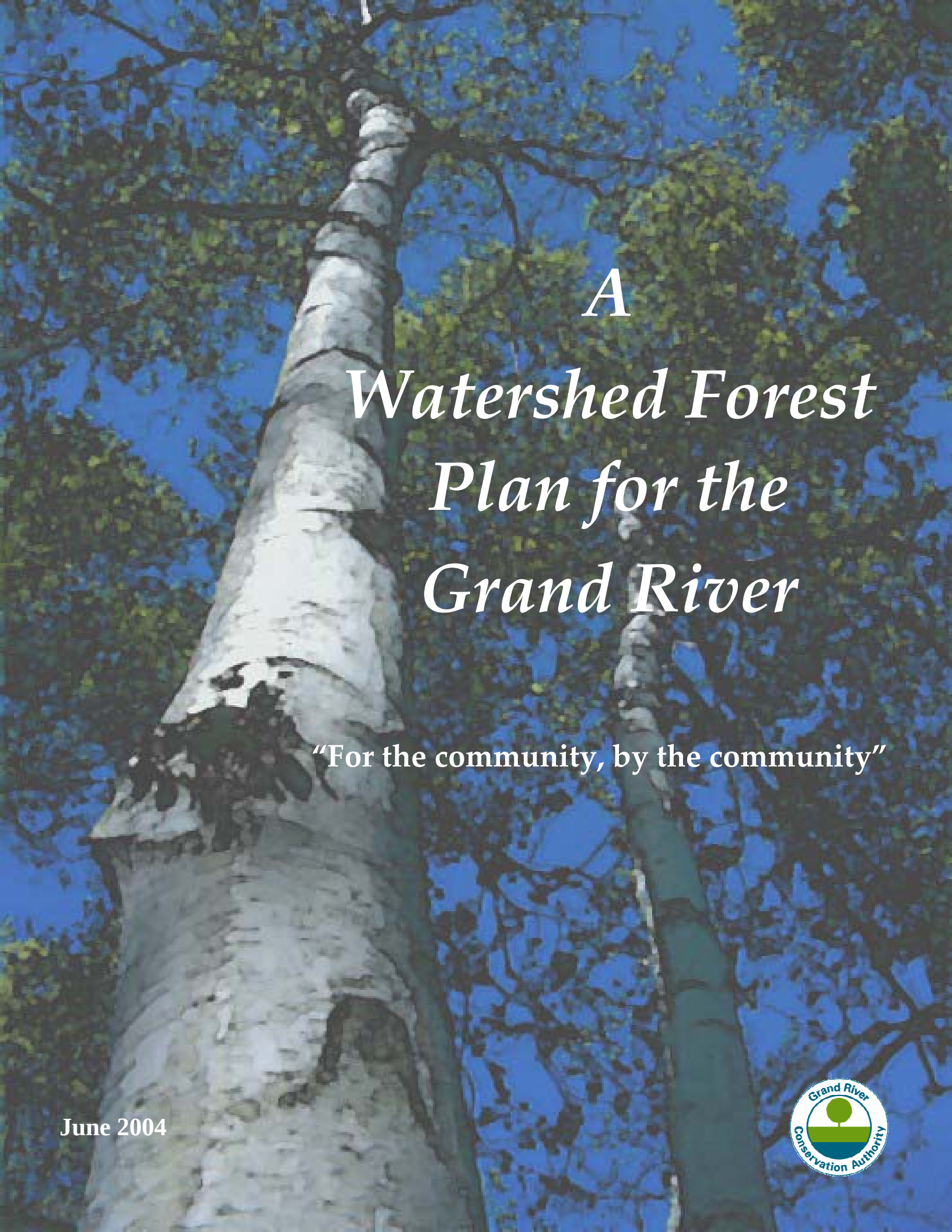

A Watershed Forest Plan for the Grand River

"For the community, by the community"

June 2004

Grand River Conservation Authority

A Watershed Forest Plan for the Grand River

Sponsored By:

The McLean Foundation

Grand River Conservation Authority

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Many people collaborated to bring to completion "*A Watershed Forest Plan for the Grand River"*. The guiding principle for this process was " *by the community, for the community"*, and so the Stakeholder's Group is at the heart of this success – interested citizens from across the watershed representing various viewpoints. Their knowledge, time, and interest made this plan possible.

The following were primary authors of sections of the plan:

1.1 A Brief History - Virgil Martin

2.2 Invasive Exotics and 2.5 Significant Natural Areas – John Ambrose

2.3 Diversity – Cathy Nielsen

2.4 Species at Risk – Jason Culp

3.1 Municipal Planning, Land Use, and the Forest – Wayne MacMillan

3.2 Urban Forests – Andy Kenney

3.3 Agroforestry – Peter Williams

3.4 Tree-Related By-Laws and 3.5 Silviculture – John Irwin

4.1 Education and Communication – Frank Glew

4.2 Tree Planting – Martin Neumann

Other sections were compiled from more than one source, and did not as clearly have a primary author.

These authors were peer reviewed and guided by other members of the Forestry Working Group: Ted Cheskey, Mary Gartshore, Henry Kock, Terry Schwan, Ted Taylor, Dr. Suzanne Wetzel.

Several people from the Stakeholders Group were particularly active in the creation of the plan: Mary Hopkins, Cheryl Huxted, Kevin Parton, Elvin Rudy, Rob Wallis.

At editing and layout stages, several people played large roles: Liz Leedham, Jim Reid, Lara Vujanic, Dave Schulz, Virginia Gauley.

Much of the behind-the-scenes work related to meetings, communications, postings of drafts to the GRCA website, maps, photos, and much more, was ably done by Jason Culp.

All these contributions are much appreciated, and were essential in the process.

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"In a moment the ashes are made, but the forest is a long time growing."(*Seneca)*

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INTRODUCTION

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The Grand River flows through our lives and our communities, stitching them together with a natural shared bond. Together with its many contributing rivers, creeks, ditches, wetlands, source areas, and forests, it weaves a web across the watershed – a green, life-supporting web of trees and water. There is a natural link, too, between water and trees. This three-sided relationship between a grand forest, the Grand community, and the Grand River is explored in *A Watershed Forest Plan for the Grand River*.*

Why do we need a forest? How did the forest evolve? How did the relationship with people and the river evolve? What is the current condition of the forests of the Grand River watershed? What policies and programs are in place related to forests? What are the issues and opportunities presented by the current and expected circumstances? What actions can we take to make the Grand River Watershed Forest the forest that we collectively want and need? A very diverse and highly qualified group has come together to try to answer these questions. The result is an informative reference and suggested actions for caring for our watershed forest: *A Watershed Forest Plan for the Grand River.*

This group of people called the "Stakeholders' Group"**, although dedicated and with highly-regarded expertise, does not control the forests. The future of the watershed forest is controlled by the landowners, and by their communities. Therefore, this plan cannot, and does not, tell people what to do, because the plan has no authority over landowners or land managers. Rather, this plan offers suggestions, recognizing that these are not the only possible scenarios to an improved future for the Grand River Watershed Forest, the Grand River, and the community.

Things are good here. We are fortunate to live in the world's best country. We are fortunate to live in the most affluent part of this country. We are blessed with a location that offers bountiful productivity and a remarkable natural setting. For what better future could we hope? Richard St. Barbe Baker once said, "You can gauge a country's wealth, its real wealth, by its tree cover", and the same can be said for a watershed.

We live in a watershed that is recovering from an almost complete clearcut during the European settlement phase. There are examples all over the world of areas that never recover from similar abuse, but our watershed forest has made a truly astonishing partial recovery, doubling, or even tripling the amount of forest in the last century. Our story is therefore a story of success and of hope.

It is not, however, a completely rosy picture. There are many factors that work against the continuing recovery and health of the watershed forest: urbanization, pollution, climate change, an influx of new insects, diseases, and competing exotic plants and animals. Concerted effort is required just to keep the forest that we have, and to keep it healthy. The amount of forest that we have is not enough to maintain a healthy watershed into the future, and so we have not only a story of hope, but also of challenge.

The consensus of the Stakeholders Group was that our forest was not on a sustainable path, particularly on account of population growth and the spread of urbanization in the watershed. One plea from the stakeholders that came through consistently was, "let's find a way to live sustainably within the "carrying capacity" of the watershed – there is a natural limit to growth beyond which we impair our present and future quality of life". The suggested actions in this plan are only part of the solution: unless we balance growth with the capacity of the land to absorb more people, the watershed forest is in jeopardy.

The following values statement offered guidance to the Stakeholders' Group in their work:

The plan should…

- ✓ help landowners manage their forests
- ✓ get groups talking to each other.
- ✓ have the community suggest ideas to help the forest.
- ✓ help folks find out about these suggested ideas.
- ✓ describe existing conditions of the forest.
- ✓ develop a shared vision of the future forest.

Putting the plan into action should help the community…

- make the forest bigger and better.
- get more involved.
- understand the forest and the landscape better.
- share successful techniques.
- take better care of forests.

We believe we must…

- admit we're not good enough at creating new forests to accept the destruction of existing natural forests – natural forests are irreplaceable.
- "live within our means" on the land: transportation, urban areas, agriculture, forestry, etc. – all must follow the principles of sustainable development.
- direct landscape change toward the landscape that we want.
- take a holistic approach to the ecosystem.
- recognize that the community has a right to a healthy watershed, and an obligation to others now and later who have a right to the same.
- respect and balance landowner rights, values, and responsibilities with community needs, desires and responsibilities.
- value forest products and benefits.
- conserve biodiversity at all three levels: landscape, population, and genetic.
- favour indigenous species.
- respect cultural diversity as it relates to forests.
- achieve informed agreement.

The vision:

A healthy, sustainable forest contributing to a healthy, sustainable watershed and community.

The mission of *A Watershed Forest Plan for the Grand River*:

To promote a healthy, sustainable watershed forest by encouraging a mutually nurturing relationship between the community and the watershed forest

Targets to work toward:

Forest Integrity

- protection and enhancement of Species at Risk habitat
- no loss of indigenous species
- reduction of invasive exotic populations
- adequate representation of each forest type in each ecoregion
- increase of interior forest space

Forest Size

- 30% forest cover for the watershed
- 15% forest cover for each sub-watershed
- 95% watercourses and wetlands buffered with natural vegetation
- 75% of stream buffers forested
- 100% municipally-owned well fields naturally vegetated
- 40% canopy cover in all urban areas
- no net loss of forest

Social Benefits

- increased education and public awareness (targets to be set after further study)
- enhanced forest recreation opportunities (targets to be set after further study)
- improved economic contributions (targets to be set after further study)

The purpose of the plan:

- ✓ to document the watershed forest history, current conditions, and perceived issues and opportunities
- ✓ to foster dialogue within the community related to the watershed forest
- ✓ to raise awareness within the community of the watershed forest and related issues and opportunities
- ✓ to provide a "big picture" context within which the community can better understand, and more strategically nurture, their local portion of the watershed forest
- ✓ to promote innovative models, programs, and policies that offer promise for the watershed forest
- ✓ to provide a supporting document for the efforts and funding proposals of those taking action to improve the watershed forest

* *Definitions:*

Watershed – all the lands drained by a river and its tributaries

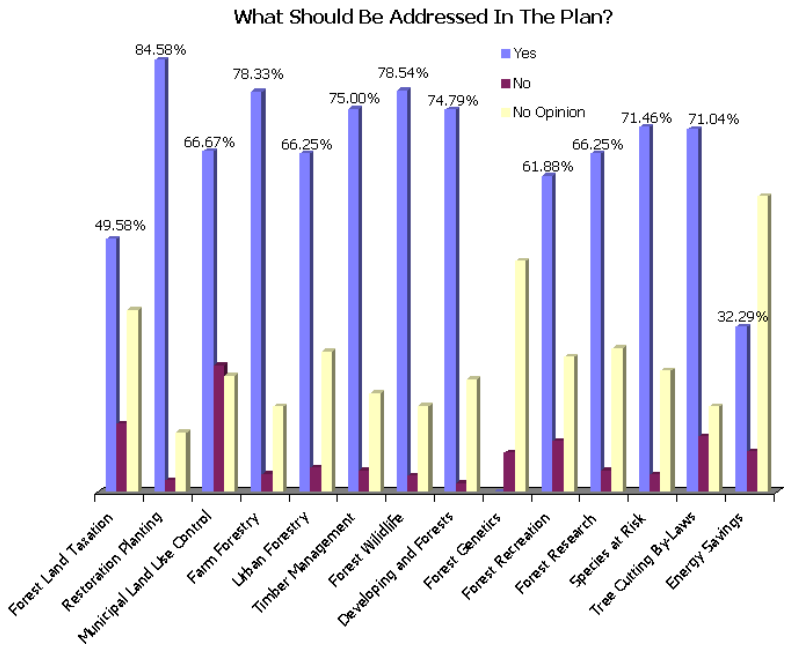
Watershed forest – the total forest and tree cover within a watershed, from single trees to large forests, rural and urban, private and public

*** complete listing of the Stakeholders Group can be found in **Appendix B**, page 152.*

The roots of the watershed forest plan are in the 1994 designation of the Grand River as a Canadian Heritage River. As a result of this designation, the Grand River Conservation Authority undertook to work with the community to create watershed-wide plans for certain aspects of the watershed. The Grand River Fisheries Management Plan was completed in 1998 with phenomenal community involvement.

A Watershed Forest Plan for the Grand River was begun in 1998, with most community involvement occurring in 1999 and 2000. The Stakeholders' Group is drawn from all over the watershed and represents varied interests in the forest. A draft plan was presented at a series of open houses throughout the watershed in the winter of 2000, with favourable response.

The plan is in four main sections: Description of the Watershed Forest (a description of the forest and how it came to be that way); Forest Health (describing various aspects of forest health, from insect and disease issues, to species at risk, to landscape-level genetic issues); Managing the Watershed Landscape and Forest (how forests are being managed, protected, created, and what future actions might be taken to improve the watershed forest); and, The Community and its Forest (discussions and ideas for education, tourism, wildlife monitoring and a comprehensive action list).



"What aspects of forestry should be addressed in a Watershed Forest Plan?" – GRCA forestry survey in 1999 of watershed residents

The topics do not divide up as cleanly as might be hoped into these four sections. A description of agroforestry in the Managing the Watershed Landscape and Forest section involves some history, for example, that might also have been placed instead in the "Brief History of the Grand River Forest" part of "Description of the Watershed Forest". This is appropriate for a reference document that mostly will be referred to section by section, but probably does not make it easy to read from cover to cover. Therefore, please read the sections that are of interest to you: they are designed to be fairly able to stand alone.

This plan is an important step in the history of the Grand River Watershed Forest, mainly because it may be the first time such a wide-ranging group has come together expressly to consider ways to improve the watershed forest. The plan, however, has only the power of persuasion and the power of the community's good ideas. It's now up to the community to advance the parts of the plan that fall into their field of interest, or mandate.

If you remember only two things from this plan, consider these: if we each plant just two trees each year, that would be over a million trees; and, the fate of our watershed forest is in our hands.

THE BENEFITS OF TREES AND FORESTS

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We all have an inherent understanding that our lives are better because of forests. People heal faster when they can see trees out the hospital window. People willingly pay much more for a home with mature trees. Forests are called the “lungs of the earth”, and work against climate change. There is a purifying and moderating role for trees and forests related to water that is more important now than ever.

These benefits are so familiar that they are often not listed, but here are just some of the many benefits.

Benefits

- ✓ Reduce flooding and low flow events by intercepting runoff and encouraging infiltration
- ✓ Improve water quality by slowing the rate at which rainfall runoff flows to rivers and streams and trapping, using, or breaking down some of the pollutants and nutrients that are harmful to water quality
- ✓ Improve water quality by lowering water temperatures with shade over streams
- ✓ Provide fallen leaves to feed soil and aquatic organisms
- ✓ Improve groundwater quality by increasing the amount of rainfall runoff that percolates into the soil and replenishes our main source of drinking water, and by breaking down or capturing toxins
- ✓ Improve air quality, especially in the summer when air quality is often compromised, by lowering temperatures, filtering dust, and absorbing ozone, carbon monoxide, sulphur dioxide, nitrogen oxides, airborne ammonia, and heavy metals, and by releasing oxygen
- ✓ Help counteract the greenhouse effect and global climate change by taking carbon out of the atmosphere and storing it in the form of wood, and by reducing winter heating and summer cooling energy demands
- ✓ Reduce erosion and help the soil recuperate where trees are planted
- ✓ Reduce summer temperature extremes and air conditioning costs by providing shade and the cooling effects of evapotranspiration, particularly in the cities
- ✓ Reduce winter discomfort, energy loss and heating bills, and snow movement with windbreaks
- ✓ Increase crop and livestock productivity and soil sustainability by sheltering fields with windbreaks
- ✓ Diversify the rural economy by providing income (or savings) from harvesting forest products such as firewood, fence posts, maple syrup, pulpwood, and lumber (over 5,000 products are derived from trees)
- ✓ Provide homes for wildlife
- ✓ Preserve and increase the diversity of plants and animals (biodiversity) which in turn improves the overall health of the community ecosystem
- ✓ Link natural areas together with plantings to provide travelways for wildlife

- ✓ Increase the beauty of the environment in our community
- ✓ Encourage healthy open-air activities
- ✓ Provide “living laboratories and outdoor classrooms”
- ✓ Reduce glare
- ✓ Filter out harmful UV rays
- ✓ Provide a calming environment by absorbing noise and improving aesthetics, resulting in less stress, less crime, and “traffic calming”
- ✓ Provide food, medicinal ingredients, herbs
- ✓ Provide an opportunity for healthy community action and involvement
- ✓ Increase property values
- ✓ Provide a ‘sense of place”
- ✓ Contribute to a quality of life that makes the area a desirable place to live and to establish enterprises
- ✓ Provide spiritual and creative inspiration
- ✓ Accentuate the seasons

With so many benefits, trees are one of the best investments a community can make: one study showed that for every dollar spent on trees, the community saw a return on investment of three dollars worth of benefits.

The list above offers the generic benefits of trees. Following is more watershed-specific details about the benefits of the watershed forest, and where gains could be made.

Water quality

A combination of factors has improved water quality in the Grand’s rivers and streams over the past three decades. Two of them are directly related to forestry:

- increased application of agricultural and agroforestry Best Management Practices (e.g., windbreaks, stream buffers);
- improved waste water treatment;
- improved storm water management; and
- increased forest cover

Forest cover has increased on the moraines, and this is precisely where forestry cover can dramatically increase (up to tenfold) the rate of groundwater recharge.

Hydrology and stream flow

Drastic deforestation during the European settlement era is one reason that river flow became more exaggerated. Stream flow is more moderate in forested areas than it is in agricultural or urban areas of similar topography and soils. Forest soils are more absorbent than agricultural soils because of higher organic matter content, and tree trunks, branches and leaves intercept as much as half of the precipitation falling on mature forest.

