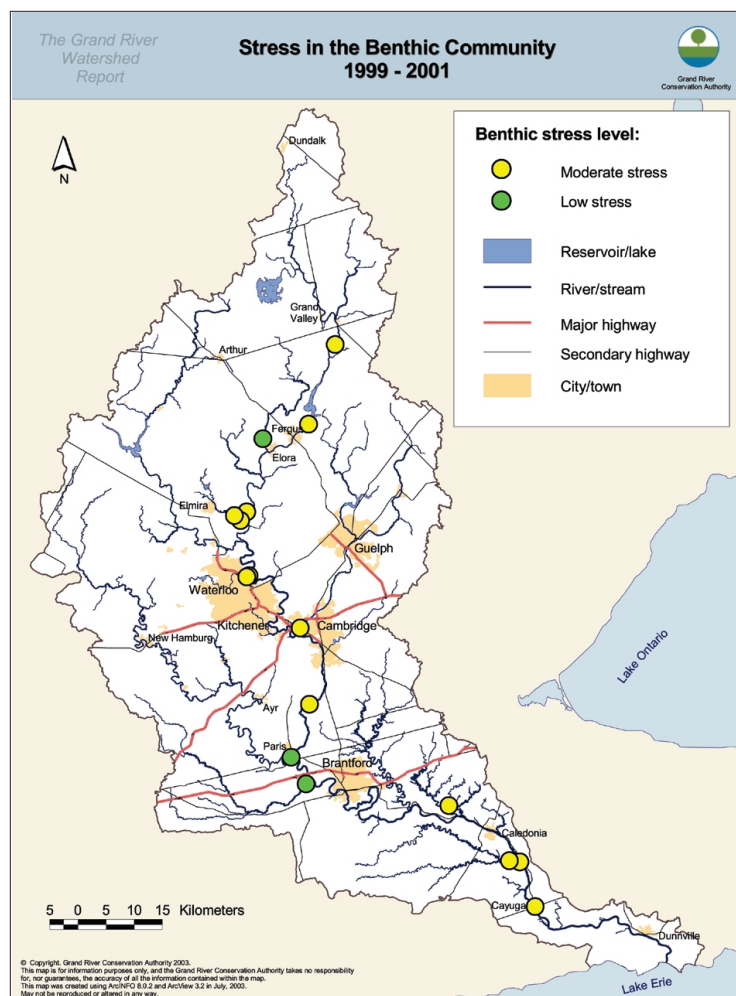
For example, brown trout prefer oxygen-rich cold water. Carp and channel cats can tolerate low dissolved oxygen and turbid water. Therefore, the presence or absence of certain types of fish will tell a lot about the water quality in a particular stretch of the river.

Many insects and other invertebrate species behave in the same way. A river that supports a rich variety of species is generally one that is in good health.

A survey of aquatic insects done in 1999-2001 shows that the impact of pollution on insects is moderate.

The hard data on water quality is also confirmed by the experience of anglers and fish experts who have seen a dramatic improvement in the number and range of high quality sport fish in the past 20 years.





Counting insects

Some species of aquatic insects are sensitive to water pollution, so a high diversity of insect species in a location is an indication of high water quality.

A study of the Grand River in 1967 reported no smallmouth bass upstream of Brantford. Today, they have recolonized the Middle Grand River, between Brantford and West Montrose, suggesting significant improvements in water quality. The same is true of the world-class brown trout fishery that has been established in the Fergus-West Montrose area.

Pike and smallmouth bass are doing well in Belwood, Conestogo and Guelph lakes. They're also finding homes in the upper Grand River headwaters in Wellington and Dufferin counties. An emerging rainbow trout population in the southern Grand, in Haldimand and Brant counties, also points to better water quality.

However, there are still some questions about the suitability of some stretches of the river as a habitat for higher quality fish. The southern Grand, near Dunnville and Port Maitland should be a

prime place for walleye, but populations are not as high as would be expected.

The rebirth of the fishery is just one sign of the rebirth of the river itself. The Grand has come a long way since it was dismissed as an "open sewer" but faced with the prospect of high population growth and more intensive farming, it will be a constant job to stay on top of the water quality issues facing the Grand River watershed.



Water quality improvements make the Grand a better place for recreation.



These photos show a farm stream before and after the construction of fencing to keep livestock out of the stream. Changes such as this produce real improvements in water quality and aquatic habitat.



Farmers help improve water

Hundreds of farmers involved in rural water quality projects

One of the best ways to ensure surface water and groundwater is clean, is to attack pollution problems right at the source.

That's the goal of the Rural Water Quality Program, which provides financial assistance and technical advice to help rural landowners adopt farming practices that protect water.

With proper best management practices in place, agriculture can be a source of clean water for all water users, both rural and urban.

The program started as an initiative of Waterloo Region and the GRCA in 1998. The region provided the financial resources and the GRCA provided technical and administrative support.

Since then the program has spread to Guelph-Wellington and Brant-Brantford. Across the watershed, all three levels of government plus two private foundations provide funding to rural water quality programs.

The program offers farmers partial grants to plant trees and build fences to establish buffer strips along streams, and construct manure storage tanks and fertilizer and fuel storage facilities. Farmers can also get

help with developing nutrient management plans, protecting wellheads and retiring environmentally fragile lands. The grants range from 50 per cent to 100 per cent of the cost, depending on the project. The landowner is expected to contribute the balance by providing money, materials and labour.

Projects are developed by the farmers in conjunction with technical advisers from the GRCA and then must be approved by a peer review committee.

More than \$6 million has been committed by various levels of government to the Rural Water Quality Program since it first started in 1998. Major contributions have come from the Healthy Futures program of the Ontario government.

So far, about \$3 million of government money has been spent, with farmers contributing another \$5 million for a total of \$8 million spent on more than 825 water quality programs.

The projects include the construction of more than 100 manure storage facilities and 115 fences along 55 kilometres of watercourse. The fences keep about 4,000 livestock out of streams and rivers. Farmers have also planted trees on more than 460 acres of streamside buffers and in groundwater recharge areas.

All of these activities help to keep nutrients, bacteria and other contaminants out of the Grand River and its tributaries.

A mussel-bound river is a good thing

Freshwater mussels like clean water, so a good way to determine the health of a river is to count mussels.

That's what scientists at the National Water Research Institute and the University of Guelph did a few years ago. They studied the diversity and distribution of freshwater mussels and then com-

pared the information to data gathered about 30 years ago. (J.L. Metcalfe-Smith et al 2000)

They found that the mussel population has rebounded significantly since the 1970s when the Grand River was more seriously affected by the effluent from sewage treatment plants.

But plant upgrades since then

have led to a significant improvement in water quality, making the Grand a more hospitable place for mussels.

Still, the researchers are concerned that the growing pressures of urbanization and agriculture may slow or stop the improvement in water quality that has taken place in recent years.



Water supply: enough to go around



The riches of the Grand River valley were obvious to the pioneers when they settled here in the early 1800s.

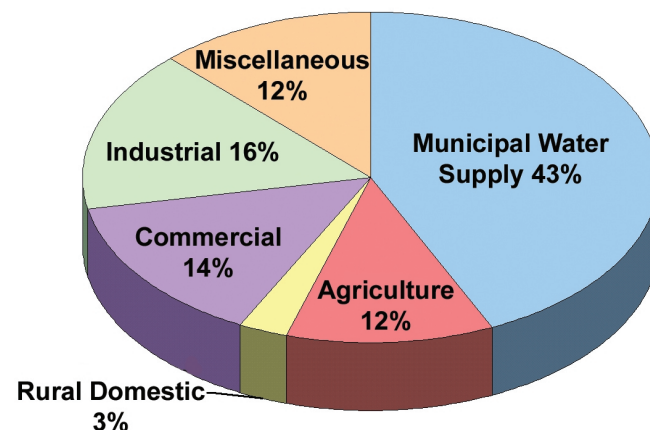
One of the greatest of its blessings was the abundant water supply provided by the Grand River and the aquifers below the surface.

The surface and groundwater resources of the Grand River support a population of more than 800,000 people, thriving businesses and a farm community called an "agricultural nirvana" because of the quality of the soil, the favorable climate and the access to market.

In fact, it is rare in Ontario for so many people to be so dependent on an inland river and groundwater. Most major cities in the province, such as Toronto, Hamilton, London and Windsor, rely on water from the Great Lakes.

Overall, about 80 per cent of the water used in the Grand River watershed comes from municipal and private wells. The remaining 20

How Water is Being Used in the Grand River Watershed



per cent comes from surface water, principally the Grand River. (Cayuga and Caledonia get their municipal water from Lake Ontario, while Dunnville gets its water from Lake Erie.)