Infiltration of precipitation into the ground is increased because the ground surface is less regular and because the soil is looser and more fractured. Evapotranspiration rates are higher for forests than other vegetation cover types; and both snow accumulation and snowmelt delay are higher in forests than in fields or cities. On balance, as a result of all these effects of forests on the hydrology cycle, both floods and 'low flow' events become less extreme and frequent as percent forest cover increases.

Flooding and low flows resulting from deforestation became evident in the Grand valley soon after European settlement had covered the watershed. Two solutions have been pursued since then: dams/reservoirs and reforestation. Some areas of the watershed have increased in forest cover, but much opportunity still exists, especially in the north and northwest parts of the watershed, to improve streamflow with additional forest cover.

Soil Quality

Soil quality has been improved through the application of agricultural and agroforestry Best Management Practices. Especially important in this regard are windbreaks, conservation tillage, and retirement and subsequent reforestation of seriously eroding farmland. Unfortunately, the windbreak establishment movement of the last two decades has not been as successful as the hedgerow removal trend of the 1960's and 1970's; that is, there is still much opportunity to establish windbreaks and to restore hedgerows.

Biological productivity

The Carolinian and Great Lakes - St. Lawrence forest regions that the Grand River watershed are within, are some of the most diverse and productive in Canada. In the Carolinian zone, the relatively long growing season and the mixing of major forest types leads to a great deal of biological productivity. Despite this relatively high productivity, the potential is even higher. The productivity could be improved by creating bigger blocks of forest.

The conversion of conifer plantations to hardwood could be done more quickly with concerted effort. Diverse plantings are becoming the norm, and this may 'jump start' the process, but there is a backlog of fairly homogenous conifer plantations, which, depending on objectives, could be diversified through thinning and underplanting and/or seeding of hardwoods such as ash, oak, and maple.

Economic and Social Benefits

Extraction of forest products

A very small percentage of forests in the watershed are professionally managed. Many others are being managed in an ethical fashion, but could yield more of the desired product or amenities by greater application of scientific management techniques. The local forests are capable of yielding, on a sustainable basis, far greater volumes and higher quality of products. Local lumber and veneer mills import logs from the United States that could be grown here.

The general economic argument in favour of forest products may be persuasive, but a more far-reaching issue is in the value that landowners place on their natural areas. If all natural areas are considered a financial burden to landowners who need to make a living from the land, then maintaining these elements of the landscape may become more difficult. If, however, landowners come to think of natural areas as an integrated part of their revenue-generating system, then perhaps more people will be interested in having and maintaining natural areas.

Social and Recreational Benefits

Demand for forest-based recreation exceeds the capacity of public open space to satisfy the need sustainably. Popular forest trails of the Grand River watershed, such as at Elora Gorge Conservation Area, Rockwood Conservation Area and others, are being used so heavily that the forest is suffering. One bright spot in this regard is the advent of the Rails to Trails program, which provides walking and cycling trails on abandoned rail lines.

Recreational opportunities are being sought by urbanites on private rural land, sometimes creating conflict. This is an area of challenge and opportunity.

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PART 1:

DESCRIPTION OF THE WATERSHED FOREST

Summary

Part 1 and this summary cover Sections 1.1 and 1.2, describing the history and the current state of the Grand River watershed forest.

The Grand River watershed was shaped by the relatively recent period of glaciation, ending about 14,000 years ago. As the glaciers retreated, the land, the vegetation and associated wildlife, changed from a tundra community to a mixed hardwood forest over several thousand years. Compared with some forests of the world, the resulting forest ecosystem is young and lacking in complexity, yet it is unique.

Forests in the south of the watershed, in the Carolinian zone, are distinctly different from those in the upstream areas, where the oaks, hickories, walnuts, and other southern species are missing or much reduced.

The native inhabitants of the Grand River watershed influenced the landscape through clearing and cultivation, and through intentional burning. From present-day Kitchener to south of Brantford, much of the land was open and park-like because of repeated fires.

The Iroquois Wars of 1649 – 1652 depopulated the Grand River watershed of Neutral and Huron peoples. The extremely low human population persisted for one hundred and fifty years, at which point the first wave of European settlers found the Indian fields and “hunting parks” were much overgrown, and young forests had become “old growth”.

European settlers saw the forest as an enemy and a hindrance to livelihood. Forests were either felled or grazed. Weather and streamflow both became more extreme, as the protective mantle of forest was systematically stripped from the land. Forest cover was reduced to around 5 or 6% during the 1800’s – a virtual clearcut of the entire watershed in the short span of one century. The damaging effects of deforestation were observed here and elsewhere in Ontario, and reforestation programs were initiated to win back some of the land that should have remained in forest. Forest cover has increased to 19% since 1900 by means of reforestation, natural regeneration, and the cessation of forest pasturing.

The severe and incredibly fast reduction of forest cover made the watershed forest less suitable for species requiring large or interconnected forests. Many new species, mainly from Europe, were introduced to the ecosystem, with varying impacts.

Sprawling urban areas jeopardize forests, and change their characteristics, but stronger policies to protect woodlands during urbanization are helping to minimize these impacts.

The Grand River watershed forest was completely destroyed by glaciers, and nearly destroyed again by European settlement. Forest cover has rebounded significantly since the 1800's. Forests change over time in response to climate change and other factors. Understanding the past is necessary to meet the challenge of achieving a healthy and sustainable watershed forest.

Forest is the natural condition for most of the Grand River watershed, but after being almost eliminated during European settlement, it has rebounded to about 19% of the watershed. Forests vary greatly throughout the watershed, and the patterns of forest are influenced by topography, soils, drainage, climate, land ownership patterns, and even the original settlement-era land survey patterns.

The various combinations of these influences can be divided into areas of similarity for the purpose of describing, understanding and managing the forest. In this section the forests and forest patterns are described for the 11 physiographic regions of the watershed.

Some aspects of the forest transcend the physiographic regions. The forest is highly fragmented, with many small forests and too few linkages between them. Also under-represented, are big blocks of forest, old growth, savannah, and prairie. 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. The Eramosa River valley is an example.

The urban forest is not even fully recognized by many people as part of the greater web of the watershed forest. However, 81% of our population is in urban forests, and therefore it must be emphasized that this is the most important part of the watershed forest from the standpoint of how many in our community benefit from and experience it daily. Urbanization itself, paradoxically perhaps, is perceived as the single greatest threat to the watershed forest, as forests are impaired or liquidated in the path of urban expansion and "suburbanization" of rural areas.

1.1 A Brief History

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Post Glacial Era

The last great Ice Age ended about 14,000 years ago with an abrupt warming of the climate and a desolate landscape of mud, sand, and gravel emerged from under the retreating glaciers. The 60,000-year-long winter had sterilized the land, and it had been completely reshaped by the relentless bulldozing of the mile-thick accumulation of snow and ice. The pre-glacial Grand River earlier emptied into Lake Ontario through a spectacular gorge at Dundas; but this route was now blocked by glacial moraines, forcing the river into a long, meandering detour to Lake Erie. A mantle of tundra vegetation soon moderated the harshness of this newly exposed land.

The post-glacial forest in the Grand River Valley was dominated by spruce, similar to the present day tree line in northern Canada. This initial forest followed the receding ice front, laying down the beginning of a soil profile and setting the stage for more southerly species. From pollen records preserved in lakes and bogs, we know that the spruce forest gave way to pines. Maples, oaks, elms, and ironwood soon joined these, along with birches, and aspens. Around 9,000 years

ago, beech, various hickories, walnut, and many other broad-leaved species augmented the forest. In the wetter areas, hemlock, tamarack, fir and cedar flourished. A basic semblance of our modern forest was emerging.

Over the centuries, changes in precipitation and temperature favoured some species over others. An increasingly diverse and complex forest developed, as species found their way here by wind and water, by hitchhiking with birds and animals, and sometimes by humans.

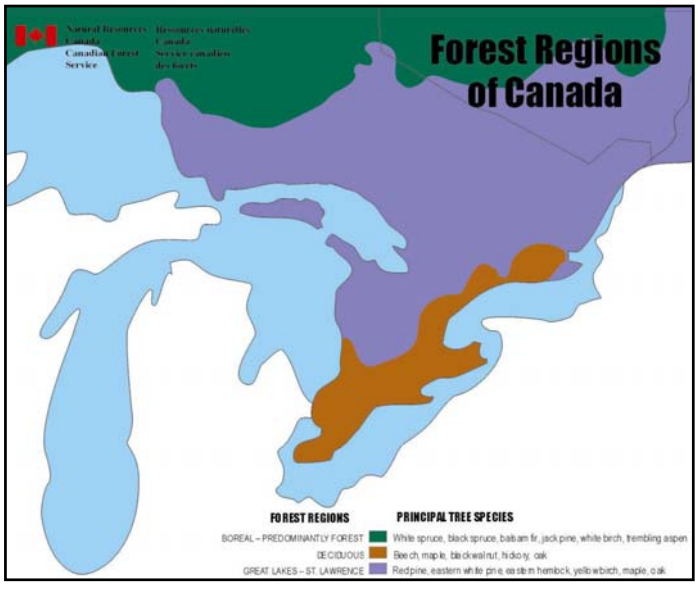
The northward march of tree species was accompanied by the migration of many other plants species, including shrubs, wildflowers and mosses, and also by wildlife species. The potential recruits in this process of colonization were drawn mainly from the south, where some more northern species had found refuge in the Appalachian Mountains. They also came, to a lesser extent, from the Atlantic seaboard and the Great Plains. The Great Lakes served as a partial barrier to the northward advance of some species, an effect that is still evident today.

As the forest evolved and adapted to the warming climate, the diversity of wildlife also increased. There is reason to believe that Woodland Bison, occasional Moose, and Elk once lived in the Grand River Valley. There were carnivores as well: Black Bear, Timber Wolf, Eastern Cougar, Lynx, Fisher, and Marten. Wild Turkey, Passenger Pigeon and Spruce Grouse are also known to have been here. These and many more were an integral part of the forest and their presence no doubt influenced both its look and composition.

From a global perspective, the forests that developed in southern Ontario could be considered comparatively recent and species poor. From the science of biogeography, we know that, given more time, more species will accrue, through both migration and evolution. This should not be taken to mean that the ecosystem is somehow incomplete or imperfect; it suggests only that there could be further changes in the direction of increasing complexity. The plants and wildlife native to this region, although generally having ranges much beyond, co-exist here in characteristic communities that are distinct from every other on Earth.

The Modern Forest

Across North America, broad bands of forest types have been defined and, in fact, blend into one another. These forest types reflect mainly the predominant climate, particularly the length of the growing season and precipitation. Topography influences local climates, but in southern Ontario, relief is not sufficient to be a major factor. The Great Lakes, on the other hand, have a moderating effect sufficient to influence forest types. Away from the Lakes, the north-south temperature gradient is the primary controlling factor.



From source to mouth the Grand River spans a remarkable range of ecosystems. The Carolinian Forest type reaches its northern limit in the Grand River Valley in the vicinity of the City of Cambridge. In general, this forest type is dominated by sugar maple and beech along with basswood, silver maple, and several species of oak. Many more broad-leaved species are

only slightly less prominent including several species of elm, ash and hickory, black cherry, and yellow birch. Numerous characteristic plants and animals, having a broad distribution southward, reach their northern limit in the southern half of the watershed. Among these are several trees, including the hickories, sycamore, sassafras, black oak, Chinquapin and dwarf Chinquapin oaks, and (formerly) American chestnut.

In the northern half of the Valley, the Great Lakes-St. Lawrence Forest predominates. It is similar to the Carolinian in many respects, but without the characteristic Carolinian species. Instead, eastern hemlock, white pine, eastern white cedar— while by no means exclusive to this forest type—play a more prominent role. Within the Grand River Valley, balsam fir, white spruce and white birches reach their southern limit in this zone. Here and there in the upper reaches are found cool hollows where there persists wetland vegetation reminiscent of the muskeg of the Boreal forest. The characteristic tree species of these sites is black spruce.

Forests of all types are not static. In addition to long-term climate change, many short-term and local disturbances affect the composition and structure of the forest. Wind, ice storms, disease, insects, drought, flooding, fire, and old age eventually and inevitably take their toll on forest trees, leaving openings in the woods, usually small but sometimes extensive. These openings are essential to the maintenance of the forest, as they allow the understorey of saplings to flourish, some eventually to be recruited to the canopy to complete the cycle. Increased sunlight and reduced competition in the openings also contribute greatly to the bio-diversity of the forest, as many plants and animals depend on the temporary conditions available only here.

Early Settlement and the Forest

There is evidence that humans began to inhabit this area shortly after the glaciers receded; and although their impact was indirect, these nomadic hunter-gatherers may well have influenced the development of the forest by altering the balance among herbivores that fed on it.

Later, the widespread practice of periodic burning, as a means of improving hunting, became the most significant human influence on the forest. By opening up the canopy and providing a fresh charge of nutrients to the soil, grasses, herbs and shrubs responded vigorously. This provided forage for game species, particularly White-tailed Deer, as we know from frequent references to the abundance of game in the writings of the earliest European visitors to the area. From various descriptions in the literature, we know that this management technique greatly altered the appearance of the forest. We can also safely surmise that every aspect the ecology of the forest would have felt the effects—from the songbirds in the canopy to the microorganisms in the humus of the forest floor.

From the middle reaches of the Grand (present-day Kitchener) southward to Lake Erie, over large areas of well-drained soils, the forest seen by French explorers in the early 1600's was open and park-like, dominated by well-spaced, large oaks, American chestnuts, white pines, and walnuts—species adapted to periodic ground fires. Between the trees, wildflowers of every colour created a garden-like panorama. These openings were fingers of the tall-grass prairie ecosystem that stretched west- and southward to the Mississippi. And although the white settlers apparently did not understand it, we now appreciate the role of fire in maintaining this ecosystem—fires most often deliberately set by the Indian inhabitants. Regarding the Brantford area, in 1821, John Howison wrote: "This river, flowing between its shrubbery-clad banks, and meandering through a fertile and open tract of country, has a most pleasant aspect. The prospect displays a minuteness and an unobtrusiveness, which are strikingly opposed to that vastness which characterize most of the scenery of North America." (*Sketches of Upper Canada, 1821*, Coles Canadiana Collection)

Agricultural ways began to be adopted, beginning with corn cultivation about 1500 years ago, and the introduction of squash and beans some 600 years ago. The reduced dependence on fish and

game allowed settlements to become larger and more permanent. By the time of European contact, the Neutral Nation had considerable land around the western end of Lake Ontario under cultivation. Village sites would now be occupied for up to a decade or more. Fields, irregular in shape and untidy to the European eye, were carved out of the forest nearby by burning smaller vegetation and girdling larger trees (which produced fuel wood as a by-product). Eventually, the soil nutrients were depleted, and fuel and game became scarce in the vicinity. Weeds would increase, as would fleas and other pests.

Upon abandonment, the forest would reclaim the garden plots. Although the ensuing forest was noticeably different after cultivation, over the decades and centuries it dissolved into the background. The effect was similar to temporary clearings in the forest created by natural disturbances; shade-intolerant species predominate for a time, providing the shaded conditions that ensure succession to the characteristic climax species of the area. Although these agricultural activities had a short-term effect on the ecology of the forest, from a practical perspective, they can be regarded as falling within the spectrum of natural disturbance. A similar disturbance in the forest today would have radically different consequences in that dozens of aggressive non-native species would compete successfully with the native flora.

European Settlement

The first arrival of Europeans on the continent had mostly indirect affects on the Grand River Forest. The fur trade affected wildlife populations over vast areas, including the Grand. It also spawned new alliances and rivalries among the First Nations. In 1649-52, the Iroquois, at war with the local Neutrals and Hurons, swept through southern Ontario from south of the Lakes, leaving the land virtually depopulated for decades afterward. Gradually, Ojibwa people (later known as Mississaugas) re-occupied the area. But there can be no doubt that in the century prior to 1800, the role of humans in the ecology of the forest was very much reduced. As a result, the forest generally reached an old-growth state, and the tall-grass prairie retreated significantly.

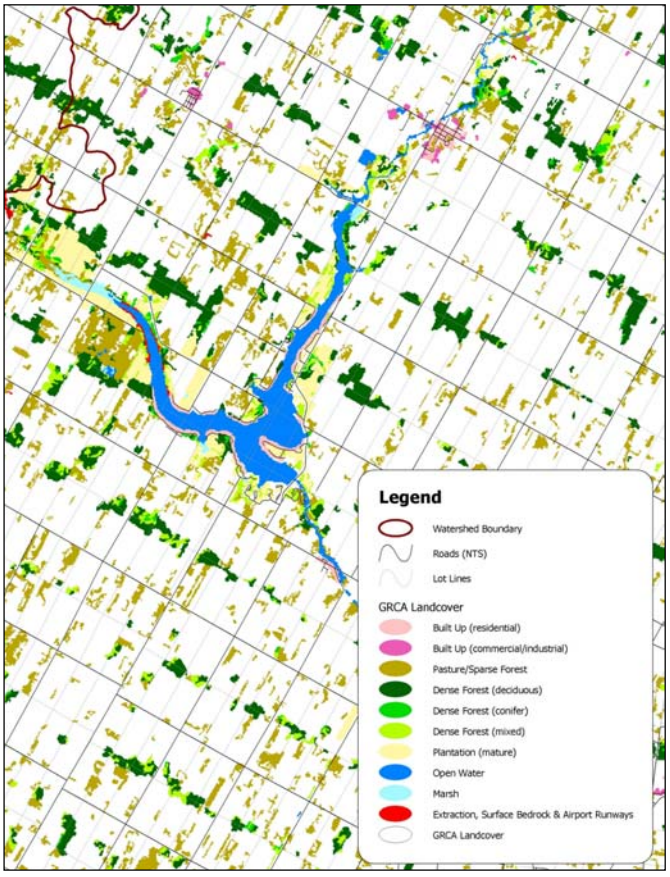
Following the American War of Independence, the Six Nations Iroquois, under the leadership of Joseph Brant, were granted a tract of land originally described as “six miles deep from each side of the river, beginning at Lake Erie and extending in that proportion to the head of the said river”. At the time, no one understood the true extent of the Grand (or the “Ouse” as it was commonly called), and eventually the upstream end of the grant was terminated near Fergus. Within this vast heartland of the Grand River Valley, five of the Six Nations soon established permanent settlements in the Brantford area and southward. However, they made limited use of the hinterland, and for many decades, the Mississauga continued to roam the area, hunting, fishing and gardening. The onslaught of European settlement eventually pushed them out of the area or onto the New Credit Reserve near Brantford. At the close of the 18th century, however, the Grand River Forest remained quite intact and largely undisturbed by human hands.

Inevitably, the pressures of colonization began to influence the course of events. Brant was anxious to sell large sections of the Six Nations Tract to establish an annuity for the benefit of his people. These upper sections of the Tract, he claimed, were “as hunting grounds entirely useless.” This contrasts sharply with pioneer accounts of plentiful fish and game. But these lands had not been intensively occupied for at least 150 years, which may explain the difference in perceptions. Left to nature, large trees dominated the forest, and there was little vegetation in the deep shade under the tight canopy. The township-sized blocks sold by Brant, and also the surrounding townships, were surveyed and sold to speculators. These in turn sold the land to settlers, some of whom soon established farms on their new holdings. Many of these early settlers took advantage of the Indian clearings where they could still be found, and the Indian hunting parks (the “plains”) were especially desirable because they could be occupied with minimal effort.

The arrival of white settlers immediately affected every aspect of the landscape. From 1800 to the 1870's, the forest was primarily seen as the major hindrance to making a living and, therefore, to be eliminated. Huge amounts of time and effort went into the gruelling and dangerous business of chopping down trees, cutting them into lengths, and drawing them into piles to be burned. Trees had no intrinsic value. Only when split into shingles or sawed into boards, or when used in log houses and barns and fences were they considered to be anything more than a nuisance. Most trees were burned, their ashes enriching the soil, used in soap-making, or exported to Europe as potash.

The initial clearings of the white settlers were in some respects like those of their Indian predecessors. But the newcomers came intent on making permanent and widespread changes to the landscape. Nothing pleased the settler's aesthetic sense more than the opportunity to "see some distance around;" and nothing offended more than land that remained "unimproved". There was an acknowledged trade-off though, in that the summers became noticeably hotter and the winters harsher after the removal of the forest. It was noted, too, that springs that had been a reliable source of water, soon dried up after forest clearing. As the frontier retreated northward into the swampy headwater areas, flow in the tributaries of the Grand was drastically affected. Spring floods grew yearly more menacing, taking out bridges and dams in the older settlements, and damaging and eroding what bottomland forests remained. These floods were followed by summer lows that all but dried up the Grand and many of its tributaries.

The Development of Agriculture



2000 satellite imagery shows the clearly defined "back 40" woodlots common throughout much of the watershed.

On most "jobs", settlers chopped their way in from the road (or from the allowance that was to become a road). Most years saw a few more acres brought under cultivation. Eventually, the need for fuel and the annual production of maple syrup began to moderate the penchant for clearing land. On most farms, some "bush" was retained, usually at the rear of the farm, where it often abutted the neighbour's holdings. These forest remnants impart a characteristic pattern on the landscape, reflecting the underlying survey of lots and concessions.

In the Grand River Valley, as across most of southern Ontario, most surveys were laid out in a rectangular grid pattern, with no consideration of the natural features of the land. A notable exception occurred in the German Company Tracts and some of the associated smaller tracts of Waterloo and Woolwich townships. Here, the surveyor laid out 350-acre lots with an eye to providing access to a stream or river on each lot. There were no road allowances. The resulting

pattern of settlement and roads grew in a rather haphazard fashion, and this is evident in the pattern of forest remnants, as well. In contrast to being arbitrarily relegated to mid-concession, in this area they are most often found on the land *least* suited to cultivation—land that is either too swampy or too well drained.

Sometimes the desire to maximize production from cultivation led to complete clearing of a farm. To meet the need for wood products, the farmer would purchase a plot of 10 or 15 acres in a nearby woodlot. Sometimes many such parcels were created, many of them landlocked, together in a woodlot. Even where such ownership arrangements did not develop, there remained a strong presumption of communal rights regarding the "bush." Hunting and berry picking were carried on with little or no regard for proprietary rights—it simply did not occur to anyone to ask permission. This sense of collective rights, which to some extent persists even today, seems to be a carryover from the early days of settlement, when the bush was perceived by European settlers as the domain of wolves, bears and Indians. The bush was regarded as a no-man's-land, where European concepts of property rights did not apply. Perhaps this attitude also helps explain why the forest is now so often used as a private garbage dump, or for roadside dumping.

The key difference between Indian and European agriculture involved livestock. The settlers generally brought cows, oxen, pigs, sheep, and chickens with them, but provided minimal shelter or fodder. Instead, cattle were turned into the bush to fend for themselves for much of the year. Fences, initially at least, were built to keep livestock and wildlife *out* of fields and gardens. The practice of grazing cattle in the bush was still commonplace in the first half of the twentieth century and can be seen occasionally today. Light to moderate grazing over a limited number of years has few lasting impacts on a forest ecosystem. When intensive, or continued for many years, however, the results are usually devastating. Regeneration of trees is halted, root systems and bark are damaged, soil is compacted, native herbaceous plants are mostly eliminated, and non-native weeds and grasses are introduced. Many acres of bush were converted to pasture in this way, particularly on river bottomlands.

Less than 100 years ago forest cover in the watershed had been reduced to 5-6 percent as land was cleared for agriculture.

By the end of the 19th century, the transformation from forest to farmland had been pushed to the point where perhaps five or six percent of the valley remained under forest cover. But even that estimate may be too generous if one considers the impact of grazing, which reduced much of the remaining cover to a marginal condition. To our eyes, the denuded landscape of the Grand River Valley a century ago would have looked utterly desolate, although no longer so raw and ravaged as a few generations earlier. The desire to open up the country was fulfilled, and prosperity rewarded those who undertook this work. But of the forest, and wildlife that had once inhabited it, there remained only relics and bones. The forest was pushed back from all sides leaving a patchwork of thousands of small woodlots—islands in a

sea of fields. For example, the forest retreated to the very brink of the Elora Gorge; old photographs clearly show that only the cliffs themselves remained treed.

Agricultural capability largely determined the enduring pattern of forest cover. The most level and fertile areas have the least remaining woodland, while the Guelph Drumlin Field in the east-central section of the watershed, and the extensive wetlands in the northern headwaters, have retained noticeably more and in somewhat larger aggregations. Despite considerable regrowth and reforestation in these areas, the overall effect remains one of a rather uniform speckling of tiny patches. By far the most striking anomaly on the map is the heavy forest cover on the lands of the Six Nations of the Grand River. Here, a series of mid-concession forest tracts form broad, nearly contiguous corridors, with the coverage being an order of magnitude greater than the surrounding area. The difference is clearly cultural in origin. However, from an ecological perspective, it is a matter of quantity rather than pattern; although the forest is extensive, the many deep incursions of fields impinge on interior conditions.

Forest Changes and Wildlife

The severe fragmentation of the Grand River Forest had—and continues to have—many undesirable effects. Small patches of forest lack the interior conditions and the extensive tracts necessary to sustain some plants and animals. Mammals at the top of the food chain were among the first to go. Not only was their need for extensive habitat no longer met, but they were also hunted vigorously. Black Bear, Timber Wolf, Eastern Cougar, Lynx, Fisher, and Marten were all displaced or exterminated, probably by mid-century from all but the most northerly areas. Other effects became apparent much more slowly: for example, the Red-shouldered Hawk, an interior woodland species, remained the most common hawk in the Valley throughout the 19th century. Gradually, however, the Red-tailed Hawk, a species better adapted to forest edges and open plains, became more common. By the 1980's, the displacement was complete and, today, Red-shoulders are seen only as rare migrants. Site tenacity, perhaps from generation to generation, may have been a factor in the Red-shoulder's ability to persist as long as it did. With plants, certainly, site tenacity is an obvious consideration. Many forest plants are very long-lived, and once established, a plant may persist even though conditions are no longer conducive to reproduction. We are still very much in a period of re-adjustment; with many species likely to fade away over time in response to permanently altered conditions, while others find the new conditions favourable.

Among the species to take advantage of the edge conditions of the fragmented landscape, many arrived here from other continents with the assistance of humans. The earliest Europeans to explore the Grand, in the early 1600's, are said to have left European weed seeds in their wake. These "Old World" weeds—like the many other insects, earthworms, diseases (bacteria, viruses, and fungi), parasites, vermin, "nuisance" wildlife, and fish that eventually found their way across the Atlantic—had a competitive advantage derived from a long association with agricultural societies.

Although many species that are alien to North American ecosystems are apparently quite benign, the disruptive impact of others can hardly be overstated. Some of the most disastrous introductions are comparatively recent. Chestnut Blight all but wiped out the American chestnut within a few decades of its introduction in 1904. Chestnut was perhaps the most important tree, both economically and ecologically, in the Carolinian Zone. Dutch Elm Disease has a similar history. Introduced in the 1920's, it swept across our area in the 1960's and '70's, decimating this large and distinctive tree. Although American elm was found throughout the forest, it was characteristic of elm swamps, which have virtually disappeared as a distinct community. Typically, these swamps have converted to silver and red maple. Dutch elm disease also devastated our urban forests, where elms were by far the most common street trees.

The Rise of Forest Preservation

The negative effects of wholesale forest clearance were obvious, but it was not until the late 19th century that the notion that anything could be done about it began to take hold in some individuals. Despite legislation such as *The Ontario Tree Planting Act, 1896* introduced by E.W.B. Snider, M.P.P. for North Waterloo, and the highly progressive *Report on the Reforestation Waste Lands in Southern Ontario*, (1908, Ont. Dept. of Agriculture) by E.J. Zavitz of Guelph, little effective action was taken. Sporadic initiatives during these decades were aimed mostly at the planting of roadside maples, which certainly left us with an aesthetic improvement and a reduction in wind erosion. It was not until the 1930's and '40's, however, that serious efforts began to be made to increase forest cover through active reforestation. These plantations, which became the backbone of the system of County Forests, were invariably coniferous, primarily pines, and many of the species used were not native. They were, however, a vast improvement over the eroded farmland that most were established to ameliorate. The same momentum sparked the creation of Conservation Authorities across southern Ontario, including the Grand River Conservation Authority. Although their mandate is primarily focused on water resources, the connection with woodland cover has been obvious from the beginning. Conservation Authorities are now major players in the establishment and management of forests. In the Grand River Valley, the Grand River Conservation Authority owns 4,115 hectares of naturally forested property and has assisted with the reforestation of 8,480 hectares (5,342 ha on Grand River Conservation Authority lands and 3,138 ha on private land).

Urbanization in the Valley has wiped out considerable areas of remnant forest and jeopardized the integrity of many others. Within the City of Waterloo, for example, there was a 35% loss in woodland cover between 1955 and 1990. In recent decades, however, there has also been a marked greening of attitudes toward the environment. The *Provincial Policy Statement*, issued under the *Planning Act*, now affords a certain level of protection for significant woodlands. Increasingly, forest remnants are being incorporated into the urban fabric.

Tree saving practices continue to evolve and improve; root zones extend well beyond the branches.

Overall, the extent of forest cover, over the past 60 or 70 years, has increased rather dramatically due primarily to natural regrowth on abandoned or marginal farmland. There are many benefits—reduced erosion, shading of streams, the establishment of corridors, to name a few—arising from the return of trees to these areas. Such "replacement woodlands" now make up over half of the Grand River Forest, and their importance will continue to grow. On the other hand, remnants of the "original forest," by definition, can only hold their ground at best; more realistically, we can expect they will continue to diminish in area. These remnants are all that we have left of the great expanse of pre-settlement forest.

If forests were no more than assemblages of trees, we would require little more than foresight and patience to replace these remnants. But forests are complex ecosystems, and we are only beginning to understand them. The majority of their biodiversity exists in the soil; however, we know very little about the life and ecology of the forest floor. If we identify and retain our few remaining remnants of the original forest, we can learn much about the function of our natural ecosystems—ecosystems that have evolved over thousands of years to be precisely tuned to the unique circumstances of their particular place. This legacy of adaptation is, therefore, the key to the future health of the Grand River Forest. It is this heritage of remnants that we must look to first, if we hope to restore and heal the landscape.

Action Items

- **Identify and retain remnants of original forest to serve as benchmarks of natural ecosystem function and act as classrooms for learning**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

1.2 Forest Types and Physiographic Regions

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General Forest Types

(from the GRCA - State of the Watershed Report 1997)

About 19 % of the watershed is forested today. Environment Canada suggests 30% forest cover is needed to sustain a healthy watershed. Less than 3% of the watershed's land base is publicly owned forestland. The amount of natural area that is protected to some degree from development by municipal designations (e.g., Environmentally Sensitive Policy Areas) may be as high as 10%, but exact figures are not compiled. The effectiveness of these designations in preventing degradation of the sensitive areas varies considerably, but can certainly not be considered absolute protection. Most areas of the watershed are protected under municipal tree cutting by-laws. These are designed to prevent degradation of the forest from an extraction/productivity perspective, and have been somewhat effective in this regard.

In the Grand watershed there are no known examples of large areas untouched by human activities. There are, however, many areas where the trees are older than 100 years (a commonly used threshold age in defining “old growth”). The recent discovery that the gnarled eastern white cedars along the Niagara Escarpment are one of the most significant old growth forests in eastern North America, draws to mind the possible parallels with the limestone cliffs at Elora, Rockwood, and Everton.

There are many woodlands that exhibit old growth characteristics in the watershed, but with the possible exception of the cliffs, there are probably no ‘virgin’ forests. Some areas already supporting very old trees should be allowed to move towards a realistic facsimile of what old growth in this region would look like. The strategy should include core and buffer areas, and provide a representative sample of old growth forest types for the Grand.

Many species are adapted to the seclusion and microclimate of large forests, or their range is so large that only a very large forest sustains them. These “interior forest” dwellers are at risk throughout southern Ontario, because most woodlots are too small to meet the needs of these species. Only a handful of forests in the watershed are larger than the 400 hectares deemed necessary for significant interior habitat. Throughout the watershed many stands of trees,

wetlands and other natural landscape features have been converted for housing, industry, agriculture and recreation. Summer logging, land grading, and artificial land drainage have impacted remaining woodlots. Breeding and rearing of wildlife have been heavily impacted.

Migratory songbirds are perhaps one of the best indicators of the state of wildlife habitat. While naturalists and environmentalists raised concerns and awareness in the 1970's and 1980's of the substantial losses of the rainforests our birds migrate to in winter, this watershed has continued on its path of incompatible forest management practices here at home. Now, we have several species on the rare, threatened, and endangered lists and continuing declines of more than a dozen neotropical songbirds since 1966. There is a need for the creation of several large woodlands greater than 400 hectares in extent to function as source areas and refuges to compensate for the population "sinks" in the smaller ones, which are vulnerable to disturbance and predation.

South of Ottawa Street in Waterloo 1994

South of Ottawa Street in Waterloo 1997

South of Ottawa Street in Kitchener 2000

There is currently a high edge-to-interior ratio in forests of the Grand watershed. Conditions are far from ideal in most parts of the landscape for species that require forest interior habitat. Edge habitat favours generalists, while forest interior favours specialist species such as thrushes, warblers, and vireos. The microclimates, and exposure to predation and disturbance, are two edge factors that work against the specialists.

Edge habitat was long ago recognized as being favourable for sport hunting, and because of this, many land management programs of the past encouraged the creation of edge habitat. Currently, the emphasis is on increasing the core interior forest areas somewhat to bring edge and interior habitat into a better balance.

Some wildlife species increased in relative abundance because the landscape changes (e.g. more edge) favoured them: white-tailed deer, red fox, and raccoon. Others moved into the area when conditions suited them after the landscape change: coyote and brown-headed cowbird.

Many forests today have a very simple structure: one or two ages of trees with nothing in between. This is not necessarily bad, and having some forests like this is undoubtedly good. It may require some conscious decisions to ensure that a good sample of more complex forests occurs in the watershed. The complexity would involve species composition and an all-aged structure, including a healthy shrub layer. Some species will prefer these conditions, and the struggling interior forest-dwellers will be among them.

Today in the Grand watershed, pasturing in woodlands is virtually non-existent, and during the past three decades many floodplain pastures have been abandoned. Many of the abandoned pastures

have been reforested, or now offer opportunities for forest restoration. This general trend away from livestock grazing in forests and floodplains may in fact be one of the two most profound and far-reaching influences on the current state of the Grand landscape.

Urbanization is the other. With the growth of the cities and development of transportation systems, it became more and more common for many urbanites to live in the surrounding countryside. The ownership and management of the landscape is no longer the exclusive domain of the farm community.

An urban forest grew in the cities sometimes by default at first, but increasingly by design. The urban forest today often has a canopy coverage greater than the surrounding agricultural landscape, but since the understory is mainly houses and turf, direct parallels are hard to make. The urban forest now is only beginning to be managed using an ecosystem-based approach.

The current state of urban forests in the Grand watershed is not entirely encouraging, despite the significant achievements of municipal urban forestry departments. Much progress has been made in protecting remnant forests, yet development continues to erode the surrounding forests as cities spread outward.

The contribution of the urban forest to the health, vitality, sustainability, liveability, and even economic success of communities is poorly understood. It is often overlooked in decision-making processes, and often ranked low on the list of priorities when conflict arises between various uses or potential uses of urban land.

The problem of native plants being displaced by opportunistic non-native plants is certainly most acute in urban areas. The majority of street trees are selected from a very few street-hardy species, such as Norway and silver maple, green and white ash, linden, and honey locust, and therefore our ‘streetscapes’ lack the diversity in species composition that might protect them from disease and insect epidemics.

Community involvement in urban forest establishment and care is growing. The trend in parks is away from totally manicured situations toward a balance of ‘naturalized’ and manicured areas. There is a general trend in municipal projects and also in a growing segment of the general population, toward planting indigenous species. Forests are probably given a higher priority than ever before for protection from development pressure. As cities grow significant natural areas are incorporated into, and protected within, development plans as never before.

Comprehensive inventories are not available for all urban areas in the watershed, and it is difficult to quantify the state of urban forests in the Grand watershed. However, it is reasonably safe to say that awareness of the urban forest’s importance is growing, protection from development has improved, and that political and financial support need to be strengthened to make significant improvements. Opportunities and challenges exist in the management of naturalized areas, maintaining or enhancing the integrity of existing natural areas, and maintaining ‘streetscapes’. Education programs are needed to help the public and politicians understand the urban forest.

The ‘suburbanization’ of the countryside continues to have an incredible influence on the landscape. Naturally, there are more houses in the country. Many of them have been built into existing forests, and thereby converted what may have been healthy forest habitat to ‘edge’ habitat. Although all types of habitat have their value for some creature, prairie, savannah, wetland, and interior forest habitats appear to be the types of habitat most in need of protection and restoration. Edge habitat and the species that depend upon it are both plentiful in the Grand watershed.

In parts of the watershed, notably the hilly portions of east Wellington County and the Galt-Paris Moraine, rural non-farm landowners have done much of the reforestation. Between carving

building lots out of forests and planting so many trees, the rural non-farm landowners have perhaps been a mixed blessing for the watershed forest, but they represent an undeniably important trend.

On balance, there is (probably) more land going into forests watershed-wide than coming out of forests. However, it may be that the quality of the ecosystems is not of comparable 'value' to society or as wildlife habitat, if urbanization losses of natural forests are being offset by the creation of plantations elsewhere. Plantations have many benefits, but they cannot compare to natural forests for habitat and many other values.

Physiographic Regions

There are 11 regions in the watershed, which are described as "minor physiographic regions" by L. J. Chapman and D. F. Putnam in *"The Physiography of Southern Ontario"*. Ecosystem diversity is affected dramatically by the presence of the two major climatic or plant growth zones, the Alleghenian and Carolinian. The physiographic regions of the watershed are described below, in order from north to south.