In most cases, a municipality, business or individual who wants to use a large amount of ground or surface water must get a permit from the Ontario Ministry of Environment. This is called a Permit To Take Water.

In the Grand River watershed there are more than 800 active permits allowing the holders to take a total of about three million litres of water each day. (Not every permit holder takes the maximum amount all of the time. Consumption is affected by weather, the season and other factors.)

Municipal systems top water users

Municipal water systems account for the largest single use — about 43 per cent of the water takings. Most of this is groundwater, taken by Guelph, Waterloo Region and the towns and villages throughout the watershed. Two communities — Brantford and Ohsweken in the Six Nations Territory — take their water solely from the Grand River.

There are thousands of private wells throughout the watershed serving individual homes, farms and businesses. Permits are not needed for residences or for watering livestock.

Industrial uses, such as gravel pit operations and factories with their own water supply, account for 16

per cent of water use. Golf courses are the largest commercial user, with water bottlers and other businesses also fitting into this category; total commercial use is about 14 per cent.

Agricultural uses for irrigation add up to about 12 per cent of the water used.

However, there are two important points about irrigation. First, much of the irrigation is concentrated in the sandy regions of Brant, Oxford and Norfolk counties in the southwestern portion of the watershed. Second, most of the irrigation tends to take place during July and August, so that can put a heavy demand on the aquifers and streams (such as Whiteman's and McKenzie Creeks) that flow through the sand plain. At its peak, agricultural use can occasionally be as great as municipal use.

While the water resources of the Grand River watershed have served us well, two critical issues have to be addressed if we are going to continue to count on them.

Country	Domestic Use (litres/day/capita)
United States	382
Canada	343
Italy	250
Sweden	200
France	150
Israel	135

Big water users

Canadians use more water than residents of almost all other industrialized countries.

Water quantity facts

Water Supply

- ❑ About 80 per cent of the water used in the Grand River watershed comes from wells.
- ❑ Canadians are among the greatest users of water in the world: 343 litres per person a day.
- ❑ Domestic water use in Canada rose five per cent between 1996 and 1999.
- ❑ Many municipalities in the Grand watershed have water conservation and outside water use programs.
- ❑ In the City of Waterloo, part of Waterloo Region, conservation efforts cut domestic water use by 13 per cent between 1991 and 1999.
- ❑ Surface water enters the ground through loose or sandy soils to recharge groundwater systems. In the Grand River watershed about 80 per cent of the recharge takes place in 30 per cent of the territory.

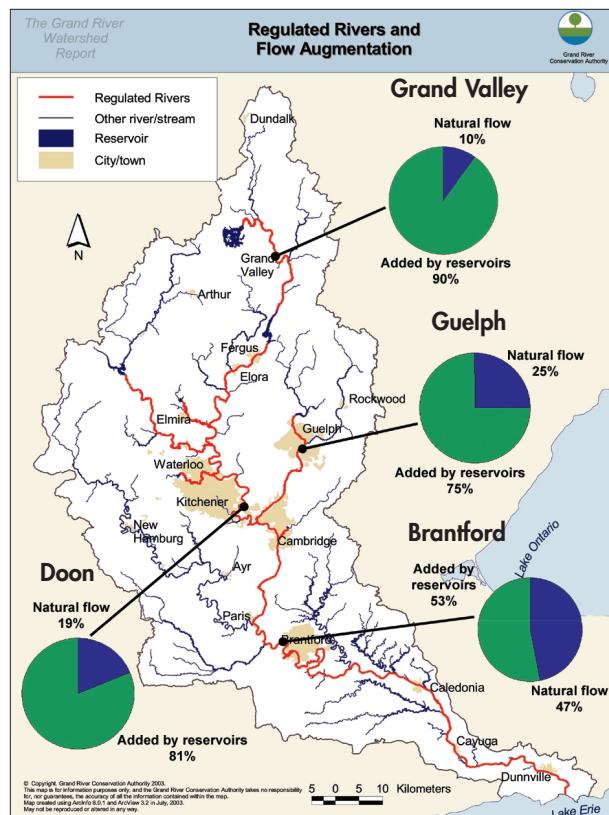
Flooding

- ❑ Many cities and towns in the Grand River watershed are located in the floodplain, making them susceptible to high water.
- ❑ A series of floods in the early 1900s led to the construction of a network of reservoirs to hold back spring runoff and reduce flood damages.
- ❑ The current value of all the reservoirs, dikes and other flood control structures is estimated to be about \$250 million.
- ❑ Flood control structures, flood forecasting and warning programs have reduced annual flood damages by about \$5 million a year.
- ❑ There are about 8,800 structures in the floodplain of the Grand river and its tributaries, which means there is still a high potential for damage during a flood.

Drought

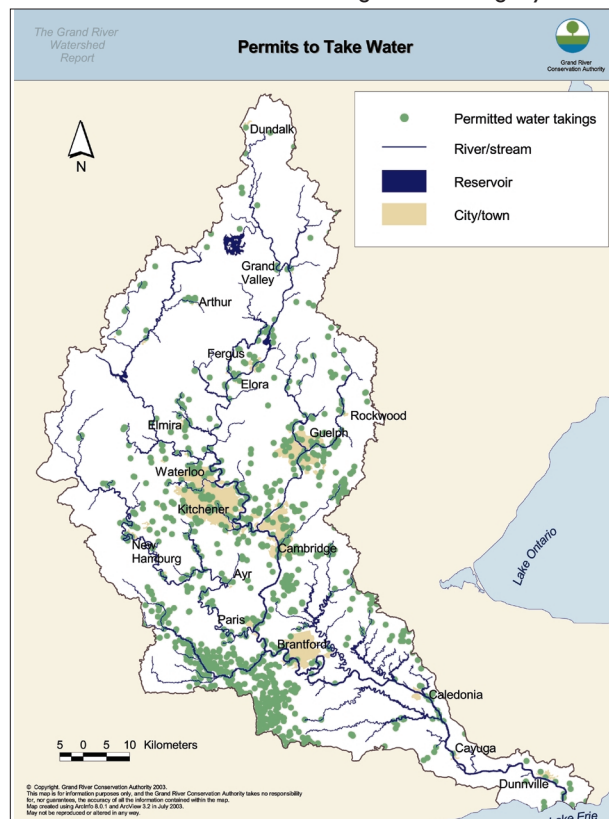
- ❑ During a drought in the 1930s, the flow of the Grand River through Kitchener was about one cubic metre per second.
- ❑ Using water from its reservoirs, the GRCA is able to maintain a flow of about 10 cubic metres per second through Kitchener. It maintains a flow of 17 cubic metres per second through Brantford, which gets all of its drinking water from the Grand.
- ❑ In 2002, when conditions were similar to the 1930s, there were times when 95 per cent of the water flowing in the Grand at Kitchener was coming from GRCA reservoirs.
- ❑ Conservation measures to respond to the low water situation in 2002 were adopted by farmers, golf course operators, gravel pit operators and municipalities.





Keeping the rivers flowing

These pie charts show the proportion of natural flow and reservoir water in the Grand and Speed Rivers at key locations in the watershed during recent drought years.



Watertaking permits

There are more than 800 active watertakings in the watershed. They include municipalities, farm irrigators, golf courses, aggregate producers and industry.

First is the amount of water we use. Second is coping with issues raised by the high rate of population growth and agricultural intensification.

Canadians are among the greatest users of water in the world. In fact, only the U.S. uses more water per person, than Canada.

One reason is that Canadians pay less for their water than residents in most other industrialized countries, says a report by researchers at the University of Victoria in British Columbia. ("Flushing the future? Examining Urban Water Use in Canada," Oliver M. Brandes with Keith Ferguson)

The report says the average Canadian served by a municipal water system uses about 343 litres of water a day. That's double the rate in most of Europe where consumption is about 150 to 200 litres per day.

And while water use is steady, or even shrinking, in many countries, it has been rising in Canada. The study found that domestic water use rose five per cent per capita in Canada between 1996 and 1999.

However, there is good news from the Grand River watershed. Perhaps because the urban and rural communities of the watershed rely on a limited supply of water, there has been a greater emphasis on water conservation here.

Several municipalities have implemented water conservation programs targeting outdoor water use and to encourage use of low-flush toilets.

For example, the Region of Waterloo, which is heavily dependent on groundwater, has a program to reduce water consumption by about 10 per cent by 2009.

It has promoted toilet-replacement programs for several years.

Most recently it targeted the village of Ayr where about 700 new toilets were installed, which save as much as the total water used by 100 households.

Conservation efforts have produced significant results in another part of Waterloo Region, too. The University of Victoria study ranked 20

Canadian cities on their water use and found that the City of Waterloo is one of the most efficient in the country.

In Waterloo, residential water use totals just 215 litres per person per day, which puts the city seventh from the top on the national list. That compares to the Ontario average of 290 litres per day and a national average of 343 litres per day. (By comparison, the average residential consumption in the top city in the survey was Charlottetown at 156 litres per person. At the other end of the scale, residential water use in St. John's, Nfld. was 659 litres per person per day.)

The study also found that domestic consumption in the City of Waterloo dropped about 13 per cent between 1991 and 1999.

In Guelph, a water conservation program has resulted in savings of almost 50 litres per person per day as a result of reductions in residential, industrial and institutional settings.

Reducing water use

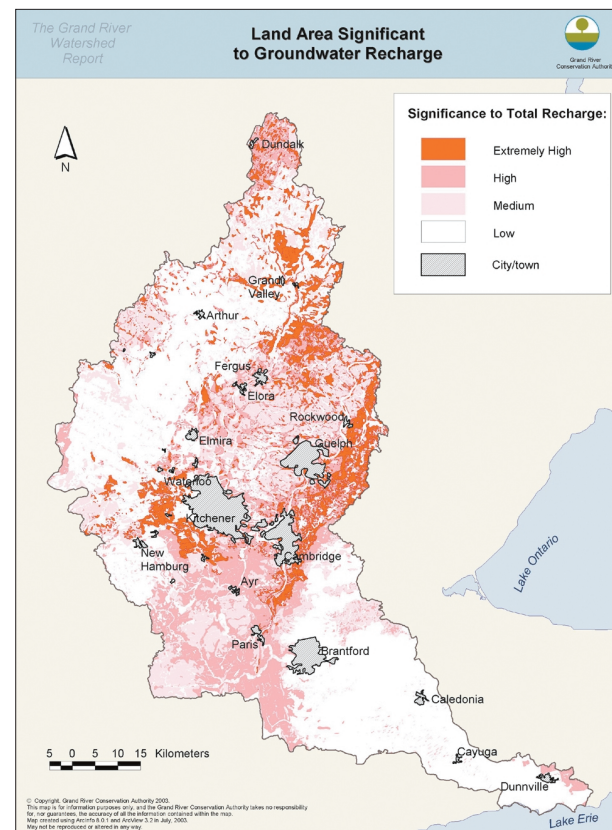
Most urban areas in the watershed are covered by outdoor water use bylaws governing lawn watering, car washing and other uses. Waterloo Region, Guelph-Eramosa Township, Brantford, Brant County, Fergus, Elora, Oxford County, Haldimand County and Hamilton all have bylaws.

These programs can produce dramatic results. During 2002, amid a dry spell that lasted about two months, the City of Guelph imposed a ban on lawn watering. The city found that water consumption dropped about 30 per cent during that time.

One reason that conservation is so important in the Grand River watershed is because of its high rate of growth.

The watershed has a population of more than 800,000 people and is adding another 100,000 every decade, with most of the growth concentrated in the major cities of Guelph, Waterloo, Kitchener, Cambridge and Brantford.

These cities also happen to



Groundwater recharge

When snow melts or rain falls, some of the water makes its way into the ground where it recharges wells and feeds coldwater springs. Soils that are loose and sandy let more water into the ground. The areas marked in red on this map are the places that are the most important when it comes to groundwater recharge. In the Grand River watershed, about 80 per cent of the groundwater recharge takes place in 30 per cent of the territory.

be located near the richest groundwater sources in the watershed.

The central part of the watershed is covered with moraines – hills made up of loose soils with high levels of sand and gravel.

When snow melts or rain falls, the water soaks into the ground, which feeds, or "recharges" the aquifers below ground.

Some of the water feeds shallow aquifers and eventually feeds coldwater springs, or seeps directly into rivers and streams, providing them with a source of cold, clear water, even in summertime.

The rest of the water makes its way into deeper aquifers, where it feeds the municipal wells serving Guelph, Kitchener, Waterloo, Cambridge and many other communities.

In fact, about 80 per cent of the groundwater recharge

takes place in just 30 per cent of the land area of the watershed. Thus, it is important that the functions of these moraines and sand plains be preserved in the future if the groundwater and surface water systems are to be protected.

Each of the major cities of the watershed is growing into a major recharge area. How do we deal with this, with all of the pavement and drainage associated with urban development?

We can either learn how to build our communities so that the water continues to enter the ground and that it goes in as clean as it can be. Or we can develop our cities in another direction.

The water resources of the Grand River watershed have made this region one of the richest, most dynamic parts of Canada.

If that is to continue, they will have to be used wisely.





Galt in the 1930s

Flooding was so common in the first half of the 20th century that many people took the small ones in stride.

Floods: constant effort required to reduce impact

Every spring, residents of the Grand River watershed turn a cautious eye to the closest river or stream, watching and wondering if this will be the year when there's another big flood.

The Grand River system is prone to flooding. The size and shape of the watershed, its soil types, the size of the cities, the amount of farmed land, the loss of wetlands – all of these make flooding a possibility every year.

Floods in the Grand River watershed always carry with them the threat of significant danger to people and property.

That's because many of our largest communities were built in the floodplain of the Grand and its tributaries. The founders of Elora, Cambridge, Brantford, New Hamburg, Dunnville and other communities picked their town sites because they were close to rivers providing water, transportation and power for industry.

Over the years, other human activity has made the problem worse. We have so transformed the Grand River watershed that many of the natural systems, which would have moderated the frequency and severity of floods, no longer exist.

Before the watershed was opened

to European settlement two centuries ago, it was a land of forests and wetlands. However, within a few generations, the forests were cut down, many of the wetlands drained or filled, with cities and farm fields covering the land.

The impact has been dramatic. The lack of forest cover means the winter snows melt sooner, allowing the water to rush off the land in a shorter period of time. Summer rain falls directly onto the ground, rather than onto a canopy of leaves.

Rural drains carry water off the fields, so it no longer sits in low spots or soaks into the ground. Most of the marshes and swamps are gone and so is their function as natural reservoirs.

Urban growth adds to flooding

Last, but not least, there is the impact of urban development. Water rushes off paved streets into storm sewers and then into the river. Our cities have crowded the river, reducing the number of places where it can safely overspill its banks.

The effects of these changes in the landscape started to be felt in the late 1800s and early 1900s.



Brantford in May 1974

Much of Brantford was inundated in May 1974, one of the worst floods to hit the watershed. This area, in the Eagle Place neighbourhood of Brantford, is now protected by dikes.

Floods occurred more often and the floodwaters would rise higher and higher. Some cities were visited by devastating floods every couple of years.

Floodwaters in 1929 damaged bridges and flooded a mile of Water Street in Cambridge (Galt). Damage to industrial buildings in Guelph was set at hundreds of thousands of dollars. The Penman factory in Paris was flooded and a house demolished. In Brantford ice floes were scattered through the lower parts of the city and the waterworks were damaged.

The costs of the floods and the cost of building dikes and other protective works rose year after year. In the 1930s, the people of the watershed looked for better ways to deal with the problem.

The increasing frequency and severity of flooding led to the creation of the Grand River Conservation Commission in 1938. One of its first major projects was the construction of the Shand Dam, upstream of Fergus. This dam was designed with two functions in mind: first, to hold back the spring floodwaters and reduce damages and, second, to store that water until the summer so it could be released slowly to keep the river flowing.

However, spring isn't the only

season for floods. Hurricane Hazel swept through southern Ontario in October 1954. Hundreds of houses and businesses in the Grand River watershed were inundated.

Following Hurricane Hazel, the construction of dams and reservoirs took on a new urgency. Luther Dam, near Grand Valley, was completed in 1952, followed by Conestogo Dam, near Drayton, in 1958. The program continued with Woolwich Dam (Elmira) in 1974 and Guelph Dam in 1976. Several other smaller reservoirs were added near Damascus, Waterloo and Cambridge during the 1960s and 1970s.

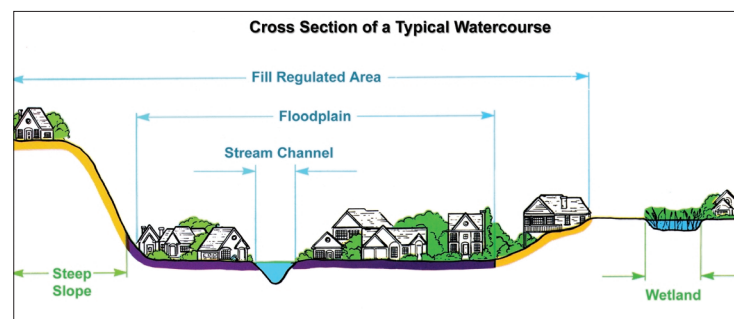
The reservoirs were strategically sited in the areas which contribute

most of the floodwaters.