The Great Lakes - St. Lawrence Region (Alleghenian zone)

The Dundalk Till Plain

The Dundalk Till Plain and headwaters ecoregion, located mainly above Highway 9, is a major headwater area for the Grand, Nith and Conestogo Rivers. It has extensive wetland complexes, wet meadows, and agricultural land in four major source areas. They are the Dundalk , Melancthon, Amaranth, and Keldon source areas.

The till plain is drained by an extensive network of agricultural drains and small watercourses which link the numerous wetlands. Two large eskers and a series of small drumlins, which are located at the northwest boundary of the Watershed, add considerable diversity to the habitat of the till plain. The western most esker runs through the Keldon swamp southeasterly to the north bog at Luther Marsh Wildlife Management Area. This is a 5,679 hectare complex of bog, marsh, mixed deciduous-coniferous swamp, upland deciduous forest, plantation, meadow and agricultural fields. There are 504 hectares of bog in the Luther Marsh complex. The well vegetated Horseshoe Moraine and Niagara Escarpment physiographic regions border the till plain on its east side. There is a noticeable transition from scarce natural vegetative cover along the west side of the till plain to extensive cover in the east.

Data from the Ontario Breeding Bird Atlas (Cadman et. al. 1987) show that diversity of bird species is lowest in the Watershed in this northwest sector. Diversity ranges from 71 to 97 species. In sharp contrast, there are 134 species of birds at Luther Marsh. Sub-boreal vegetation and the extent of the marsh and forest make this area attractive to birds usually found much farther north. It is important to migratory birds and significant breeding birds such as Black-crowned Night Heron, Red-necked Grebe, Wilson's Phalarope, Osprey, Common Loon, Great Blue Heron and Hooded Merganser.

The Stratford Till Plain

The Stratford Till Plain lies south of the Dundalk Plain and comprises the Listowel and Stratford ecoregions. This flat clay plain is wedge shaped with its broadest sector in the west, between New Hamburg, Millbank and Highway 9. The point is in the east, between Belwood and Highway 9. As on the plain to the north, natural vegetative cover is more extensive in the east. The valleys of the Conestogo, Irvine and Grand Rivers are more deeply cut through this area and wildlife corridors in a north-south orientation are somewhat developed. The headwater area of the Nith River, in the western sector is very open and there is little wildlife habitat. The most northerly

source area for the Speed River in the east has slightly better covered drainage ditches and small watercourses.

Lake Conestogo and valley lands in the Drayton area have the most extensive habitat on this till plain between Glen Allen and Wallenstein, on the Conestogo River, there is a diverse valley forest accompanied by floodplain meadows. This area has several species of birds and plants that are rare or uncommon in Wellington County.

Another area of relatively high quality habitat is the Rich Tract, a Wellington County Agreement Forest located between Fergus and Arthur along Highway 6. It has sub-boreal plant communities and bird species uncommonly observed in the Watershed.

The Hillsburg Sand Hills

Prominent sand hills and a transitional area adjacent to the Horseshoe moraine and Stratford Till plain characterize the Hillsburg Sand Hills physiographic region. This is a very scenic area of the watershed with hills slightly higher than those of the Waterloo Hills region. Agricultural use is limited due to topographical and drainage factors. The region is approximately 30% forested and much of the forest is composed of provincially significant swamps located in the valleys between the hills.

The Guelph Drumlin Field

The watersheds of the Speed and Eramosa Rivers lie within Guelph Drumlin field physiographic region. This region has the most extensive network of forest habitat in the watershed. Large forests typically cover the valleys between the numerous hills and drumlins. The areas of lowest elevation are swamp and flood plain.

At the toe of the slope there is often a seepage line or numerous springs, which support rich cedar swamps and communities of ash, birch, hemlock, balsam fir and hard and soft maple. The cedar swamps form a large network of valley habitat with several large core areas that are linked by streams. Beaver have built dams on the majority of the streams, affecting fish habitat and creating marshes. The beaver activity is supported by extensive areas of aspen and balsam poplar, which are located in transitional areas on the slopes adjacent to swamps and marshes. The drumlin field provides several thousand hectares of the best habitat in the watershed for mammals such as beaver, muskrat, deer, mink, raccoon, flying squirrel, red and black squirrel.

Seven well known areas of importance in this sector of the watershed are the Elora Gorge, Grand River Valley from Inverhaugh to Winterbourne, Swan Creek valley and swamp, Salem Forest, Speedside Forest, Eramosa River Valley, Ariss Woods. Most of these were documented in the South Wellington Environmentally Sensitive Areas Study (Eagles et. al., 1976). They provide over 1500 hectares of significant/sensitive habitat.

The limestone walls of the Elora and Salem Gorges and the floodplain meadows and swamps of the downstream river valley are inhabited by several species of plants, which are rare in the Watershed. They include Cut-leaved Grape Fern, Slender Cliff-brake, Smooth Cliff-brake, Maidenhair Spleenwort, Green Spleenwort, Butterwort, White Camas, Grass of Parnassus, and Twin Leaf. This same area supports a trout fishery. A headwater swamp at Highway 6 in the Swan Creek valley has a number of uncommon plant species and uncommon birds, including Red-breasted Nuthatch and Red-headed Woodpecker.

At the northwest corner of the drumlin field, in the Lutteral Creek watershed there is swamp/upland forest known as the Speedside Forest. This diverse area supports five species of ferns that are rare in the watershed. The Ariss woods are located on a significant esker and have importance due to size and botanical features. The Eramosa River Valley follows a lengthy glacial spillway from Brisbane to Guelph. The Brisbane Swamp, which is a major headwater area

for the river, and the upper river valley, above Ospringe, are within the drumlin field. From Ospringe, the Eramosa River flows through the Horseshoe Moraine physiographic region to its confluence with the Speed River.

Horseshoe Moraine

The Horseshoe Moraine region is very a dynamic area and provides extensive habitat, including 5000 hectares of wetlands. The southern arm of the region extends from Erin to Puslinch Lake in the Alleghenian habitat and plant growth zone then southerly through the centre of Brant County to Simcoe in the Carolinian Zone. Approximately 30% of the moraine region is forested, field sizes are slightly smaller, and fencerow vegetation is often very well developed.

The Eramosa River cuts deeply through limestone bedrock from Everton to Guelph. All types of wetlands are represented, and Puslinch Lake, the largest natural lake between Toronto and Windsor is present. The watersheds of Hanlon, Irish, Mill, Aberfoyle, and Torrance Creeks and the corridor of the lower Speed River are within this physiographic region.

Stretches of these creeks and the Eramosa River are classified as cold water. Karst-like topography is found in the Rockwood area. There are several swamps and upland forests that have interior breeding habitat for birds requiring seclusion. The main ones are source areas for, or centred on, the above stated creeks and are named after them. The Eramosa River-Blue Springs Creek wetland complex with a total area of 1045 hectares is home to significant species including Northern Flying Squirrel, Mourning Warbler, and Eastern Goshawk.

The wetlands and valleylands once supported Canada Lynx, Bobcat, Eastern Cougar and River Otter. Puslinch Lake and associated wetlands form a complex with an area of 350 hectares and the fens, bogs and swamps along its south shore make it one of the most diverse and dynamic areas of habitat in the Watershed. The lake is a fishery and stop-over for migrating waterfowl. Eastern Ribbon Snake is found in the southern half of the complex.

In the late 1950’s, Highway 401 was constructed through the middle of the Watershed, from Morriston to Woodstock. To preserve high quality agricultural land the highway was routed through wetlands and woodlands at the backs of farms.

As a result the highway split the 1400-hectare Mill Creek wetland complex in half and severed the 113-hectare Irish Creek swamp from its source area in the Puslinch Lake complex. Drainage and wildlife movement patterns were severely disrupted. Mill Creek wetlands support several species of orchids and 3 rare species of ferns and the creek itself is a regionally significant trout stream. There are 7 regionally rare species of ferns and several regionally rare herbs in the Irish Creek swamp. The swamp and its adjacent maple, beech, hemlock upland woodlands provided habitat for Red Shouldered Hawk in the 1970's.

From the Eramosa and Puslinch areas of southern Wellington County the Galt moraine component of the Horseshoe Moraine region extends southwesterly through the Townships of North and South Dumfries, Brantford and Oakland. The Grand River cut through the moraine south of Cambridge creating a deep, richly vegetated valley. Adjacent to the valley are patches of prairie, kettle bogs, and headwater swamps of small tributary streams. Water from precipitation infiltrates to the water table in areas of sand and gravel deposits in the moraine and the local ground water flow is toward the rivers and streams.

The ground water discharge in the forms of springs, seepage lines, and upwelling, supports very important habitat. The discharge supports small cold-water streams that flow year round; it affects soil formation, thereby creating special habitats for plants and reptiles and amphibians; it causes wetland development on steep slopes; and it creates upwelling of water in the river that is cooler than air temperature in summer and warmer than air temperature in winter. Due to the influx of

warmer water, sections of the Grand River in this physiographic region do not freeze over in the winter and as a result Canada geese and other waterfowl can overwinter on the river.

Wildlife habitat in the Horseshoe Moraine physiographic region is further enhanced in the area south of Puslinch Lake because of the climatic influence of the Carolinian Zone. This plant growth and habitat zone is characterized by growing seasons and relatively mild winters that are typical of parts of the Carolinas. This area of Ontario, which is located south of a line from Grand Bend to Toronto, is the most southerly portion of Canada. Special attention is given to the Carolinian Zone - the “banana belt” of the Watershed, later in this report.

Waterloo Hills

Much of the core of the Watershed and the most of the Regional Municipality of Waterloo is located within the Waterloo Hills physiographic region. This area has the greater portion of the watershed population and urban development. Wildlife habitat is threatened here.

The Grand River has cut its valley in a north-south direction through the eastern half of the region and two of its major tributaries, the Conestogo and Speed, converge on the Grand in this area. These were the major water-based wildlife corridors in the past but functions have been limited by all of the urban land uses in the vicinity. Water was used for transport and power at the time of settlement and towns and villages grew up along the rivers at the expense of wildlife travelways along rivers. Urban development has extended outwardly from these nodes engulfing whole tributary watersheds.

The eastern half of the Waterloo Hills physiographic region includes the Grand River corridor and the Cities of Waterloo, Kitchener, and Cambridge.

The Waterloo Hills region has a higher percentage of easily managed land for agriculture than the till plains to the north and the Horseshoe Moraine to the east. As a result, wildlife habitat has been reduced to ‘islands of green’, which have been invaded by several non-native plant species introduced for agricultural and urban landscaping purposes.

The invasions of aggressive exotics coupled with management and harvesting practices have reduced the level of natural integrity of these remnants of our natural heritage. Due to the competition for the use of land in urban growth and extensive agriculture, new non-agricultural development has frequently been pushed into the naturally vegetated lands with less capable soils. There are approximately 100 areas in the region with high levels of diversity and integrity of habitat and there is widespread interest in sustaining them.

The western sector of the Waterloo Hills region drains to the Nith River and, as on the Stratford and Dundalk Till Plains, there is less forest cover in the west than in the east. Large woodlots in the Amulree, Wellesley, Crosshill, St. Clements, Bamberg, Josephsberg, St. Agatha, and Phillipsburg areas provide a range of habitat for significant wildlife species. Most are dominated by Sugar Maple, Beech, and Hemlock in rich stands on hummocky ground. This is the Wilmot ecoregion; named after its largest municipality, the Township of Wilmot.

Small low-lying kettle depressions occurring in the generally upland woodlands are usually covered by Soft (Red or Silver) Maple. Larger kettles at St. Clements and Bamberg are bog like, with numerous plant species that are found on acidic soils including Black Spruce, Labrador Tea, and many orchids. The woodland at Josephsberg is primarily swamp, dominated by Soft Maple and White Cedar. Some of the significant species found in these areas include Red-backed Vole, Snowshoe Hare, Dwarf Mistletoe, Pale Laurel, Clubspur Orchid, Ragged Fringed Orchid, and White Water-crowfoot.

The central and eastern sectors of this region lie within the watersheds of the main Grand and Conestogo Rivers and creeks of medium size including Laurel, Boomer, Martin, Schneider and

upper Alder Creeks. Water from precipitation infiltrates in the sand hills and discharges as ground water to the headwater wetlands and source areas of the streams, creating fens, bogs, kettle lakes, swamps, marshes and sufficient baseflow in streams to support trout fisheries. There is a great concentration of these areas in the Erbsville area in the Laurel Creek watershed. Over 625 hectares of wetlands and a trout stream amidst a series of hills, plus ground water recharge and discharge areas make the area very dynamic. The kettle lakes in this sector are Paradise, Sunfish, and Spongy Lakes. Significant species in these areas include Early Coral-root, Pink Pyrola, Leconte's Sparrow, Barred Owl, and Red-shouldered Hawk. Wildlife is enhanced somewhat in this area by the Laurel Creek reservoir as numerous migratory bird species stop over there in spring and fall, including Double-crested Cormorant, Osprey, Snow Goose, Common Loon, American Golden Plover, and Terns.

Northeast of Elmira there are two landforms of recognized significance. They are the Woolwich sand hills and the Woolwich swamp. The prominent sandy hills were reforested approximately 65 years ago. The plantations provide habitat which is unique in the region as the hills are surrounded by heavy soils characteristic of till plains. Pinesap and Red-breasted Nuthatch, which are more common in northern Ontario, are found in the plantations. At the bottom of the hilly area or its southeast side, there is a large swamp, which is a headwater area for a branch of Canagagigue Creek. Coniferous species including Black Spruce, White Spruce, Balsam fir, and White Cedar make up a large percentage of the swamp canopy.

The valleys of the Conestogo and Grand Rivers in the Waterloo Hills region have been utilized as pasture land for generations and natural vegetation has been suppressed in many bottomland areas. Narrow ribbons of forest on steep slopes and in flood plain seepage areas provide some fragmented woodland habitat. These areas have potential to become broad corridors with diverse core habitat and routes for daily and seasonal wildlife movement.

The Carolinian Zone

The Carolinian Zone is the land of the Flowering Dogwood, Sassafras, Hickory and Tulip trees, and is recognized as a nationally significant resource. These trees and unique animal associates are found in forests of ash, maple, oak, beech, and many other species commonly found outside the Carolinian Zone.

Flamborough Plain

The western side of the former Township of Beverly, now the Town of Flamborough, lies within the Flamborough plain physiographic region and Beverly ecoregion. Shallow soils over bedrock in the Sheffield-Rockton area provide interesting habitat that is characterized by swamps, marshes and bedrock outcrops. The west end of the Beverly Swamp and the headwater area of Fairchild Creek are located in this region.

The 2000-hectare Beverly Swamp is the third largest remaining interior wetland in Southern Ontario and it is home to several species that are at the southern limits of their ranges in Canada. They are Black Spruce, Porcupine, Northern Flying Squirrel, Snowshoe Hare, Woodland Deer Mouse, and Water Shrew (Ecologistics, 1976)

There are relatively flat exposed bedrock plains in the Kirkwall, Rockton area with alvar-like vegetation. Eastern Red Cedar or Juniper is one of the species that is often found in patches in such areas. Extensive areas of meadow in this vicinity supported large populations of sparrows. Reforestation and agricultural practices have drastically reduced the quality and extent of the meadow habitat.

Horseshoe Moraine - Carolinian Sector

The southern arm of the Horseshoe Moraine physiographic region stretches into the Carolinian Zone and splits the Norfolk Sand Plain physiographic region into west and east halves in the Watershed. This southern arm comprises the core of the Dumfries ecoregion, named after the Townships of North and South Dumfries. East and west fringes of the ecoregion are on the Norfolk sand plain. The combination of the till moraine and the climatic factors of this plant growth zone creates high diversity in habitat. The diversity is further enhanced by the deeply cut valley of the Grand River in the middle of the region and by the sand plains on the flanks.

Some of Ontario's most significant and most sensitive habitat is located in this lower sector of the moraine region. There are 35 recognized natural areas of provincial interest, including all types of wetlands, prairie, upland forest, riparian corridors, islands and meadows. They cover over 2550 hectares. Species of wildlife that are rarely found in this part of the watershed are also rare in the rest of Canada.

Because this is the most southerly part of Canada, many species are at the northern extent of their range here. One species, American Chestnut, is threatened by Chestnut Blight. In addition to Chestnut, 3 other species, Bird's Foot Violet, American Ginseng, and Common Barn Owl are also present in this moraine region, but threatened in Ontario. There are approximately 10 species classified as vulnerable and approximately 100 which are regionally rare and provincially significant. Several are provincially rare.

There are two noteworthy areas that were recently discovered in Brantford. These are indicative of the status of our inventory of natural heritage areas in the Watershed. In 1990 the Brantford perched fen and adjacent savannah site and the Brantford Golf Course prairie and adjacent savannah were discovered and documented by botanists. Several rare grasses, sedges, herbs shrubs and one rare tree, Dwarf Chinquapin Oak were found in these areas. More work by botanists and other natural heritage specialists may uncover other significant resource areas.

Norfolk Sand Plain

The area of the watershed that has the greatest capability for agriculture and plant growth, in general, is the Norfolk Sand Plain physiographic region. Lands here are rated above prime and are used for specialty crops grown in few regions in Canada. Wildlife habitat is threatened here because there is little marginal land left for wildlife. Land uses, which are not agricultural, have traditionally been allocated to the marginal lands, leaving habitat highly fragmented. Few core areas other than large swamps exist. Examples are Falkland Swamp (240 ha), Oakland Swamp (800 ha), and Burford Swamp (820 ha.)

There are two parts in this plain region, one being west of the southern Horseshoe Moraine region, the other east. The western portion covers the watershed from a line extending from Ayr to Princeton and southerly to the watershed boundary in the vicinity of Scotland and Oakland. The Waterford ecoregion is within this part of the physiographic region. The lower half of the Whiteman's Creek watershed, all of Charlie Creek watershed, and source areas for McKenzie Creek and Boston Creek are located in this physiographic region.

Whiteman's Creek has a large watershed extending from its source area in the Oxford Till Plain region, through the Norfolk Sand Plain region to the Horseshoe Moraine region where it has cut a deep valley to the confluence with the Grand River. In the sand plain the gradient of the creek lessens and it is linked to a large complex of small wetlands, most of which are swamps and marshes.

Within and adjacent to these wetlands are many irrigation ponds, usually ringed with willow trees and shrubs. Few significant species have been found in this region. Whiteman's Creek is a very

significant trout fishery in the moraine region and its headwater area in the Princeton-Innerkip area has a variety of significant species and habitats.

Fairchild Creek and Big Creek drain the eastern portion of the Norfolk Sand plain region, in the Peter's Corners, Ancaster, and Cainsville area. Wetlands in the Fairchild Creek watershed complex (205 ha.) are important to this region. Again most natural areas are small, fragmented and narrowly sinuous along streams and steep slopes.