The landscape of the northern and western side of the watershed is marked by dense, clay soils. During spring runoff and rainstorms, water runs off this land quickly, feeding the Conestogo, Upper Grand and Speed Rivers.

By the time all of these rivers converge in Kitchener and Cambridge, flows in the main channel of the Grand can rise a great deal in a very short period of time.

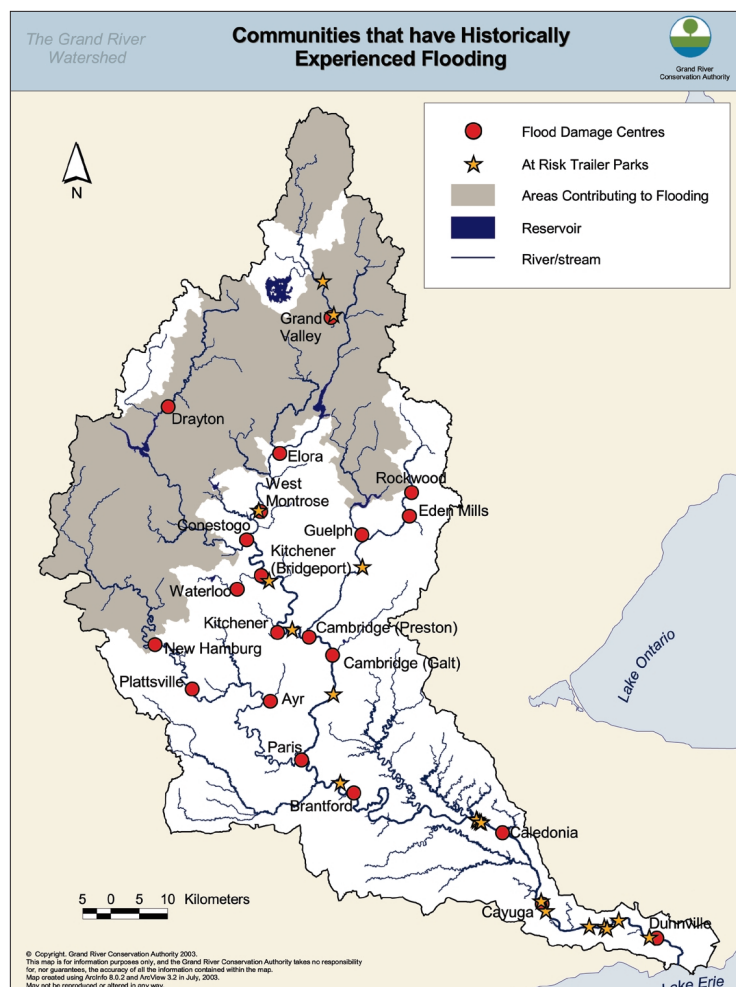
The reservoir network plays a critical role in protecting the Grand River watershed. During the spring, the reservoirs are filled up with snowmelt and rainwater. In some cases, floods can be avoided altogether; in others, damages and the



The floodplain

Many communities in the Grand River watershed are built in the floodplain, making them vulnerable to high water.





At risk

Almost every corner of the watershed has experienced floods over the years. The areas marked in grey are areas with dense soils, which contribute a lot of runoff to the Grand River system.

extent of flooding can be reduced.

Over the summer, the water is gradually released to maintain minimum flows in the river. By the fall, they again have plenty of storage capacity available to deal with a hurricane or other major storm.

Dikes play an important role in limiting flood damages, too. Some communities started building dikes in the 1800s and early 1900s. Many of the older dikes do a good job of dealing with the normal rise of water in the spring, though they are not high enough to deal with floods of the magnitude that would accompany a hurricane.

New dike systems, such as those build in Brantford and Cambridge (Galt) during the 1970s and 1980s were designed to withstand a storm of that size, which is called a "regional storm." In some cases, river channelization projects, which allow the river to carry more water, are done in conjunction with dike construction.

Other ways to limit damages

Dikes and dams are the "structural" answers to flood protection. In addition, there are "non-structural" ways of dealing with flooding.

First, there are limitations on construction in the flood plain, which is defined as the area that would be flooded in the event of a "regional storm" of the magnitude of Hurricane Hazel.

About 10 per cent of the land area of the watershed is in the floodplain. In most places, construction of new buildings in the flood plain is banned, and there are some limitations on renovations to old ones. In cities where new dike systems have been built in recent years, some construction is allowed in protected areas.

Second, the GRCA has developed a sophisticated flood forecasting system. Every day of the year, the GRCA gathers information

from weather forecasts, seven manual and 14 automated weather stations, 36 river level stations and regular field surveys of snow buildup and soil conditions. This information is fed into a computer model of the watershed and used to predict when, where and how high the rivers will get.

With that information, the GRCA can issue flood warnings to watershed residents and municipalities, who can then take appropriate action to protect themselves and their property.

Annual savings total \$5 million

Over the years, the investment in flood protection works, the forecasting model and the warning system have been considerable. The value of all the river works — dams, dikes, channelization projects, etc. — is about \$250 million in current dollars.

However, the investment pays off every year in reduced property damage and reduced threat to human life. In property damage alone, the GRCA estimates that the flood protection system reduces annual property damages by more than \$5 million. And that's to say nothing about the potential loss of life and health risks to entire communities that could accompany a major flood.

Although planning controls limit the number of new buildings that can be constructed in the flood plain, there are more than 8,800 older buildings that remain vulnerable.

There are new issues to deal with, too. A new complication is

Upper Tier Municipality	Number of Structures
City of Brantford	3,742
City of Hamilton	36
County of Brant	475
County of Oxford	220
County of Perth	25
Dufferin County	187
First Nations	1
Grey County	13
Haldimand County	1,003
Norfolk County	3
Regional Municipality of Halton	9
Regional Municipality of Waterloo	2,685
Wellington County	1,483
TOTAL	8,882

Flood plain structures

There are more than 8,800 structures in the flood plain of the Grand River and its tributaries, which means the potential for damage in a major flood remains high.

the number of seasonal and recreational facilities that have been developed in the floodplain.

As the Grand has been revitalized over the past decades, it has become a more inviting place to visit and play. That means there are more seasonal and recreational facilities, such as trailer parks, golf courses and playgrounds in the floodplain.

For all that has been done over the generations to cope with flooding, the threat is — and always will be — a concern in the Grand River watershed.

First, there are watercourses that do not have reservoirs, such as the Nith and Eramosa Rivers. Indeed, some smaller watercourses can be brought to flood conditions by local, isolated summer storms.

Second, ice jams are a threat throughout the watershed. A major ice jam in Brantford in 1996 brought the Grand River to within a foot (0.3 metre) of the top of the dike. About 5,000 people were

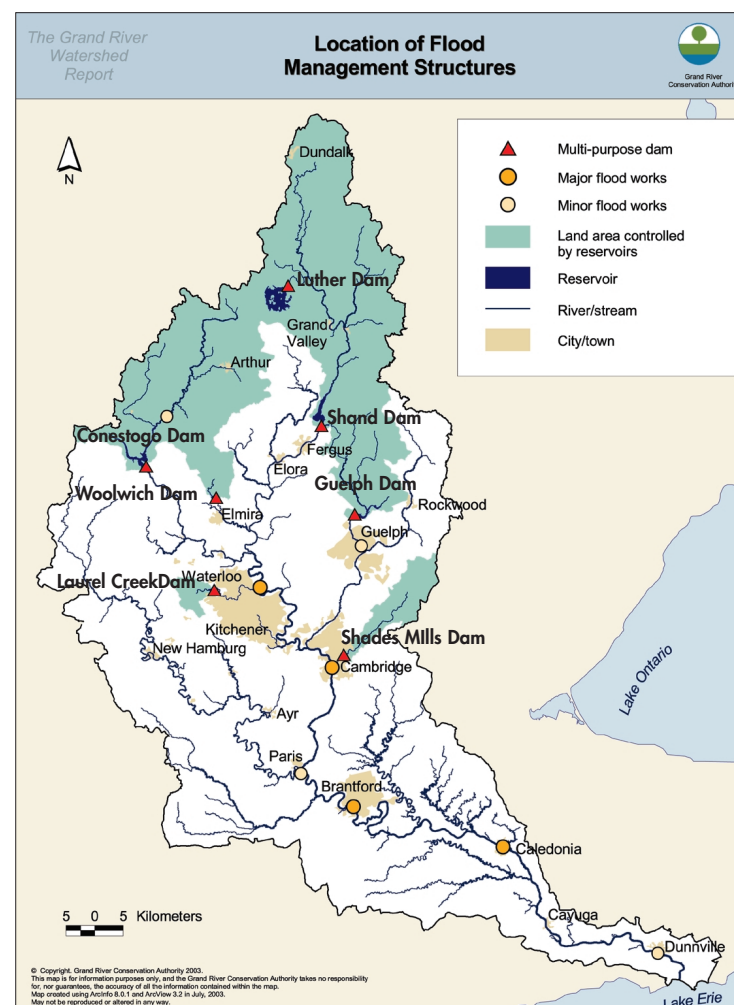
preparing to evacuate when the ice jam receded.

Third, there is always the risk that something could break down. Most of the older dikes in the Grand River watershed have failed at one time or another and there is always the possibility it could happen again.

Finally, there is always the unknown. The best flood protection works in the watershed are built to handle the kind of storms that hit every 100 years or so. But what if a storm of even greater magnitude were to strike?

The residents of the Grand River watershed have wrestled with flooding issues for more than a century. The dikes, dams and forecasting systems offer a high degree of protection to the people and their property.

But the risk of flooding will always remain and so too will the jobs of predicting, warning and protecting.



Keeping back the waters

Reservoirs and dikes are some of the tools used to control flood damages in the Grand River watershed. The reservoirs capture the water coming from the areas shaded in green.



Drought: watershed is ready to handle low water conditions

There were days, during the long hot summer of 2002, when it seemed like it might never rain again.

July and August of last year were among the driest months on record in most of the Grand River watershed. During the last two weeks of August, GRCA weather stations near Fergus, Elmira, Waterloo and Cambridge recorded only a few millimetres of rain — hardly enough to wet down the dust.

And the dry summer of 2002 was just one in a string stretching back to 1997. During that time, precipitation across the watershed was down considerably. At Shand Dam, near Fergus, total precipitation over that period was down about 11 per cent, which translates into about

600 mm (two feet) of rain. That shortfall is equivalent to about eight months worth of rain.

The recent drought has had an impact on watershed residents and businesses.

Most cities have imposed controls on outside water use, such as lawn watering and car washing. Businesses such as gravel pits and golf courses have reduced their water use. Farmers, particularly those working the sandy soils of Brant and Oxford counties, were asked to reduce the amount of water they were using for irrigation. Anglers were asked to stop fishing in coldwater streams such as Mill Creek (Cambridge) and Whiteman's Creek (Brant).

This wasn't the first time the

Grand River watershed has been hit by a drought of this length and severity. There were similar droughts in the 1930s and the 1960s.

But what sets the latest episode apart from the earlier ones is that the GRCA and the people of the Grand River watershed were far better prepared to deal with the most serious implications of water shortages.

The Grand River never stopped flowing in 2002, in contrast to the 1930s when that's exactly what happened.

Hugh Templin wrote about the drought of the 1930s in an article published in Maclean's Magazine on Jan. 1, 1937.

The Grand River itself stopped flowing between its source, near Dundalk, to Fergus, about 80 kilometres.

In Kitchener, the flow was reduced to less than one cubic metre per second, compared to springtime flows hundreds of times higher.

Reservoirs built to store water

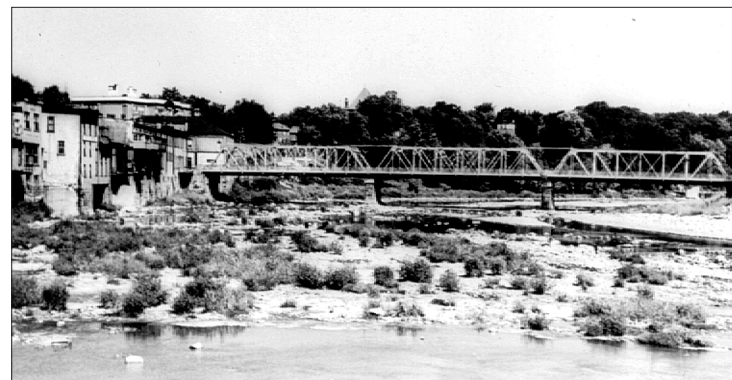
The drought of the 1930s inspired the residents of the Grand River watershed to take action.

The Grand River Conservation Commission (the forerunner of today's GRCA) was formed in 1938. As its first major project it built the Shand Dam near Fergus, creating Belwood Lake which was designed to store spring runoff for release gradually over the summer months.

From the 1950s to the 1970s major reservoirs were built at Luther Marsh, Conestogo Lake and Guelph Lake. Smaller reservoirs were also added in Waterloo, Elmira, and Cambridge.

The reservoirs are operated to ensure that minimum flow targets are met at key spots.

One goal is to ensure there is enough water in the river to properly receive the effluent from municipal sewage treatment plants. The other goal is to make sure there is enough water to allow Brantford and Ohsweken to take the water they need for their communities.



Paris in the summer

The Grand River dried up to a trickle along much of its length in 1936. Although 2002 was equally dry, the rivers continued to flow with water from GRCA reservoirs.

The network was put to the test in 2002. At times during the summer, about 95 per cent of the water flowing through the Grand at Kitchener came from GRCA reservoirs. At Brantford, reservoir water accounted for more than 80 of the Grand River's flow. In Guelph, the reservoir produced 75 per cent of the flow in the Speed River.

The GRCA was able to maintain flows of about 10 cubic metres per second through Kitchener during 2002. (That is about 10 times the flow in the river noted by Templin during the drought of the 1930s.)

Other steps were taken in 2002 to respond to the recent drought. For example, farmers in the Whiteman's Creek area, near Brantford, formed an irrigation advisory committee to make best use of the available water. Golf course operators, gravel pit owners and others adapted their water use strategies to share the burden.

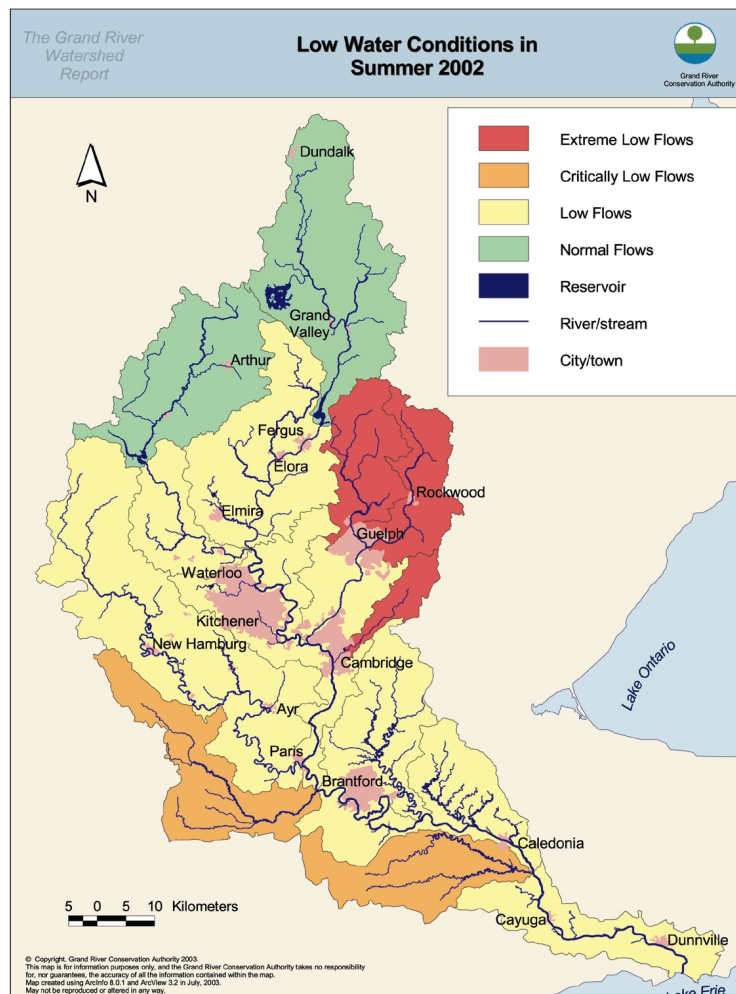
Although the drought was most noticeable in low flows in the rivers

and streams, it is important to involve well users in drought response plans, because there is a strong relationship between the surface water and groundwater systems of the watershed. Some groundwater leaves the ground through springs that feed rivers and streams helping to maintain base flows in the watercourses. Low streamflows are a good indicator of low groundwater levels.