The Norfolk Sand Plains region has been significantly affected by the development of Highway 403. As was the case with Highway 401, 40 years ago, planners tried to minimize land severances and agricultural impacts. The road therefore was routed through the middle of many wetlands and woodlots from Woodstock to Ancaster across this physiographic region.

Oxford Till Plain

The Oxford Till Plain physiographic region is located in the Plattsville, Drumbo, Princeton, Woodstock area and it is a source area for Black Creek and Whiteman's and Homer Creeks. The eastern fringe of the Woodstock ecoregion and the western half of the Blenheim ecoregion are within this physiographic region. All of the blocks of natural habitat of any significant size are wetlands in this region. There are two main complexes. The Black Creek complex drains to the Nith River and has an area of 890 hectares. This complex supports deer and waterfowl and four provincially significant species and has over 30 regionally significant species.

The upper Whiteman's Creek complex has a number of wetlands within it, which are provincially significant on their own merits. They include Chesney Bog, Pine Pond, Lockart Pond, Buchanan Lake, and Benwall Swamp. The complex totals 2486 hectares. One endangered species, Small Whorled Pogonia, is present in the central portion of the complex adjacent to Highway 401. There are six provincially significant and 29 regionally significant species in these wetlands. Upland woodlands are small and highly fragmented while riparian vegetation corridors are well developed in many areas.

Mount Elgin Ridges

The Kenny Creek watershed and the Norwich ecoregion are located in this northeastern tip of the Mount Elgin Ridges physiographic region. The landscape is dominated by a succession of ridges composed of imperfectly drained clay or silty clay and hollows having alluvial swamps, and deposits of sand and silt. Colles Lake and adjacent wetlands, which are centrally located, are typical features of the physiographic region. The wetlands of the Kenny Creek watershed, which are mainly riparian swamps, are provincially significant and the creek supports a warm water fishery.

Dairy farming is the primary land use in this area, in contrast to the sandy lands to the east, which are tobacco, and specialty croplands.

Haldimand Clay Plain

The lower Grand River Watershed, southeast of a line through Alberton, Onondaga, and Bealton is within the Haldimand Clay Plain region. The core of the watershed from Caledonia south to Lake Erie lies within the Cayuga ecoregion. The Grand River corridor is well developed in this ecoregion with extensive marshes, floodplain meadows, oak savannahs, woodlands, and willow lined riverbanks, between the roads that parallel the river.

There are several areas of significance in the region, some for their size and others for their high quality habitat. The Six Nations and New Credit Indian Reserves comprise the Tuscarora ecoregion within this physiographic region and they are almost 50% forested. An ecological study was carried out in the area in the early 1980's and observations of a few regionally rare species

have been reported. The most important observation, however, is that the large mid-concession blocks of forest have several large core areas which are separated from the forest edges by 200 to 400 metres. The potential nesting habitat for interior nesting species and the potential habitat for Carolinian species requiring large amounts of forest in daily and seasonal ranges is phenomenal.

Other large areas of forest of importance are the North Cayuga slough forest (1214 ha.), the Oriskany Sandstone woodland and Dry Lake wetland complex (306 ha.), the Taquanyah wetland complex (142 ha.), the lower Grand River marshes (1106 ha.), the Dunnville northwest woodland and wetland complex (230 ha.), and the Mount Healy woods (81 ha.). These areas are worthy of special attention.

The North Cayuga slough forest is a diverse forest dotted with vernal pools and sloughs that are ringed by swamp communities. Sugar Maple, White Ash, and Red Oak dominate upland areas. Red Maple, Swamp White Oak and Black Ash dominate low wet basins. There are transitional areas having a broad range of species. The area is drained by 2 creeks; Oswego Creek to the east and tributaries to the Grand River to the west. One creek extends westerly through a woodland and ravine system at Ruthven.

This is a valuable area and Macdonald (1980) noted 460 plant species, of which 14 are considered nationally, provincially, and or regionally rare, including Black gum, Flowering Dogwood, Southern Arrow-wood, and a sedge (Carex seorsa). Of 73 bird species recorded, four are rare in Canada, Ontario and regionally. They are Red-bellied Woodpecker, Acadian Flycatcher, Tufted Titmouse, and Prothonotary Warbler. There is also a heronry in the forest.

The Grand River and Dunnville marshes are two of the best examples of riverine marshes in Southern Ontario and are significant stopover areas for migratory birds. Significant bird species are King Rail, which is nationally and provincially rare, and Black Tern.

The Oriskany Sandstone woodlands and Dry Lake wetland complex is a very dynamic and significant area of the watershed. This is the only outcrop of Oriskany Sandstone in the province and it is the western end of the Onondaga Escarpment, which extends into the Niagara Peninsula. The area has several mysterious clay knolls scattered throughout and examples of karst features. Of 627 species of plants found, 12 are provincially and nationally rare and 27 are regionally rare. This area is the only known home of the nationally and provincially rare Black Rat Snake in the watershed. Red-bellied Woodpecker, Orchard Oriole, and Yellow Breasted Chat, all of which are provincially rare, were also found here. Two nationally and provincially rare mammals, the Woodland Vole and the Southern Flying Squirrel are on record for this area.

Action Items

- **Profile the unique characteristics of each physiographic region within the watershed in terms of habitat and species diversity**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

PART 2:
FOREST HEALTH

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Summary

Part 2 and this summary cover Sections 2.1, 2.2, 2.3, 2.4, and 2.5. These sections explore more fully some of the forest health issues that have been touched upon in the Description of the Watershed Forest.

The cumulative impact of natural and unnatural stresses (Section 2.1) combines with invasive exotics (Section 2.2) and aspects of diversity (Section 2.3) to favour or disadvantage certain species or communities. These impacts manifest themselves in many general ways, and specifically, species at risk (Section 2.4) and significant natural areas (Section 2.5) are indicators of forest ecosystem health.

"Pests" and their "victims" generally achieve some kind of balance in undisturbed ecosystems. It would be unlikely now to find any undisturbed ecosystem on the planet, and certainly the whole of the Grand River watershed is heavily impacted by human activity, so that balance has been lost. Consequently, even pests that have lived in relative harmony with their hosts may gain an advantage on account of additional stresses that the tree/forest is experiencing. Forest health is a cumulative thing, where each additional stress creates the opportunity for added injury from another source.

The greatest challenge in forest health is to keep species and forest communities from being overwhelmed by a combination of factors, or by one newly introduced pest. This is a challenge in both rural and urban areas. Keeping trees alive long enough to fulfil their "mandate" is the major challenge in often-harsh growing conditions of cities.

Invasive exotics are species accidentally or purposely introduced from afar that are very successful in reproducing in their new locales, at the expense of indigenous, or native, species. They take advantage from their adaption to similar climates, their "generalist" or weedy status, their favourable response to polluted or disturbed sites, and in some cases, their lack of enemies, predators, or counterbalancing factors. Some of the best-known invasive exotics lately are purple loosestrife in wetlands and zebra mussels in the Great Lakes. Many introduced species have had massive impacts on the forest, including chestnut blight and Dutch elm disease, but now the pace of introductions has accelerated in step with global trade, and the conditions have become more favourable for weedy and other invaders.

Forest biodiversity comes at different levels: landscape level, within populations, and within the individual. Diversity in this context speaks to the pattern of the watershed landscape and the distribution of forest communities throughout, the distribution of populations across that landscape, and the genetic makeup of the individuals comprising those populations. Biodiversity is a cornerstone of ecosystem health, it provides a mechanism at all three levels to constantly evolve in response to change, and it enriches the lives of humans. As the world and this watershed head into a future of accelerating change, the possibility of evolving in response is crucially important, and significantly hobbled by the fragmented nature of the watershed forest and other factors.

Species at risk are our "canaries in the coal mine" – they signal improving or deteriorating habitat conditions. The Grand River watershed is naturally a forested landscape with an unnaturally scant amount of forest, so it is no surprise that most of the species at risk are directly or indirectly

dependent on forest health for their continued survival. Extinction, it has been said, is forever, and each extinction is a further impoverishment of the planet and humankind. The species at risk require direct assistance, and they need generic assistance aimed at their habitat and landscape needs.

Significant natural areas may be an ironic title, as all natural areas are significant, especially when only 19% of the watershed is in forest. The most significant natural areas have been identified in various planning and other documents, and many receive some level of protection.

This complex interaction of stresses and influences on forest health is explored in this section, along with some measures for responding to the challenge.

2.1 Insects, Disease, and Other Stress Factors

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Disturbance and Stress

The pattern of arrangement of natural areas across the landscape can be a major contributor to various disturbance and stress mechanisms. As an example, hedgerows joining forest patches are suspected of sometimes helping the spread of invasive exotic organisms (species introduced from afar that reproduce and spread very successfully at the expense of indigenous species).

Development in woodlots has a severe and permanent effect on the forest's health.

In the central part of the Grand watershed are the cities of Brantford, Kitchener-Waterloo, Cambridge and Guelph. Tremendous development pressure is put on adjacent lands. Some woodlots are destroyed, some are built into, and some are 'preserved'. Saving a woodlot from having houses built within it is worthwhile, but certainly does not prevent stress and disturbance impacts. Increased or new traffic (walkers, bikers, etc.) can pummel the forest floor plants and soil. Even if not a single person walks into the woodlot, recent studies at the University of Waterloo show that interior forest-dwelling birds may not inhabit woodlots near subdivisions.

The amount of forestland affected is significant. Although it is almost certain that gains in forest cover in rural parts of the valley exceed losses from urbanization, the loss of function of these woodlands is still very important. The woodlots being affected near cities are often high quality forests, while newly established forest cover is probably decades away from providing similar calibre of habitat.

Climate change is predicted to make this area warmer and drier. Extreme weather events may become more frequent and severe. Hail storms, ice storms, drastic freeze-thaw cycles in mid-winter, late spring frosts and early fall frosts, and extreme cold without snow cover on the ground, are all harmful to trees. Droughts have been increasingly common and severe in recent years, making tree establishment difficult, and stressing all trees. If the frequency increases, or the extremes become more extreme, the cumulative impact could put forest trees into a decline spiral. Experts believe that the decline of sugar maples in this valley and elsewhere around 1988, and commonly blamed on acid rain, was actually caused by a series of such extreme weather events.

Pollution

Acid rain and other pollutants are not an obvious stress on local forests at this time, and yet they are certainly having harmful impacts. In addition to local pollution sources, the Grand River valley lies in the path of airborne acid coming from the Ohio valley industrial areas. Although this watershed is a zone of very high acid deposition, it is also an area where the calcareous soils and underlying geology buffer the system; the lime in local soils balances the acid rain, and pH remains mainly tolerable for vegetation. This insidious chemical assault weakens the forests, even though it is difficult or impossible to see the direct damage, making the forests susceptible to other stresses.

Road de-icing salts are a major problem for urban street trees and trees and forests near major highways. The dieback on branch tips caused by salt can be seen very easily along major roads, especially Highway #401. This stress does not threaten to overwhelm rural forests, as it is a localized problem near the major roads. Most forests do not front on roads, and road salt damages only a relatively narrow band along the road. In the case of the 400 series highways, their route selection processes resulted in the highway disproportionately cutting through the middle of forests, and so where the greatest salt spray exists is unfortunately also where the most forest fronts on roads. These forests along Highways 401 and 403 bear the brunt of rural salt damage. In the urban forest, the possibility of having a relatively continuous and healthy tree canopy is seriously jeopardized by road salt along major roads. Some tree species are less tolerant than others of salt, and so they are underrepresented in the roadside “forest”. The resultant lack of diversity makes the roadside “forest” susceptible to insect and disease epidemics.

Excess low-level ozone and artificially high incidence of nitrogen from various sources may be the most important pollutants impacting on the forests of this watershed. Background (natural) concentrations of ground level ozone are increased as a by-product of chemical reactions between various fossil fuel combustion pollutants. Unnaturally high concentrations of ground level ozone are known to impair the productivity of agricultural crops such as beans, and it is certain that increased stress is being put on forest ecosystems, but information regarding the extent of the stress is still emerging. Like the acid precipitation situation, ozone is a pervasive stress agent throughout the Grand watershed. Unlike acid precipitation, there is no known natural ‘buffer’ against excess ozone.

Nitrogen availability is unnaturally high because of nitrogen fertilizers, and local and remote sources of nitrous oxide emissions. Some plants are better able to capitalize on the excessive nitrogen availability, and they succeed at the expense of others. Generally, the plants that are disadvantaged by this situation are plentiful and even “weedy”. Invasive exotics, in particular, are well adapted to taking advantage of excess nitrogen, and therefore pollutants are contributing to a skewing of the plant community and an impoverishment in biodiversity, as nitrogen intolerant species are diminished or disappear from the affected forests.

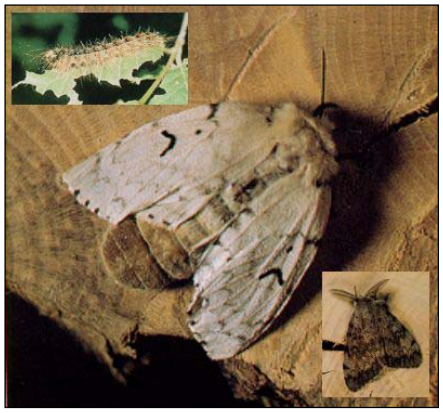
Climate Change

Climate change predictions for northeastern North America include 2-3 degrees of warming. Predicted conditions vary, but for the most part, seem to indicate a dryer-warmer climate in southern Ontario with a longer growing season, less snow and higher minimum temperatures in winter. One of the important aspects of our natural environments' ability to adapt to climate change will be the genetic diversity present in species. Conserving a broad genetic base is one of our best "insurance policies" against the negative effects of environmental change. We must also maintain populations large enough to support prolific reproduction. This will provide a large pool of "candidate" offspring for selection pressure to act upon in the evolution of populations of trees and other species that may be adapted to new climatic conditions.

Predicting which seed sources may be best suited for tree planting under the predicted future climatic conditions is difficult because the trees will have to survive the current conditions as well as future conditions. On an operational basis it is still recommended that we use seedlings from the same seed zone as the planting site, however, documenting the location of seed collection will become even more critical as we try to understand how different populations of trees are responding to climate change.

The conservative estimates of global climate change indicate that the climate will change more quickly than trees can genetically adapt or shift their ranges (through regeneration). It will probably also prove futile to try to anticipate the climatic conditions at a site and plant a tree now that will be genetically adapted to the conditions at maturity. The tree might have to survive and grow for decades in unsuitable circumstances before the climate changed to what was suitable for it. Therefore, all the genetic variability that is available will be needed to protect against the potential impact of climate change.

Insects & Diseases & Drought



Gypsy moth larvae (upper left), adult female moth (center), adult male (lower right)

Native insects and diseases tend to rise and fall in cycles, and so the problems of one year can be negligible several years later. Even so, it's worth outlining some of the key insect and disease concerns for the Grand River watershed forest. Introduced insects and diseases, in contrast, often expand exponentially in their newfound territory until they reach some balance with their new hosts, and sometimes the host tree species are defenceless and succumb totally. The following summary of insect and disease problems relevant to this watershed is culled from *Forest Health Conditions in the South-central Region of Ontario 2001 (H.J. Evans, B.E. Smith, W.A. Ingram; E.J. Czerwinski, Natural Resources Canada and Ontario Ministry of Natural Resources)* and in part from *Control Measures in the Fight Against the Asian Long-Horned Beetle and the Emerald Ash Borer (Canadian Food Inspection Agency. 2004. http://www.inspection.gc.ca/english/plaveg/for/pestrava/controle.shtml*)

Around 1990, the gypsy moth invasion became an issue in this watershed for the first time. These voracious imported caterpillars strip the leaves of most tree species, but show a marked preference for oak, poplar, and birch. Their preference for oak makes them a devastating insect in forests of the Carolinian zone. All of the Grand's section of the Carolinian zone was affected, as the large number of oaks was very much to their liking.

Two of the worst hit spots were the lands of the Six Nations of the Grand River, and Byng Island Conservation Area. At Byng, the combination of soil compaction from recreational use and gypsy moth defoliation has put many of the magnificent oaks there into decline. Pinehurst, Byng, Lafortune, and Taquanyah properties of GRCA, and many private woodlands were sprayed with Bt (bacterial insecticide) in 1992. Gypsy moth populations have declined throughout the infestation area, possibly in part because of unfavourably cold winters. This insect is expected to cause more problems in the near future.

Dutch elm disease is familiar to most as the cause of the decline of the once ubiquitous elms. Many folks have noticed recently another wave of the disease sweeping through the millions of young elms that have sprouted from seed since the initial local wave of the disease (~1965 – 1975). The trees become increasingly susceptible to the disease as they age because their bark becomes increasingly desirable as beetle habitat. The drought also compounds the effects of the disease. Now the elms must also cope with a more virulent strain of the disease that is causing whole-tree mortality in one growing season. In spite of all this, there is hope for the elm, because it is very prolific in regeneration, and also because work at the University of Guelph Arboretum and other places is getting closer to providing a disease resistant strain of elms.

Pine shoot beetle was first found in Ontario in 1993, and spread across all of southern Ontario in the following decade, in spite of quarantines on moving pine logs out of affected areas. This non-native insect is now firmly in place throughout the Grand River watershed, affecting mainly Scots pine.

At Conestogo Lake, about a hundred hectares of Scots pine plantation was killed by the beetle on Grand River Conservation Authority property. Many other areas in the watershed have moderate to severe damage. In the case of the Conestogo Lake infection, all affected areas had an understorey of native trees and shrubs, and so the demise of the pines lead to the release of the more desirable indigenous forest underneath. This is a classic case, although not a classic transition, of a conifer plantation acting as a “nurse crop” that encourages the creation of a native hardwood forest.

Oak wilt is a serious fungal disease of oaks in the United States, and surveys are done annually to detect its appearance in Ontario. Many of the sixty survey locations are in the lower Grand River watershed, and all sixty sites were negative for oak wilt. This disease will probably become a problem for the lower Grand River forests in the future.

Two of the most recently introduced pests to Canada are the Emerald Ash Borer (EAB) and the Asian Long-horned Beetle (ALHB). These forest pests were accidentally introduced through the shipment of infested wood packaging materials into Canada. The Emerald Ash Borer was first confirmed in Windsor in the summer of 2002. By Spring 2004, an estimated 100,000 to 200,000 ash trees in Essex County are likely to die, and three other isolated infestations have been detected in Chatham-Kent County. The first sighting of the Asian Long-horned Beetle in Canada was September 2003 in an industrial park in the Toronto-Vaughn area. The Asian Long-horned Beetle is known to attack and kill healthy deciduous trees including maple, birch, poplar, elm, ash, willow, horse chestnut, hackberry and sycamore. Because of the wide range of preferred host species, the beetle is considered a major threat to urban and natural forests throughout the Northern Hemisphere. At present, the only effective method of control known for these forest pests is the removal and destruction of infested trees for the purpose of preventing further spread. Other management strategies include intensive surveillance, restriction of the movement of host materials eg) firewood, from infested zones and public awareness campaigns. There has been no evidence to show that Emerald Ash Borer and Asian Long-horned Beetle are present within the Grand River watershed to date, however, the possibility of infestation in the future has not been discounted.