This year, 2003, has been wetter than 2002, but that doesn't mean the effects of the drought are over.

Much of the rainfall in the summer of 2003 came from short, localized cloudbursts. In these kinds of storms, water will run off quickly, raising river levels but not contributing much to the groundwater system.

And given the deficit of the last five years, it may take months or even a few years of wet weather to restore some groundwater systems to normal levels.



Low water conditions

Most parts of the Grand River watershed were affected by low flow conditions in 2002. This map shows the conditions in different sub-watersheds.



Ready for summer

Guelph Lake reservoir is part of the network of reservoirs maintained by the GRCA to store water in the spring for release during dry periods of the summer.



The changing landscape of the Grand River watershed



These two photos show some of the changes that have taken place in the Grand River watershed over the past century. These pictures show a road intersection east of Rockwood. The picture on the left shows a relatively treeless area and was taken about a century ago. The one on the right, taken during the 1990s, shows the new tree growth that has taken place as a result of reforestation and natural regeneration.
(Photo at right courtesy of Virgil Martin)

Land resources: key to healthy watershed

There is more to a watershed than water. Much more. The health of a river is intimately tied to the health of the natural areas surrounding it – the forests, wetlands, hills and fields that shape the river, define it and give it direction.

The characteristics of the land also determine, to a large extent, the amount and quality of the water in the river.

We have learned in the Grand River watershed what can happen to a river when the landscape is radically reshaped. Unless we guard the land, we have little chance of protecting the river.

When the first European settlers

arrived in the Grand River valley about 200 years ago, they found a landscape that had been sparsely settled.

Forests and wetlands covered most of the watershed. In the middle regions — Waterloo, Brant, Norfolk and Haldimand — stretches of savannah and prairie grassland interrupted the deciduous forest.

It was a particularly rich and varied landscape. The Grand River watershed is long enough that it stretches through two major forest zones.

The northern half, above Cambridge, is part of the Great Lakes-St. Lawrence zone. Here can be found plant and animal species

that have reached the southern limit of their range with forests featuring sugar maple, white ash, eastern hemlock, white pine and eastern white cedar.

South of Cambridge, the moderating effect of the Great Lakes allow species to thrive that are typically found in the Carolinas in the U.S. In the Carolinian zone, along with maples and ash, can be found Carolinian species such as black walnut, oaks, hickories and even uncommon species such as sassafras and sycamore.

However, when the settlers looked at the highly productive land they understandably saw the forests and wetlands as a source of

raw materials to be harvested or a hindrance to their plans to farm the land. They struggled over generations to clear the forests and drain the wetlands.

By the end of the 19th century, the transformation from forest to farmland was virtually complete. Only an estimated five or six per

cent of the watershed remained under forest cover. It had been pushed back from all sides, leaving a patchwork of thousands of small, isolated woodlots and fencerows. The only large blocks of forest remaining were in those areas that were too wet, too hilly or too rocky to farm.

Land resource facts

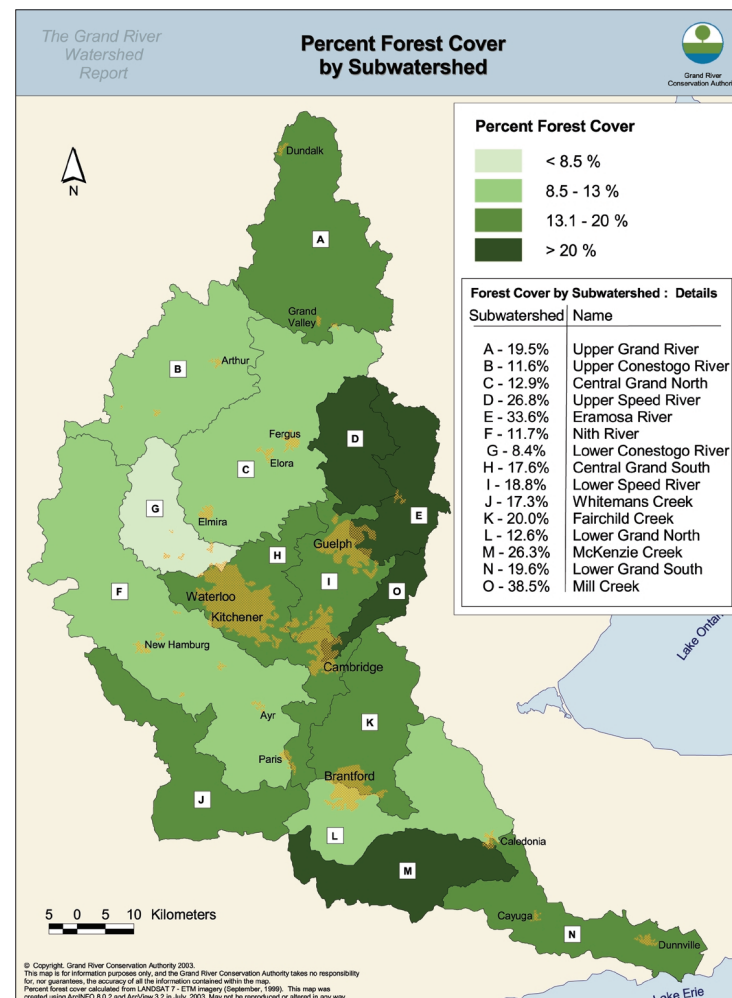
- ❑ Early settlers cleared away most of the Grand River forest. By the end of the 19th century only about five or six per cent of the forest remained.
- ❑ About 65 per cent of the wetlands across the watershed were eliminated. In some areas, wetland loss reached 85 per cent.
- ❑ The loss of forest cover resulted in the loss of some species, such as wolf, black bear, cougar, bobcat and lynx.
- ❑ The Grand River watershed makes up less than one per cent of the land area of Ontario but is home to 37 per cent (80 species) of the at-risk species in the province.
- ❑ The shortage of "big block"

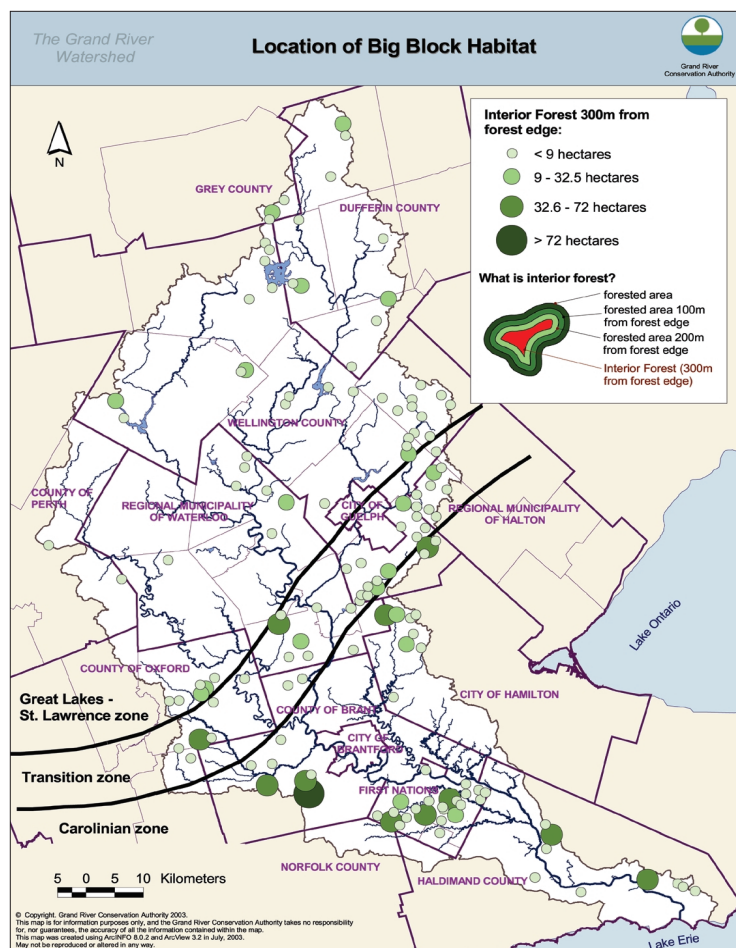
forests in the watershed accounts for some of the threats to plant and animal species that need lots of territory and the cooler, darker and more remote area of a forest interior.

- ❑ The GRCA has planted more than 26 million trees in a reforestation effort dating back 60 years.
- ❑ The GRCA owns 4,115 hectares of naturally forested property and has assisted with the reforestation of 8,500 hectares, including 5,500 hectares of GRCA land and 3,000 hectares of private land.
- ❑ Less than three per cent of the watershed consists of publicly owned forest. Another seven

per cent of environmentally sensitive land, much of it private, is protected by municipal regulations.

- ❑ As a result of reforestation efforts and natural regeneration about 19 per cent of the watershed is now forested. Environment Canada recommends that a healthy watershed have 30 per cent forest cover.
- ❑ Vegetation along a river or stream helps water quality but only about 26 per cent of the river banks in the Grand watershed are vegetated.
- ❑ Urban trees are recognized as a way to combat pollution, cool neighbourhoods and keep cities quieter.





A shortage of big blocks

When the Grand River watershed was cleared in the 1800s, few big blocks of forest remained. This had a significant impact on water quality and flows, and also on wildlife that need interior forest space that is at least 100 metres from the outside edge.

In most places, trees and vegetation were cut down right to the water's edge – an area known as the "riparian zone" – eliminating an important buffer between field and stream. Riverside trees shelter water against the hot summer sun, keeping the water cooler. Vegetation soaks up nutrients, preventing them from entering the water. Trees and bushes also hold the soil in place, reducing erosion. When the natural vegetation in the riparian zone is reduced, it can lead to warmer, siltier and more polluted water.

The loss of wetlands was dramatic, too. Wetlands are an especially rich environment, supporting a wide variety of plant and animal species. They also play an important role in watershed health, by filtering polluted water and by holding back water that would otherwise fill the river in the spring. Since settlement began, about 65 per cent of the watershed's wetlands have disappeared, with the figure rising as high as 85 per cent in some areas.

Loss of habitat affects species

With the loss of forest and wetland habitat in the 1800s, many wildlife species requiring large expanses of forest disappeared, including the timber wolf, black bear, cougar, bobcat and lynx. Other species survived, but just barely – southern flying squirrel, eastern mole, Jefferson's salamander, and a whole group of forest birds such as the Acadian flycatcher and the prothonotary warbler. Tree and plant species that were already rare, became more so.

The effects were felt by the human inhabitants of the watershed, too. Fresh coldwater springs that had been a reliable source of water soon dried up after forest clearing. As the frontier expanded northward into the swampy headwater areas, flow in the tributaries of the Grand was drastically affected.

Spring floods grew more menac-

ing and more frequent and during summer the river was often reduced to a trickle.

By the 1930s, it was no longer possible to count on the river for much, except as a place to dump barely-treated sewage. This led to health concerns in river communities, particularly those, such as Brantford, which draw water from the river.

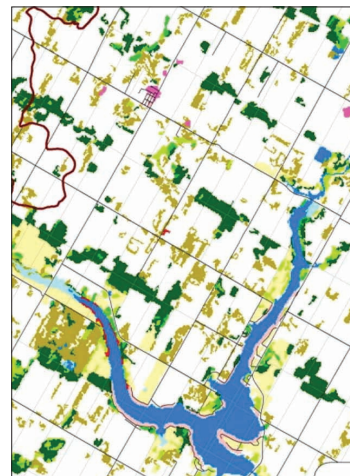
The effects of water shortages and soil erosion were felt on watershed farms. Some farmers abandoned their properties, which were soon taken over by local municipalities where they became the site of reforestation efforts.

In the 1930s and 1940s serious efforts began to be made to increase forest cover through active reforestation. In addition, the Grand River Conservation Commission – a forerunner of the GRCA – was created to address water supply issues.

It also became involved in reforestation programs as one way to restore some natural balance to the river system.

Over the years, the GRCA has played a significant role in the reestablishment and management of

forested areas. The GRCA owns 4,115 hectares of naturally forested property and has assisted with the reforestation of 8,500 hectares, including 5,500 hectares of GRCA



The Back 40

In most of the watershed, the only remaining stands of trees are the woodlots often found along the back edges of farm properties. The pattern shows clearly in this map of the Conestogo Lake region.

Species at risk in the Grand watershed

Because of its size and location, the Grand River watershed is home to a large number of species-at-risk.

It makes up less than one per cent of Ontario yet is home to 37 per cent (80 species) of the at-risk species in the province.

Here are some of them.

Mammal - American badger

Location: Brant, Haldimand, Norfolk

Causes for concern:

Habitat fragmentation, reduction in prey, increase in agriculture, isolated from other populations.

Population: Up to 200 individuals in southwestern Ontario.



Amphibian - Jefferson Salamander

Location: Most of the Grand watershed

Causes for concern:

Loss of wetlands and destruction of forests; killed on roads during migration

Population: Unknown



Bird - Acadian flycatcher

Location: Brant, Haldimand, Norfolk, Hamilton, Oxford, Waterloo

Causes for concern: Loss of habitat due to urban and rural development

Population: About 20 to 30 pairs



Fish - Eastern sand darter

Location: Brant, Haldimand, Norfolk, Oxford

Causes for concern: Siltation, dams preventing migration

Population: Small number

Plant - Red mulberry

Location: Halton

Causes for concern: Habitat loss, small populations, hybridization with white mulberry, twig blight

Population: 200 trees

Reptile - Black rat snake

Location: Brant, Haldimand, Norfolk, Wentworth

Causes for concern: disturbance of winter hibernation areas

Population: Unknown



land and more than 3,000 hectares of private land.

The GRCA has planted more than 26 million trees over the years. Municipal government, provincial agencies (notably the Ministry of Natural Resources), private industry, service clubs, community groups and individual landowners have all participated in the reforestation of parts of the watershed.

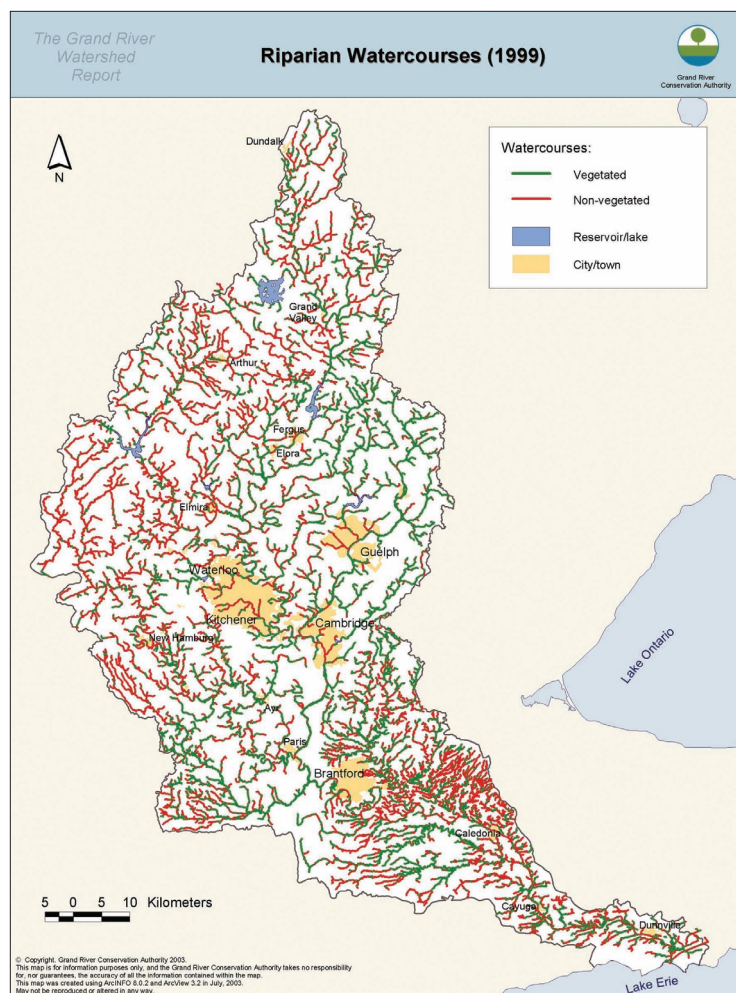
Public role critical in reforestation

In fact, public involvement is a key element of reforestation efforts in the Grand River watershed. Less than three per cent of the watershed consists of publicly-owned forestland. An additional seven per cent, much of it privately owned, is protected by municipal regulations.

That means that continuing the reforestation of the watershed depends a great deal on the involvement of landowners who own unprotected land.

Overall, the extent of forest cover over the past 70 years has increased rather dramatically, due primarily to natural regrowth on abandoned or marginal farmland.





Riparian watercourses

This map shows the extent of “riparian vegetation” in the watershed, which means vegetation along a river or stream. There is little riparian vegetation in the Conestogo River valley and along creeks east of Brantford, creating problems with erosion and runoff. Areas north and east of Guelph still have strong riparian cover, which helps keep the Eramosa and Speed Rivers cool and clean.