Beech bark disease is yet another introduced forest pest gaining recognition for its potential toward debilitating otherwise healthy forests. Beech bark disease consists of a complex of a sap-feeding scale insect and at least two species of fungus. The disease is not new to Canadian borders and was first detected in Nova Scotia in 1890. Since this time, beech bark disease has been continually spreading westward throughout the Maritime Provinces and into the United States, and most recently into Quebec and Ontario. Vigorous trees free of the disease are often found in heavily affected areas. Recent trials with some of these trees have shown them to be resistant to the scale insect. This offers hope that methods can be developed to increase the levels of resistance in affected forests. Relative occurrence of the disease is not yet known in the Grand River watershed.

Other insect and diseases currently having notable impact in the Grand River watershed include the following: anthracnose (oak and ash); Sycamore anthracnose (sycamore and London plane tree); cedar leafminers (cedar); white pine blister rust and white pine weevil (white pine); oystershell scale (sugar maple, beech); eastern tent caterpillar (broadleaf trees); birch leafminer (birch); beech bark disease (beech); and, imported willow flea beetle (willow).

The Forest Health Conditions report includes other factors that affect tree health – notably drought, which is reported as having the single greatest impact on the current condition of trees and forests. The year 2001 was a severe drought year, and this features prominently in the report, and 1998, 1999, and 2002 were also drought years. Trees have now endured the worst 5-year period in decades. Not only does this mean that many trees are unhealthy now as a direct cause of the drought, it also suggests that several years of secondary impacts can be expected to follow. The trees are severely weakened and are therefore very susceptible to insects and diseases, which routinely prey on stressed or weakened trees.

In this watershed, the forests south and east of Brantford were hardest hit, but all forests were affected. Newly planted trees, trees on droughty sites, and trees in wet areas were hardest hit. Oak, ash, maple and basswood were most commonly affected. In the low-lying areas, where it might be incorrectly assumed that the drought would have less impact, the balsam fir, elm, ash, bur oak, and red maple were particularly hard-hit.

The sandy and gravely soils between Cambridge and Brantford failed to sustain mature spruce windbreaks during the drought, resulting in total loss of the windbreak in some cases.

Traditionally, a series of drought years like this might hit this watershed every decade or fifteen years, but there is concern that global climate change may increase any or all of the length, frequency, and severity of droughts. This could be a serious threat in the future.

The area damaged by the insect known as oak leaf shredder coincided with the worst hit drought area south and east of Brantford.

Probably not coincidentally, the worst area in the province for “red oak mortality” is this exact area.

This scenario, with gypsy moth damage preceding drought, followed by oak shredder, is a great example of how stress on trees is cumulative. Consider that any of the many factors that work against tree health, as noted in this section, are usually not enough on their own to kill a tree, but in combination with other factors, the scales start to tip toward tree mortality.

Harvesting Impacts

The level of forest products harvest has not increased dramatically in the Grand watershed over recent years. Harvesting generally takes the form of ‘improvement’ thinning in hardwood forests, and row thinning in plantations. The work is often done by small equipment at appropriate seasons (i.e., when soils are not saturated and thawed) so that damage to the forest is minimal.

There are unscrupulous logging outfits operating in the watershed, but their impact is limited to a relatively small number of woodlands. Improvement thinnings were often cut according to the marking of the Ministry of Natural Resources. Private consultants have recently replaced the Ministry of Natural Resources in the provision of tree marking services and forest management on private land.

Many tree species such as the oaks that are prized both economically and ecologically are intolerant of heavy shade. This means that they cannot thrive in heavy shade, and therefore require some form of disturbance to regenerate in the forest. Natural disturbances include fire and wind storms that remove parts of forests and allow shade-intolerant species to regenerate on the sunlit forest floor. Fire has occurred less frequently in the past few decades than what would historically have been the case. Many forests of today have sprung up following severe logging operations that would probably be considered unacceptable today. Both severity and frequency of fire have declined, and action is needed to maintain these 'shade intolerant' species as an important part of our forests. In an effort to secure the presence of shade intolerant species on the landscape, forest managers and researchers should continue to explore the effectiveness of various silvicultural treatments that emulate natural disturbance patterns and promote the establishment of these species.

In the natural progression of succession, shade intolerants are in time replaced by shade tolerant species such as beech and maple. Changes in the pattern of disturbances can therefore be seen as a pushing or pulling forests this way and that along the succession continuum. The composition of our forests could become far less diverse if all forests become dominated by shade tolerant species. To avoid this possibility, various types of disturbances are being experimented with, especially prescribed burns coupled with thinning.

Action Items

- **Develop and implement a long-term woodlands monitoring system to detect changes in forest health and monitor impact of insects, disease and other stress factors**
- **Continue to apply and demonstrate the effectiveness of silvicultural treatments and harvesting regimes that emulate natural disturbance patterns and help maintain the presence of shade intolerant species on the landscape**
- **Employ satellite imagery to update the GIS forestry layer, monitor changes in the forest canopy and perform a detailed landscape analysis of the watershed**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

2.2 Invasive Exotics

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One of the more negative influences to the biological diversity and functioning of natural areas is the spread of plants and animals from distant lands. Some of these have overwhelmed wild areas; think of Purple Loosestrife in wetlands, Zebra Mussels in the Great Lakes, buckthorns in fields and river valleys, Garlic Mustard in woodlands.

Natural adaptations of species to local conditions have led to the great biological diversity of the Earth. Across Ontario, one sees a progression of different forest types, based on changes in local climate as well as soil types, moisture levels and other factors. Travels farther afield reveal even greater differences in vegetation and reflect the local adaptations of the particular vegetation of a

region to local conditions. In regional sites of similar conditions, such as swamps, the combination of species will likely be quite similar. Across continents, new species will be found, resulting in forests with new characteristics. Due to the long time the plant communities have had to develop and adjust to the local conditions, high levels of ecological balance among the species, efficient resource utilization, and efficient energy capture are generally present. The introduction of exotics can break down these special adaptations to local conditions, with local specialists being replaced by cosmopolitan generalists, such as many of our common weeds.

Plants that have been in these local regions since the first historical records are considered to be native. The term 'native' can be a little confusing; it can be applied to a whole country, a province, or a local region. The local natives are also called "indigenous" to distinguish them from national natives. Furthermore, a plant can be native to a local region, but not throughout the region, just to certain habitats, such as swamps. These distinctions are important considerations when restoring lost or damaged plant communities.

The concern of this section is the introduction of non-natives, in the local sense, that have become invasive within a local ecosystem and thereby impacted it through reduced natural biodiversity and/ or ecological functioning, compared to before the invasion.

Source of exotic introductions

Humans have been introducing plants and animals from one region to another for nearly as long as they have been migrating across regions. The Romans introduced European chestnuts across much of the Roman Empire from their narrow original distribution in the Caucasus mountains of eastern Europe. Indigenous people brought valuable nut and fruit tree seeds with them when they colonized southern Ontario. Early European settlers brought lilacs, apples and daffodils. More recently, the rural landscape is being transformed with the widespread deliberate planting of exotics for slope stabilization along highways and in regional parks. Escapes of landscape exotics are becoming more common, and all of these are finding their way into natural woodlands, river valleys and meadows. How do we make sense of all this? Should we be concerned about every non-native tree or herb in the forest, or are some especially troublesome, deserving our focussed attention?

When are exotics a problem?

Many exotic species are not a serious problem in natural habitats and it is questionable if an effort should be taken to eradicate them. Some provide an interesting cultural context as we hike through the countryside, such as a persisting apple tree near a foundation of a long abandoned farmhouse.

If an open meadow is changing to a forest, either through natural colonization of tree seedlings or through planting, many exotic plants of the meadow will not tolerate shade. Efforts to remove them might best be spent on other activities.

But even with highly invasive species, why not just accept the new immigrants in our changing forests and fields? We could consider that our local forests of the future will consist of Norway maple, European Birch, Manitoba maple, European buckthorns, Black Alder, Crack Willow, Eurasian honeysuckles, White Mulberry, Oriental Bittersweet, with periwinkle and goutweed covering the forest floor, and likely a few native trees that have persisted. Our wildlife might be composed of English Sparrows, Starlings, Norway Rats, House Mice, with native racoons, coyotes and skunks. The choice is really ours, to allow the continuing globalization and simplification of ecosystems, or try to restore what is called "ecological integrity" or "ecosystem health" to our local natural landscapes, with its rich diversity of woodland and meadow species and finely tuned ecological functioning.

There are a few observations to be made here before deciding as to whether this is a problem worthy of fixing. Many of the above species are ecological generalists and excellent colonizers, but not narrowly adapted to a specific habitat. Many fit into their adopted habitat differently than the native species, e.g., Norway maple produces a dense shade that precludes both the establishment of native tree seedlings as well as the persistence of the ground flora that retains the forest soil on slopes. In contrast, Sugar maple seedlings readily establish under the shade of Sugar maple trees, and have a more open canopy that promotes the retention of a rich forest floor vegetation of spring wildflowers, woodland sedges and other soil holding herbs. As the result of Norway maple's presence, the ecology of the site is simplified, usually in lower species diversity and less efficient systems of nutrient cycling and energy capture. The wildlife that such an ecosystem can support is generally less diverse. Overall, with a less healthy ecosystem, human use for sustainable forest product harvesting, the ecosystem services provided to the broader landscape such as ground water recharge and processing, and enjoyment through hiking and nature watching, are all greatly diminished.

The potential social loss deserves closer examination. Our sense of local place–where we live and work–is defined by the images we have of it, many of which are of the locally native vegetation. If these images are transformed from the locally distinctive natural history to cosmopolitan invasive species, we have lost a part of our local identity and connection to the local landscape.

Some examples of serious exotics

While the list of known invasive exotic plant species in southern Ontario is very long, examples of especially troublesome species include:

Norway maple (*Acer platinoides*): this species is widely planted as a park, street and urban residential shade tree; in the past it was also planted along highways and roadsides. We now know that it freely establishes in upland Sugar maple forests. It is especially a problem in urban parks and ravines where seeds blow in from nearby planted trees. The rural roadside plantings are also serving as a seed source of invasions into adjacent Sugar maple forests. This species precludes the regeneration of native forest species by it dense shade; it also leads to increased levels of soil erosion through the loss of the protective native ground flora.

Dog Strangling Vine (*Cynanchum* or *Vincetoxicum* spp.): this species does best in open fields and shrub meadows where it can form solid stands, but it can also tolerate partial shade. This species is especially troublesome in the valleys and ravines of Toronto and other localized areas, such as Burlington and Presqu'ile. If it is discovered in the Grand River watershed, timely efforts to eradicate it are worthwhile since it is extremely difficult to control once established.

Garlic Mustard (*Alliaria petiolata*): this species was introduced for culinary use and now is a serious weed in open forests where it can completely cover the forest floor, excluding many of the native spring wildflowers. Since it is tolerant of partial shade, it persists in all but the densest forests.

Oriental Bittersweet (*Celastrus orbiculatus*): while not as attractive as the native bittersweet, it is widely sold in garden centres (sometimes as the native species) and in a few areas of southern Ontario it is becoming established in native forests where it can climb high into the canopy and cover the trees of open oak forests, much as Kudzu Vine does in the southeastern USA. With bird-dispersed seeds, it can travel and establish well beyond where it is planted as an ornamental. This is one to watch for; it is not yet widely established in the Grand River watershed.

Black Alder (*Alnus glutinosa*): this European species is a tree form, while the alders native to Ontario are multi-stemmed shrubs or small trees. It was made available for planting from government nurseries in the past and now is forming dense thickets in many riparian areas of southern Ontario.

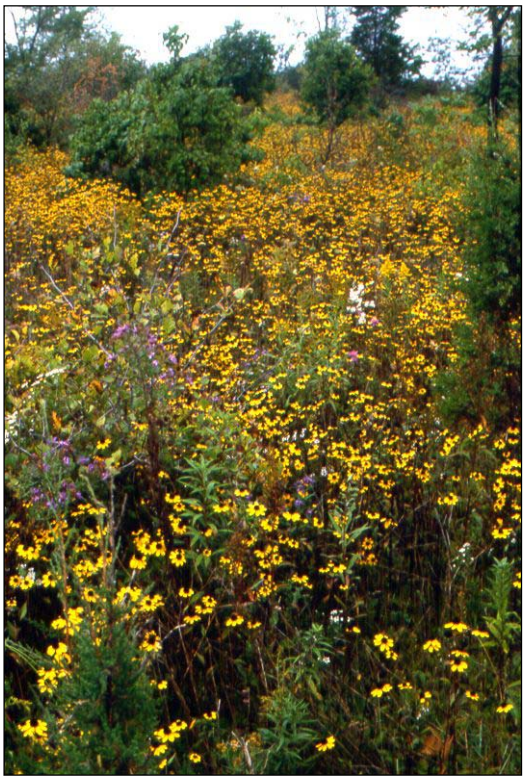
Buckthorns (*Rhamnus* spp.): Common (*R. cathartica*) and Smooth (*R. frangula*) buckthorns are widespread in southern Ontario; Common buckthorn in old fields and open woodlands, and Smooth buckthorn more localized, but generally in wet sites where it can form solid thickets.

White Mulberry (*Morus alba*): this species colonizes fencerows, old fields and open forests. It is having a severe impact on the endangered Red Mulberry with which it freely hybridizes.

Japanese Knotweed (*Polygonum cuspidatum*): locally a problem in river valleys, open woodlands and forest edges where it slowly spreads from plantings or dumping of garden waste.

Watershed ecosystems impacted by exotics

Flood plains: with the combination of periodic disturbance, waterborne deposition of seeds, broken twigs and root pieces, and good fertility due to natural depositions during spring floods as well as runoff from nearby fields, flood plains are very vulnerable to invasions. Because early settlements tended to be along watercourses, there is a long history of introduced plants that are potentially invasive, and a good concentration of stock to move along the river corridor. Flood plain forests were also a popular place to let livestock graze, providing disturbance to open these sites to invasions as well as a steady flow of seeds from livestock fur and excrement as they moved from place to place. Where a rich diversity of herbaceous plants and shrubs once occurred it is diminished by aggressive invasives. Bird-dispersed shrub species such as buckthorn and honeysuckles are replacing the woodland currants, Burning Bush, and Bladdernut; in the open, Common Buckthorn, White Poplar, privet, European High-Bush Cranberry and Eurasian roses are edging out a diversity of hawthorns. The native tree willows, Peach-leaf and Black, are now far less common than the exotic White and Crack willows and the hybrid between these two species.



Tallgrass prairie and meadow habitats are some of the rarest in the watershed.

Upland forests: near or in municipalities, Norway maple is a serious problem in the forest canopy; in some areas one can also find concentrations of Siberian Elm, White Mulberry, Tree of Heaven, Black Locust, Sweet Cherry or Sycamore maple. In the understorey, Eurasian honeysuckles, buckthorns, Japanese Knotweed and barberries are often to be found in forests, with Autumn Olive, Multiflora Rose, and privet at the edges. In the ground flora, Garlic Mustard can be widespread and locally dominant while periwinkle, goutweed, Lilly-of-the-Valley and scilla are often locally dominant from past nearby plantings or spread from dumped garden refuse.

Meadows, prairies, and savannas: These special habitats are often misunderstood. While meadows are typically transitional after natural disturbance, they still are special communities that are often dominated by Eurasian grasses and wildflowers mistaken for native species, such as Dames Rocket and Miscanthus (a Chinese grass) in moist meadows; numerous Eurasian forage grasses, sweet clovers, Canada Thistle (not native despite its name), Field Bindweed, Bird's-foot Trefoil, and locally, Dog Strangling Vine. Exotic woody plants, such as European Birch, Siberian Elm, Scots Pine,

Autumn Olive and buckthorns can be serious invaders.

Prairies and savannas, maintained by fire, are special plant communities only recently receiving full recognition. Both are subject to invasion by native and exotic woody plants when fires are suppressed, such as Common Buckthorn, cherries, Siberian Elm. Cool season Eurasian grasses (in contrast to the native warm season grasses of these communities), sweet clovers, Canada Thistle, Tufted Vetch, knapweed and Leafy Spurge are some of the herbaceous invaders.

The Grand River watershed has many examples of these plant communities; it is important to understand their special character and resist choosing them for tree planting sites.

Understanding the process of change

Why are ecosystems susceptible to invasions? The presence of propagules (e.g., seeds dropped by birds or wind, twigs that float downstream and root, root or rhizome pieces) is certainly a necessary factor, but we must also consider the impacts that degraded sites have received that open them to these natural colonizing (i.e., weedy) species. Soils that lose their important soil organisms, including the fungi that make close connections with plant roots and transfer nutrients (mycorrhizae) may be more open to invasion. Old industrial sites are obvious areas of heavily degraded soils, but there is evidence that even on undisturbed sites atmospheric inputs, especially of nitrates, as found in areas of high air pollution, also negatively impact natural systems, first changing nutrient balances in the soil which effects the soil organisms and then the plants. If one compares the number of exotic plants in urban natural areas, (e.g., the Don Valley of Toronto) to a rural river valley of southern Ontario, considerably more exotics are generally found in the urban setting. Thus, the problem appears to be the result of general environmental degradation as well as the presence of the exotics; to make long-term reversals will require both attention to the problem species as well as the bigger environmental problems.

What can you do about exotics?

If you are convinced that invasive exotics are a serious problem and you want to help to restore natural systems in your local area, here are some ideas that individuals and local groups can do to lead to positive results:

Action Items:

- **Promote the use of native species in landscape plantings.** Promote native planting in your local municipality: urban parks, schoolyards, streets and roads. Native habitat landscaping, especially near conservation areas, is more appropriate than using “off the shelf” exotic landscape stock. It can also provide the rich experience of natural systems in schoolyards and neighbourhood parks. Non-invasive exotic species are welcome in a framework of a native landscape to complement the natural landscape.
- **Work with established programs to restore degraded habitats and naturalize urban areas** (e.g. field days sponsored by the Nature Conservancy of Canada and the Society of Ecological Restoration, Ontario Chapter, the Evergreen Foundation’s “Learning Grounds” program)
- **Advocate for the enactment of local by-laws for natural landscape plantings during municipal planning and development**
- Dialogue with garden clubs, naturalist groups and retail garden centres and nurseries: present both the problem and viable alternatives (for more background information, see the listed contacts at the end of this section).

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

2.3 Diversity

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Species Diversity

The massive changes that the landscape of the Grand has experienced have favoured some species at the expense of others. There may be more species in the watershed now than before European contact, but this kind of unnatural diversity is not a true indicator of ecosystem health. It has become evident in the past decade that some species that rely on interior forest habitat or wetlands are suffering; they are the species at whose expense the others have flourished. In order for species diversity to give an accurate indication of ecosystem health, this context must be remembered.