At present, about 19 per cent of the Grand River watershed is forested, an increase of three times from what it was in the early 20th century.

That doesn't include what is called the “urban forest,” the trees that line city streets and fill yards and parks. The size and importance of the urban forest is a newer area of scientific investigation, but there is no doubt that trees make cities more livable by moderating water flows, cleaning the air, buffering noise, keeping houses cooler and providing wildlife habitat.

Still, for all of the efforts undertaken in the past century, the forest cover of the Grand River watershed remains far below the 30 per cent forest coverage, which Environment Canada suggests is necessary for a healthy watershed. The recommended level is reached in some parts of the watershed, notably in

the Eramosa River region east of Guelph, but in other parts of the watershed, notably along the western side, the amount of forest cover remains far below the watershed average.

Generally, the watershed forest is highly fragmented, with many small forests and too few linkages between them. In some parts of the watershed, natural forests are confined to low-lying areas, meaning that swamps may be well represented in that area, but upland forests are not.

Only a small number of savannah and prairie areas exist.

Also under-represented are “big block forests” which are defined as forests with an interior that is at least 100 metres from the edge.

There are only about 12 forests in the entire watershed of more than 32 hectares, and only one greater than 72 hectares.

There is also a shortage of “riparian” forest cover, which refers to the forest lining rivers and streams. These play an important role in keeping water cool, preventing erosion and soaking up nutrients before they get into the water.

The Grand River and all of its tributaries have a total of about 22,650 kilometres of shoreline (counting both banks of each river and stream). Of that shoreline, only about 26 per cent is vegetated, and in some areas, the figure is far lower.

The pattern for shoreline vegetation is quite similar to general forest cover. The east side of the watershed, along the Eramosa and sections of the Speed, has retained much of its forest cover, although much of it was pastured up to the mid-1900s. About 52 per cent of the Speed-Eramosa riverbank is still covered with vegetation. (Those areas of the Speed and Eramosa also rate in the “good” category for water quality.)

But the amount of vegetated shoreline is quite low in the western and southern portions. Only 15 per cent of the Conestogo River shoreline is vegetated, and only 21 per cent of the Lower Grand has cover.

Urban growth affects forests

As our cities grow they continue to affect remaining, large forest tracts on their outskirts. In addition, the practice of cutting housing building lots out of forests has resulted in a loss of “interior” forest, threatening those species that need the space, isolation and cooler temperatures associated with a large block of forest. The result is an increase in the proportion of “edge” space – the place where forest meets the field – further favouring species that are already abundant.

For example, red-shouldered hawks, which require interior space,



Shady river, better water

A line of trees and vegetation along the edge of a river, known as the riparian zone, shelters the water to keep it cool, reduces erosion and intercepts runoff from adjacent fields. All of these help to keep river water healthy.

are now rare visitors to the Grand River watershed. In their place can be found red-tailed hawks, which prefer living in an edge habitat. This loss of diversity, in both plant and animal life, has affected virtually every corner of the watershed.

In fact, the Grand River watershed makes up less than one per cent of Ontario yet is home to 37 per cent (80 species) of the at-risk species in the province.

The woodlots being lost today are often high quality, older forests. New, more recently planted forests, are probably decades away from providing the same kind of habitat as those being lost.

Thus, given current trends, remnants of original forest can only hold their ground, at best; more realistically, we can expect they will continue to diminish in area.

Plants that are native to the watershed also face competition from species that have been introduced, deliberately or accidentally, over the past two centuries. The Norway maple, for example, is commonly planted in parks, streets and backyards. In a forest setting,

though, the dense shade it provides can block others species from surviving, including native sugar maples and woodland plants. Similarly, garlic mustard, introduced for culinary use, is now a serious weed in open forests and has taken space away from native spring wildflowers.

More protection for wetlands

Wetlands have been given more protection in recent years by provincial and municipal legislation, as well as a new wetland policy approved by the GRCA in 2002.

However, some wetlands are not covered by legislation or regulations, so wetlands are still being lost, and along with them the important functions they have in cleaning water, reducing flooding and acting as a habitat to numerous plant and animal species.

The watershed forest has made a remarkable recovery during the last two generations, and wetlands now have a greater measure of protection than ever before.

The magnitude of the recovery is even more dramatic when measured against the clearcutting and land use conversion which took place during the 1800s.

From that point of a view, the story is one of success.

But the amount of forest and wetlands we have is not enough to maintain a healthy watershed into the future. From that point of view, the story is one of a great challenge and opportunity for coming generations.

Forests face new threats and old

Disease and insects: Several species have been hit hard by these predators, such as the American elm and the sweet chestnut. (One of the last remaining stands of chestnut is near the GRCA tree nursery in Burford which is re-introducing the trees throughout the watershed.)

Drought: the last five years of drought have caused some direct losses and weakened other trees, leaving them vulnerable to disease and insects.

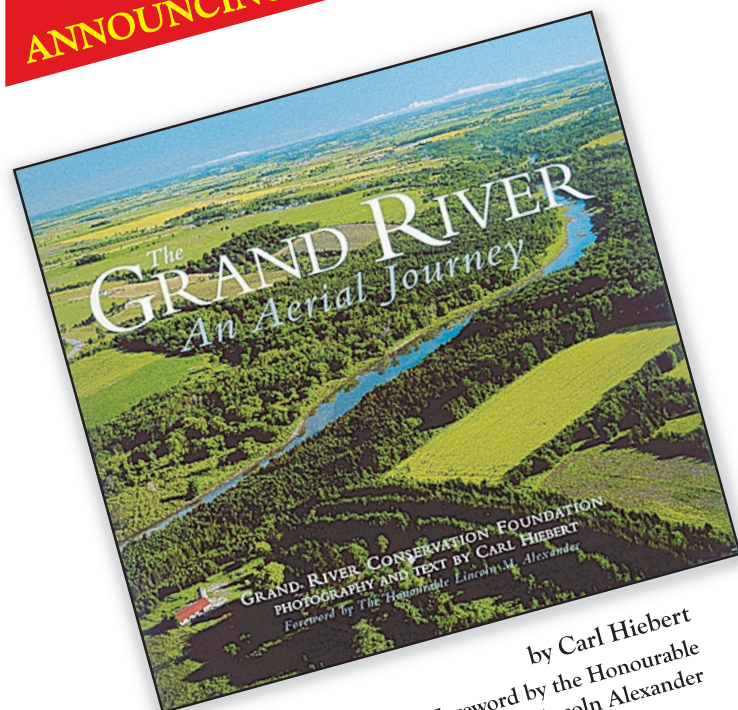
Urban pressures: Road salt, excessive ground-level ozone, high nitrogen levels, compacted soil, altered drainage and acid rain can injure trees or leave them open to attack from insects and disease.





The GRAND RIVER CONSERVATION FOUNDATION

ANNOUNCING



by Carl Hiebert
Foreword by the Honourable
Lincoln Alexander

The Grand River - An Aerial Journey

Special concert and pre-publication offer!

Open any page in Carl Hiebert's new book and you'll see the Grand River as you have never seen it before.

Carl combined his two passions - flight and photography - to gather the 150 images featured in his latest book. Sitting in the open-air seat of his tiny ultralight plane, he flew the length of the river, from Dundalk to Lake Erie, through all four seasons, swooping over treetops and city spires for these special photos.

The pictures show the grandeur of the river and its people from new perspectives, depicting our scenic landscapes, historic sites, cities and towns. Above all, the book celebrates the creativity, passion, work and wit of the people of the Grand.

Published by The Grand River Conservation Foundation, this large format, coffee table-style book is an ideal companion to the Foundation's successful *Grand River Reflections*.

To celebrate the launch of the new book, the Foundation is partnering with the Kitchener-Waterloo Symphony for a concert on Sunday, November 2nd at The Centre In The Square in Kitchener. This concert, entitled *The Cultural Mosaic in Our Community*, will feature slides of Carl's photos in a programme of light classical music that celebrates Waterloo Region's 150 year-long love affair with its music, people, and landscapes.

You have a unique opportunity to listen to the music of the KW Symphony and view exciting images of the Grand River at the same time.

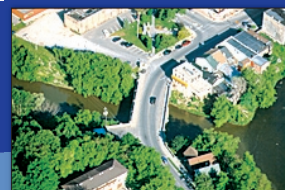
Complete the attached coupon, and enjoy significant savings on this unique book and concert promotion.

Join the Grand River Conservation Foundation and the Kitchener-Waterloo Symphony at 2:30 pm on Sunday, November 2nd, along with author Carl Hiebert who will be available to personally sign your copy of *The Grand River - An Aerial Journey*.

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