During the drastic landscape changes of the 1800's, many wildlife species requiring large expanses of forest disappeared from the list of Grand valley inhabitants. These include the timber wolf, black bear, passenger pigeon, cougar, bobcat, and lynx. Other species survive, but just barely. These include southern flying squirrel, eastern mole, Blanding's turtle, red-headed woodpecker, butterfly weed, pickerel frog, and a whole suite of interior forest birds such as warblers and thrushes. Species such as the cucumber tree, Kentucky coffee tree, and prickly pear cactus have never been common here, and are even less so today. Other species, like the bald eagle, and wild turkey, have been re-introduced.

European settlers introduced many plants and animals purposely and accidentally. Some of these species, such as purple loosestrife, capitalize on opportunities so aggressively that they potentially displace indigenous plants. Many 'natural' areas are now comprised of a strong component of non-indigenous plants and animals.

The Grand River watershed crosses the boundary of Hills Site Region 6E and 7E. This boundary also forms the boundary of the Deciduous and Great-Lakes St. Lawrence forest regions. These two forest regions combined have more than 60 tree species. Specific species can be maintained in the landscape by utilizing the appropriate silvicultural guidelines for the forest cover type being managed and incorporating regeneration techniques to ensure the regeneration of species of concern (species that are rare, vulnerable, threatened, or endangered, species that may be common in Ontario but occur at the northern or southern limits of their range within the Grand River watershed, and other species of conservation concern such as butternut and elm which have been decimated by disease).

The Silvicultural Guide to Managing Southern Ontario Forests provides guidelines for managing the forest cover types that exist in Southern Ontario including the Grand River watershed. The guidelines also include the silvical characteristics (site type, shade tolerance, seedling requirements, seed production information, etc.) of tree species and any existing conservation concerns for that species. The silvicultural guidelines also outline management techniques to maintain wildlife habitat elements and to conserve understorey species diversity.

For vulnerable, threatened and endangered species, landowners and agencies should consult with Recovery Plan teams for that specific species to identify the role they can play to contribute to the recovery of a specific species. More detailed information on this topic can be found in the Species at Risk section, Section 2.4.

Tree species of conservation concern in the Grand River watershed

Rare Tree Species:	**Other Species of Concern (disease):**
Northern Pin Oak	Butternut
Sweet Pignut Hickory	Elm
Dwarf Chinquapin Oak	Beech
Pin Oak	Ash
Black Gum	

Vulnerable, Threatened and Endangered Tree Species.

American Chestnut - Threatened (COSEWIC)

Red Mulberry - Endangered (COSEWIC)

Hop Tree - Special Concern (COSEWIC)

Kentucky Coffee tree - Threatened (COSEWIC)

Cucumber Tree - Endangered (COSEWIC)

Biodiversity

There are significant bands of vegetation, landscape units and ecosystems that extend across large portions of the watershed often at right angles to the overall drainage pattern. They are extremely important to the maintenance of biodiversity in the watershed.

On the Till Plains, the remnant woodlands found on farms are usually found at the mid-concession farm lot lines and they resemble green ribbons across the largely cultivated landscape. These ribbons are often the main wildlife corridors and they often run across the watercourses and valley lands, extending into the watersheds of the Maitland, Thames and Saugeen Rivers. Links have been established with the Bruce Peninsula.

Another area of significant vegetation is found in a triangular patch having points at Acton, Brisbane, and North Woolwich Swamp (near Elmira). Although it is patchy on its west side the forested areas in the east are extensive. White spruce is one of the significant species of this area, as it reaches the most southerly extent of its Ontario range here, and forms a significant component of lowland forests, particularly along the Eramosa River. This spruce population is considered to be very significant genetically.

A broad complex of “natural areas” extends from Brisbane southwesterly to Ayr and westerly from Ayr to Woodstock, in the general direction of the ground water flow across the watershed. The majority of the natural areas are wetlands and there are contiguous deposits of sand and gravel that are forested. Land use and development pressure is high and will become higher in this area.

Parallel to the above complex of tremendous natural heritage resources is a band of existing and potential prairie sites. It extends southwesterly from Clyde and Brantford to Woodstock and Scotland. There are many south facing sandy slopes with patches of oak savannah and some prairie elements. Again, the orientation of this band is somewhat cross-watershed.

The areas described above contribute greatly to the biodiversity of the Grand River Watershed. They are large and connect ecological communities here with those in other watersheds, the Niagara Escarpment and the remainder of the Great Lakes Basin. The maintenance of the ecosystem diversity, species diversity and genetic diversity of the watershed and parts of the Great Lakes Basin is somewhat dependent upon our ability to sustain and protect the habitats in these areas.

Genetic diversity

To understand why we should be concerned about conserving genetic diversity in our forest landscapes and the strategies and actions that will achieve this we first need to understand some general principles of genetic diversity.

What is genetic diversity?

Genetic diversity is defined as "genotypic variation in a population" however, it can also be explained as the differences between individuals caused by genes. It is the raw material for the diversity of life.

There are two aspects of genetic diversity that are important in maintaining the health of our forests:

- Fitness—ensuring the organisms in our forests are adapted to the natural range of conditions they will be exposed to throughout their lifecycle
- Diversity—ensuring that we conserve the diversity between individuals to ensure the population will survive in the event of periodic environmental stress and be able to evolve with the environment over time.

Levels of genetic diversity

Genetic diversity exists at several levels all of which are important to conserve. These are:

- Population
- Within population
- Within individual

Population

The smallest tree is from the Algonquin Park area where the growing season length is short (like Luther Marsh) while the tallest tree is grown from seed collected in the Niagara region (similar to Dunnville climate).

Think of a population of trees as a group of trees that have the opportunity to exchange genetic material through pollen (blown by wind) or seeds dispersed by birds and mammals.

We know that populations of trees are adapted to environmental conditions in which they grow. For example, trees around Luther Marsh are adapted to a 190-day growing season length whereas trees around Dunnville Marsh are adapted to a 220-day growing season length. What do we mean by adapted? Within a growing season trees must complete a number of processes such as bud break and shoot growth, diameter growth, and two cycles of root growth, etc. In the Luther Marsh area, where the growing season is shorter, the trees are genetically programmed to

squeeze all of these processes into a shorter period whereas in the Dunnville area the trees are genetically programmed to stretch out all these growth processes to take full advantage of the longer growing season. If you collected seed from white pine in the Dunnville area and planted the trees in Luther Marsh – the trees would not harden off in time and might not survive the colder minimum winter temperatures of Luther Marsh. Conversely, if you collected seed from white pine in Luther Marsh and planted the trees in the Dunnville area the trees would start growing late and stop growing early, therefore not growing as much as seedlings from Dunnville area seed. Research studies conducted in Ontario have demonstrated these principles for red oak (Figure A), white pine, white spruce, black spruce and jack pine.

This idea of genetic differences between populations of trees in geographic locations with different environmental conditions is the reason that it is important that we conserve our adapted populations of trees within the Grand River watershed. For example, if we lose all of the populations of a species in one climatic zone we cannot simply go to another climatic zone to collect seed and expect the seedlings grown from that seed to thrive and provide all the benefits that healthy forests provide. It also has implications for the seed source of the seedlings that we plant in our reforestation and restoration projects. The Ontario Ministry of Natural Resources has developed a system of seed zones for Ontario. To ensure that seedlings you plant will be adapted to the planting site, the seedlings should be grown from seed collected in the same seed zone as the planting site.

Within populations/ forests/stands

As we walk through a forest stand we can see that there are differences between trees within the same species—some of these differences are due to the site and stand conditions under which the tree has grown but some of the differences are due to genes. The next time you are in the forest compare individual maple or white pine trees in terms of the angle that the branch meets the trunk of the tree—this is a characteristic that is under strong genetic control. Characteristics such as stem form, disease resistance, drought resistance, wood quality and to some extent growth rate vary from tree to tree because of their different genetic make up. It is this genetic variation that allows some trees to survive cyclical environmental stress such as diseases, insects, drought, ice storms, unusually late frost, etc. Cutting practices such as diameter limit cutting or selection of all the best trees to cut can negatively effect this genetic variation between trees leaving all the slow growing trees of poor form to mate and produce the next generation. Trees that are inferior genetic stock produce seedlings that are poor genetic stock (slower growing and poor form). It is also this level of genetic variation between trees that tree breeders take advantage of when producing trees for fibre plantations that will grow faster and straighter. Similar to selecting the fastest racehorses then breeding them to produce even faster horses—tree breeders select the trees in the forest with desirable commercial characteristics. Trees are then grafted, put together in a seed orchard and allowed to breed with each other so that the seed produced will result in trees that grow fast and are straight.

Seedlings grown from seed collected in the same seed zone and grown under the same conditions demonstrate the potential genetic differences between individual trees of the same species.

Individuals

As with other organisms, when two individual trees that are related mate, the resulting seedling can show signs of inbreeding depression which means they exhibit less vigour or may not even survive. In the most extreme situation, when self-pollination occurs (such as the isolated tree), there is little viable seed produced at all. Under natural conditions, in most species of trees, trees with female flowers are pollinated by many unrelated trees and relatively less related trees. Millions of seedlings are produced and seedlings of low vigour (in-bred seedlings) are eliminated over time. When we have only small isolated woodlots the chance that related trees will mate is greater and increases over each generation. This is another reason it is important to have larger woodlots and a less fragmented landscape. In addition, when we manage isolated woodlots for timber, we must take care to maintain large numbers (at least 100) of mature individuals to provide regeneration of a species if we want to ensure a genetically healthy stand for the next generation.

Conserving genetic diversity

In existing woodlots

- Apply silvicultural techniques that ensure relatively large populations of healthy individuals of each species will contribute to the regeneration of the stand.
- Apply special care in managing isolated forests (greater than 2 km from another forest of the same species) ensuring at least 100 mature trees of desired regeneration species are maintained to contribute to regeneration—where this is not possible, supplemental planting of stock from the appropriate seed source should be considered.
- Maintain healthy specimens of pest-threatened trees such as butternut and alter silvicultural treatment to ensure regeneration (or provide conditions for seedlings to grow and underplant with appropriate seed source)
- Avoid harvesting methods that degrade the genetic quality of the woodlot i.e., diameter limit cutting, and high grading (removal of all the trees of good form and growth leaving the poor trees to regenerate).
- Landowners should consider seed production as an objective for their forests—(in particular if they have relatively large healthy woodlots) and consider permitting access for seed collectors
- GRCA and partners should establish/maintain a network of seed production and seed collection areas for the species they anticipate planting and for species of concern with limited distribution and abundance within the watershed. The network should cover a range of site types.

In plantations and restoration sites

The most important consideration in ensuring a genetically healthy plantation is the genetic quality of the seed collected to produce the seedlings for the plantation. The following guidelines should be followed when seed is being collected:

1. Seedlots are identified and maintained by location (and this information follows the seedlot from collection to sale of seedling) to ensure seed of the appropriate seed zone is used.
2. Seed is collected from high quality populations - avoid forests that have been high graded.
3. Seed is collected from forests with at least 100 individuals of seed bearing age.

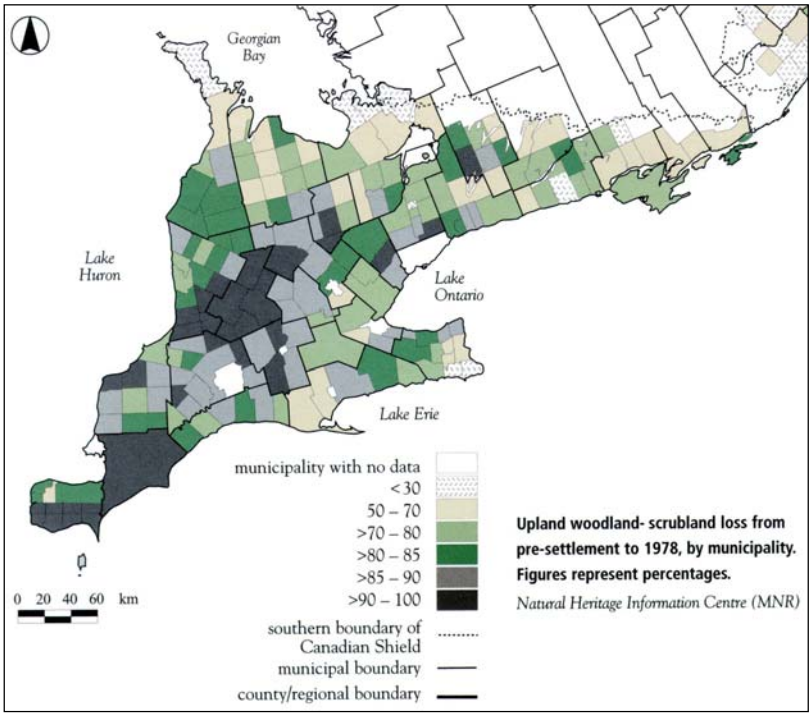
4. Seed is collected from a number of healthy individual trees within the forest, i.e., 15-20
5. Seed is collected in a good seed year.
6. Seed collected from plantations is only collected from plantations of known source or plantations of proven performance, i.e., greater than 60 years old.
7. Seed for species that are susceptible to specific diseases, i.e., butternut canker is collected from trees that are disease-free or show signs of resistance (growing over canker).
8. Landowners, the Grand River Conservation Authority, and other partners who plant trees within the Grand River watershed are strongly encouraged to request information about the source of the seed for the seedlings they purchase for planting; by *Ontario's Natural Selections* certified stock, if available.
9. The Grand River Conservation Authority and partners should coordinate their planting stock requirements to allow coordinated and planned seed collection of appropriate source.
10. Planting trees of a seed source that is not adapted to the planting site conditions has consequences for the plantation itself in that the trees have a lower probability of producing a healthy vigorous stand. This can have negative economic consequences, in that money spent establishing the plantation, which may fail or have low vigour, is wasted, as well as lost income because the plantation's commercial product will be less profitable or non-viable. In addition, a plantation of non-adapted trees can survive well enough to produce pollen and contaminate natural stands within pollination distance—therefore the planting of non-adapted seedlings has negative consequences for the forest landscape over the long term.
11. Grand River Conservation Authority in cooperation with partners and landowners should establish/maintain a network of seed production and seed collection areas for the species they anticipate planting or for species of concern with limited distribution and abundance within the watershed. (SPA- Seed Production Areas- selected as high quality stands and managed to remove poor phenotypes to increase genetic quality and density reduction to enhance crown development for greater seed production. SCA- Seed Collection Areas- selected as high quality stands for seed collection of important commercial species planted in relatively high numbers, but usually not managed specifically to increase genetic quality and seed production.). The network should cover a range of site types.
12. In addition, there are many reasons that native trees should be favoured over exotics however, from a conservation of genetic diversity perspective, native trees should be planted so that they contribute to the population base within the watershed, therefore contributing to the conservation of genetic diversity.
13. Where the long term objective for conifer plantations is gradual conversion to hardwood through thinning, confirm the presence of a seed source of good genetic quality adjacent to plantation otherwise consider augmenting natural regeneration with underplanting of stock of appropriate seed source.

Landscape and Ecosystem Diversity

A picture of pre-European forest conditions of the Grand River watershed can be re-constructed by examining historical survey records, examining remnant forests and drawing from information of remnant forests in areas of similar climate and physiography. Evidence indicates that about 90% of the forest was greater than 120 years of age with only 1% of the area in colonizing species such as aspen and birch. Maple and beech are very tolerant of shade and therefore able to

regenerate under closed canopy (low light) conditions; therefore the dominant forest type would have been maple-beech forest type. The regeneration of stands would have been accomplished in gaps in the canopy created by the death of single large old trees or small groups of trees, allowing seedlings in the understorey to grow and fill the gaps. The process above would result in what has been called a climax forest. Mid-tolerant species such as basswood, ash, and oak would have maintained a presence in the landscape by occupying larger gaps in the canopy produced during windstorms, ice storms or the death of very large old trees. Fire would have occurred on thin soil over bedrock, such as exists in the Rockton area, allowing species intolerant of shade to be established. Oak-hickory forests would have been more prevalent on drier, well-drained sites where fire would renew the stand on cycles of 150- 200 years (Woodland Heritage of Southern Ontario- A Study of Ecological Change, Distribution and Significance. 1999).

In northern hardwood forests, catastrophic disturbances occurred on intervals of 1000-1500 years, but windstorms would have removed 10-50% of the forest canopy every 200 to 300 years. Given pre-settlement records and patterns of disturbance we could expect shade tolerant species to dominate on about 90% of sites (Woodland Heritage of Southern Ontario- A Study of Ecological Change, Distribution and Significance. 1999).



Forest cover in southern Ontario is only a small percentage of what it once was.

Many of the species in the overstory of the present day forest are the same as the pre-European settlement forest but species occur in different proportions. Human-caused disturbance such as extensive cutting, grazing and burning that accompanied early settlement and agricultural development resulted in a forest that is comprised of a higher proportion of species that are mid-tolerant to intolerant of shade (require more sunlight to survive and grow). The present day forests contain more oak, ash, cherry, hickory, basswood and many of the Carolinian species in the overstory than would have been present in pre-settlement times. (Elliot, 1998)

In addition to the change in overstory composition the landscape of southern Ontario has experienced a severe reduction in forest cover.

The remaining forest exists as relatively small patches of isolated woodlots. There are many negative ecological consequences of fragmentation. For example, the amount of forest cover, size of individual patches, forest type, and linkages to other patches in a landscape determine the ability of the forests, and thus the landscape, to support wildlife species which are forest dependent, i.e., mammals and forest interior birds (Great Lakes Fact Sheet—*How Much Habitat is Enough?* produced by Environment Canada).

Ecosystem Resilience

Resilience in industrial (e.g., boreal) forest situations is a measure of the speed and integrity with which a forest regenerates after harvest. Almost all cutting operations in Grand watershed forests are selective, and usually in the positive sense of improvement thinnings. A forest canopy normally remains, although it is somewhat less dense, after a harvest operation. The disturbance is quite different from the large-scale harvests in the boreal forest. In local harvests, seed trees are always close at hand and microclimate is not drastically altered. Consequently it is not that difficult for the forest to regenerate in most circumstances.

That is not to say that there is no chance of harmful impact from improvement thinnings. Seeds of disruptive non-indigenous plants may be brought in on equipment from other woodlots, or soils and remaining trees can be severely damaged by poorly designed and implemented operations. If a thinning is so severe as to effectively extend the 'edge' effect into what had been forest interior, then the system may not rebound to the same level of integrity even though there is ample regeneration.

Abandoned farmlands are regenerating to forest naturally. This is a good sign of resilience. However, the time taken to regenerate varies quite a bit, depending on ground cover, seed source and other factors. The value of these meadows and shrubland stages prior to full regeneration should not be overlooked. Whether a field takes five years or thirty to regenerate, it provides habitat to a certain community at every stage. Non-indigenous species such as Scots pine and buckthorn often become established in regenerating fields, which is not as desirable as indigenous species such as cedar and hawthorn performing that function.

Action Items:

- **Apply and demonstrate silvicultural practices that contribute to the conservation and increase of genetic diversity within watershed forests**
- **Consider seed production as an objective in managing forests**.
- **Establish and maintain a network of seed production and seed collection areas for artificially regenerated species that are limited by seed source.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

2.4 Species at Risk

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Summary

Species at risk are an integral component of all forests in the Grand River Watershed. Whether it is dry, open savannah for Barn Owls, vernal ponds for Jefferson Salamander or open-canopied deciduous woodlands for Hoary Mountain-Mint, species at risk should be considered in all decisions related to forests. In southern Ontario, every activity from hunting, hiking, timber management or clearing for development, has the capacity to severely impact the species that inhabit our remaining woodlands. The Grand River watershed presents a unique challenge because of its diverse range of habitats and the species, which utilize its forests. A large portion of the southern watershed is included in Ontario's Carolinian Zone, which is home to some of the most threatened and endangered species in Canada. Luther Marsh in the north is designated as an Important Bird Area not only for the numbers and variety of waterfowl that utilize its vast

marshes and wetlands but for some of the rare species it hosts, such as Black Tern and Great Egret. As well, the watershed encompasses some of the most industrialized and urbanized landscapes in Ontario, with increasing demands on our natural areas for resources, recreation and space. Many species that once thrived in the Grand River watershed have already been pushed from their habitat or have been lost entirely, and the management of our remaining forested areas will ultimately dictate the future of the species at risk that depend on them to survive.

Introduction

Two centuries ago the natural landscape of the Grand River watershed was a very different place, with a high diversity and healthy populations of plants and animals. In the last 150 years, we have been responsible for the loss and decline of numerous species. Large parcels of land were converted from forest to farm crops, and later cities. Today, remnant forest areas are often small and isolated. We have either completely destroyed or degraded natural forest habitat by introducing exotic species from our gardens and farms. We have overexploited species for food and medicinal purposes, clothing and pets. Our land use practices have degraded our forests and waterways.

Humans are the major cause of the loss of species and their habitat, and this is the problem. Can we continue to support our current and ever-growing population, while at the same time protect the species we have and their habitat? How do we plan the creation of habitat for species that are already gone, in the hopes of one day reintroducing them to areas where they once thrived? Does our community want to consider this? The solutions to these problems will not be easily achieved. In the Grand River watershed, nine tenths of the land is privately owned, and the predominant land use is agriculture. The watershed also has one of the fastest growing urban populations in Canada whose demands for water and other resources will continue to put increasing pressure on the habitat of our native flora and fauna. Because so many (approximately 50%) of all the species at risk in the Grand River watershed rely heavily on healthy, forested areas for their survival, this section refers to all species at risk in the Grand River watershed and their relationship with our natural environment.

Definition of terms and risk categories

(From Canadian Species at Risk 2000 report from Committee on the Status of Endangered Wildlife in Canada COSEWIC):

What exactly is a Species at Risk? How many species are at risk in Ontario, or in our watershed? In order to understand what role species at risk play in the management of our forest resources, it is important to understand how species at risk are defined and categorized. In Ontario, “species at risk” are categorized as extinct, extirpated, endangered, threatened, or vulnerable species or a “species of special concern”. In Ontario alone there are over 200 species of flora and fauna that are considered at risk, due mainly to human factors such as habitat loss, introduction of alien species, pollution, overexploitation, and disease.

Category	Definition
Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct	A species that no longer exists
Extirpated	A species no longer existing in the wild in Canada, but occurring elsewhere
Endangered	A species facing imminent extirpation or extinction
Threatened	A species likely to become endangered if limiting factors are not reversed
Special Concern*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
Not At Risk*	A species that has been evaluated and found to be not at risk
Data Deficient***	A species for which there is insufficient scientific information to support status designation

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required".

*** Formerly described as "Intermediate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994.

NOTE: COSSARO (Committee on the Status of Species at Risk in Ontario) still uses these former designations to denote a species status in Ontario

Species at risk in the Grand River watershed

Quick Facts

- 215 species are at risk in Ontario - combining the federal (COSEWIC) and provincial (COSSARO) lists;
- the Grand River watershed makes up 0.6% of Ontario's land area and yet.....
- 80 or 37%, of the species at risk in Ontario occur in the Grand River watershed;
- 39 or 49%, of the species at risk in the Grand River watershed rely primarily on forested areas for the basic elements of survival (1 mammal, 22 plants/trees, 8 birds, 6 reptiles, 1 amphibian, 1 butterfly);
- over 90% of all the forest in the Grand River watershed is in the hands of private landowners

This suggests that watershed organizations, agencies, municipalities, and especially private landowners have a very important role to play in the conservation of these species not only in the watershed but in Ontario and Canada as well.

> "The valley of the Grand has a diversity of landscapes (ecosystems) based on the variety of geological features and soil types, and differences in climate and elevation. The climatic and elevation variation in the watershed accounts for two major life zones, the Great Lakes — St. Lawrence Region (Alleghenian Zone) and the Carolinian Zone.
>
> The Great Lakes - St. Lawrence forest is a transition zone between the deciduous forests of the south and the boreal forests of the north. Parts of the Grand watershed north of Cambridge are in the southern section of this zone where the forests still look more deciduous than boreal. This life zone in Ontario is not as heavily urbanized nor as intensively farmed as the Carolinian zone. There is a lack of glamorous species to attract attention to it, and yet it also is under pressure.
>
> The northern limit of the Carolinian zone is at about Cambridge. The extended growing season allows many species more characteristic of southern climates to enrich the diversity of this life zone. It accounts for only 0.025% of Canada's land area, yet a quarter of all Canadians live within it. As a consequence of so small an area housing so many people, the pressures on this life zone are intense. A hugely disproportionate fraction of Canada's rare, threatened, and endangered species are from the Carolinian zone"
>
> *(From the Natural Heritage Section of the State of the Watershed Report - 1997*)

The incredible, natural diversity of the Grand River watershed is both a blessing and a challenge with regard to the conservation and management of species at risk. With such a varied landscape from north to south, the range of species increases. This is a blessing in that the watershed community can enjoy some of the most biologically diverse habitat in Canada, but a challenge for resource managers and the community in attempting to balance the needs of all species. The Grand River watershed's cultural, social and historical richness and diversity compound this

situation, adding to the challenges in raising awareness, support, and funding for species at risk. And yet all these factors must be carefully considered when dealing with species at risk, as the ecosystem approach to their conservation and management may prove to be the most effective. Focusing on the individual, without understanding their role as a part of a larger system, may have been a major factor in steering us towards our current situation. Research has consistently shown that the more diverse the ecosystem, the healthier the ecosystem, and vice versa, in the majority of situations.

It is the combination of these varied natural features that makes the Grand River watershed one of the most diverse and species-rich watersheds in Ontario and therefore one of the most important with regard to the conservation of species at risk and their habitat.

See Table 1.1 – Species at Risk in the Grand River Watershed

Challenges and opportunities

"Loss of habitat is the single most important cause of species endangerment; it is a factor in the listing decision of nearly every species on the endangered or threatened list"

David Wilcove - (1998)

How do we resolve our land and water dispute with Mother Nature? On one hand we desperately need to protect and conserve our forests, wetlands, prairies and the species that live there, but we also need more space for ourselves as our global, national, provincial and watershed human populations steadily rise. So where can we find the balance?

In 1998, David S. Wilcove wrote a report entitled *Quantifying Threats to Imperilled Species in the United States*. The purpose of the report was to assess the relative importance of habitat destruction, invasive exotics (alien species), pollution, overexploitation and disease in relation to threatening the existence of native species; specifically to analyze the more specific needs encompassed by them.

Habitat destruction

Nothing is more detrimental to a species than loss of suitable habitat for the basic elements of survival. Without sufficient quality habitat no species will survive regardless of historic or current population levels. Loss of habitat does not affect just individual species. In almost every situation where habitat is compromised or destroyed multiple species and the biodiversity of the ecosystem to which they belong are at risk. If there are to be any serious conservation efforts directed at species at risk, the issues of habitat destruction, preservation, and restoration must be considered a priority.

Habitat conservation and restoration yield considerable spin-off benefits. Although organizations, agencies and individuals may choose to focus their efforts on creating or preserving habitat for one or two species, the results are often beneficial to a much larger population. If a landowner decides to

Opportunities already exist throughout the watershed for habitat enhancement and restoration…increasing interior forest habitat through the reforestation of edge areas and linking these with forested corridors should be a priority.

plant a buffer around an already existing woodlot to increase forest interior habitat for birds, his actions will also benefit salamanders, ferns, moles and numerous other forest-dwelling species, whether or not they are species at risk. In the Grand River watershed the opportunities for habitat restoration and creation for species at risk are numerous. Many farm fields are becoming available for restoration because of changes in farming and land ownership. Although most restoration work has been and will continue to be mainly along watercourses and on fragile or marginal farmland, this is often the most crucial habitat for a variety of imperilled species.

Invasive Exotics:

More recently the factors contributing to habitat loss have broadened and present new difficulties for species at risk. When we think of habitat destruction most of us think of development in woodlots, or draining wetlands. Land use planning policies and bylaws minimize environmental impact to habitat while allowing for human habitation and enterprise. Other forms of habitat destruction are immune to regulation, can be perfectly adapted to survive in our woodlots, wetlands and farmlands and have no natural predators or controls. Species from “away” are among the most pervasively harmful elements in the forest and are described in the Invasive Exotics section of this plan.

In a world where distance is becoming less of a barrier, and global trade volume is rapidly growing, invasive, alien exotics are a factor that will pose increasingly challenging problems for the watershed forest. Very little about these species is often known until after there has been a visible impact on indigenous plants, animals and ecosystems. A forest's ability to resist invasive exotics is directly linked to the forest's overall health. Widespread success of invasive exotics in establishing throughout the watershed forest indicates certain vulnerability, if not a condition of decline or impairment. Research efforts to control several invasive species have yielded some positive results. Purple Loosestrife, for example, has been knocked back by the release of a specific species of European beetle that feeds exclusively on the plant. Further research and education about these and other alien species should be a priority focus for conservation efforts and habitat restoration projects in the watershed.

Exploitation and disease:

The relatively recent decline of the Atlantic Cod and collapse of the East Coast fishery was a direct result of human overexploitation without respecting the limits of the species. In the Grand River watershed the Passenger Pigeon and the Gray Wolf are just two examples of species that inhabited the Grand River Valley long before the large-scale settlement of the watershed. Disease has also played a role in the historic and current declines of certain species at risk in the watershed. A prime example of this is the once-abundant American chestnut. Once considered the "hardest working tree in the forest" the American chestnut was historically one of the most important and abundant tree species in the Carolinian Zone of Ontario and eastern North America. The introduction of chestnut blight fungus in 1904 devastated the native population and left the American chestnut virtually eliminated by 1950.

Further research, public education and an increased knowledge of existing species at risk are perhaps the cornerstones of species survival. For many species there is still very limited knowledge of their complete habitat requirements, life cycles and even occurrence within the watershed. Detailed biological inventories of protected areas and known habitat are needed, coupled with renewed efforts to educate the general public about how they can minimize human impact and even expand the habitat of species at risk. Continued research into the treatment of various diseases, and reintroduction programs for critically endangered species also hold promise. Ironically, species are at risk because of the human factor, and also depend on human action for their potential recovery.

See Table 1.2 – Species At Risk – Population Estimates and Causes for Concern

*NOTE: Information relating to "Causes for Concern" is generated by recovery plans for species that have an active recovery team. Many species listed as extirpated, endangered, threatened and vulnerable do not yet have an active recovery team or recovery plan in place.

Programs and legislation

There are several specific pieces of legislation both provincial and municipal which can play a role in the management of species at risk in the Grand River watershed. Often it is not the legislation but the lack of available information, resources and tools necessary to enforce them that work to the detriment of species at risk and their habitat. Various Acts and Policies, which affect species at risk and their habitat, are outlined below.

1. Fish and Wildlife Conservation Act

Jurisdiction/Administration: Ministry of Natural Resources

Description: Administered by the Minister of Natural Resources. The Act enables the Ministry (MNR) to provide sound management of the province's fish and wildlife. The Act allows MNR to protect and manage a broader range of both games species, such as moose, wild turkey and black bear, and specially protected wildlife species, such as the northern flying squirrel, the peregrine falcon and the blue-spotted salamander. In general, specially protected species may not be hunted or trapped. The Act prohibits the sale of wildlife, invertebrates, or their parts obtained elsewhere if their sale is prohibited in the place of origin. Penalties now include the possibility of jail sentences to reflect the value of fish and wildlife resources to Ontarians. The maximum fine for offences that are not related to commercial activities remains at $25,000, but the Act now provides the courts with the option of sentencing up to one year in jail. A new penalty section for an offence committed for commercial purposes has a maximum fine of $100,000 fine and up to two years in jail. Judges may also sentence offenders to probation and community service orders.

2. Endangered Species Act

Jurisdiction/Administration: Provincial - Ministry of Natural Resources

Description: Administered by the Minister of Natural Resources. Prohibits the following acts - no person shall willfully (a) kill, injure, interfere with or take or attempt to kill, injure, interfere with or take any species of fauna or flora; or (b) destroy or interfere with or attempt to destroy or interfere with the habitat of any species of fauna or flora, declared in the regulations to be threatened with extinction. R.S.O. 1990, c. E.15, s.5. - any person who contravenes this Act is guilty of an offence and on conviction is liable to a fine of not more than $50,000, or to imprisonment for a term of not more than two years, or to both. R.S.O. 1990, c.E.15, s.6.

3. Planning Act

Jurisdiction/Adminsitration: Provincial – Ministry of Municipal Affairs and Housing/Ministry of Natural Resources, Conservation Authorities, Regions and Municipalities

Description: Follows regulations set out in the Provincial Policy Statement (see below).

4. Species At Risk Act

Jurisdiction/Administration: Federal - Minister of Fisheries and Oceans, Minister of Heritage, Minister of the Environment

Description: In 1992, Canada signed and ratified the United Nations Convention on Biological Diversity. The Convention included a commitment for legislation and/or regulatory provisions for the protection of threatened and endangered species. The *Species at Risk Act* (SARA), which

was passed by Parliament on December 12, 2002, is coming into force in three phases. The final phase of SARA will be in effect as of June 1, 2004. Responsibility for SARA falls to the: 1) Minister of Fisheries and Oceans for aquatic species; 2) the Minister of Heritage for species in national parks, national historic sites and other protected heritage areas; and 3) the Minister of the Environment for all other species and for the overall administration of the Act. SARA will: provide for a rigorous scientific and expert process to assess the status of wildlife species; prohibit the killing of extirpated, endangered or threatened species and the destruction of their residences; provide authority to prohibit the destruction of critical habitat anywhere in Canada; provide emergency authority to list species and/or its habitat if they are in imminent danger; provide funding and incentives for conservation and stewardship action; create the mechanisms and powers to help species recover; and provide for compensation where it is deemed necessary.

Recovery plans and teams for watershed species

The following table outlines recovery plans that have been drafted or are in place for species whose range is either wholly or in part within the Grand River watershed, their status, progress and contact information. Recovery plans are written and implemented by species recovery teams which are comprised of "wildlife experts from each of the jurisdictions and authorized wildlife management boards where the species is found. Recovery teams will call upon a wide range of people with expertise to offer, including Aboriginal traditional knowledge and local and community knowledge of the species or its habitat." (Environment Canada, National Recovery and Management Processes for Species at Risk, backgrounder report, 2001)

See Table 1.3 –Selected Species At Risk – Recovery Plan Contacts, Status, Objectives and Progress

Species profile—American Chestnut (Castanea dentate)

(taken from the Recovery of the American chestnut brochure produced by GRCA)

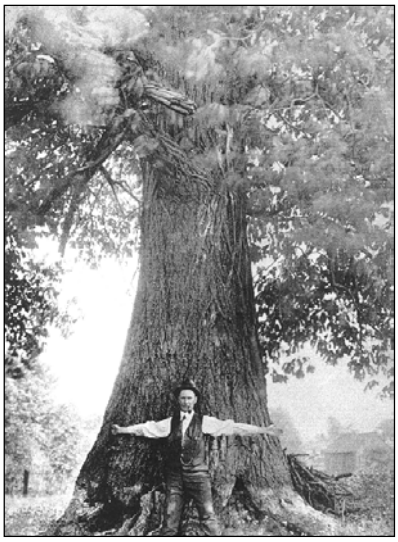
Species Information:

Scientific Name:	*Castanea dentate*
Common Name:	chestnut, American chestnut, sweet chestnut
Current COSEWIC Statue and Year of Designation:	Threatened, 1987
Range in Canada:	Southwestern Ontario (Carolinian Zone)

Rationale for Status: — Chestnut blight, an introduced disease, and loss of habitat continue to be the first and second most important threats to American chestnut in Canada. Remnant populations still persist in southern Ontario due to the chestnut's ability to regenerate from surviving root collars. Therefore, chestnut does not appear to be in immediate threat of extirpation in Ontario.

Natural history

The American chestnut was once one of the most important and abundant tree species in the eastern hardwood forests. It accounted for over 25% of mixed forest stands. The American chestnut was revered not only for its timber, but also for its high quality nut. Early pioneers depended on wood from the



Once the "hardest working tree in the forest"

chestnut tree, as its tannin imparted a high degree of rot resistance. Chestnut tannins were also important to the tanning industry, particularly in the harness trade of earlier years. The chestnut's attractive oak-like grain, durability and ability to resist decay, made this species ideal for use as wood to make telegraph poles, railway ties, panelling, fine furniture, fences, musical instruments and woodcarvings. In addition to the valuable wood, delicious chestnuts were harvested annually and sold freshly roasted by street vendors, particularly during the holidays. Wildlife, such as deer, bear, wild turkey and squirrels also depended on the chestnuts as a valuable food source. The American chestnut tree had more practical uses than any other tree in the eastern forest.

The natural range of the American chestnut extended from southeastern Michigan through southern Ontario to Maine, south to Georgia, and westward to the prairies of Indiana and Illinois. In southern Ontario, the “old chestnut belt” encompassed the counties bordering Lake Erie and all parts of counties to the immediate north, but lying south of a line extending from Oakville (on Lake Ontario) to Grand Bend (on Lake Huron). In these areas of the Carolinian forest the species thrived on sandy or gravel soils. The American chestnut was once found in abundance throughout the southern part of the Grand River watershed. Today, there is new cause to be optimistic about prospects to revive populations of chestnuts in this region.

The Uncertain Future

The American chestnut species was essentially eliminated after the introduction of the chestnut blight fungus *(Cryphonectria parasitica)* in 1904. The original blight, common in Europe and Asia, was introduced to North America on nursery stock from Japan. The first record of a diseased American chestnut tree was at the Bronx Zoo in New York City. By 1920, the blight had reached southern Ontario. The chestnut blight fungus spread rapidly, and by 1930 devastated the native North American chestnut population. It was far more destructive than the Dutch elm disease. By 1950, the American chestnut had essentially been eliminated as a forest tree.

Infecting the above-ground parts of trees, the chestnut blight causes cankers that enlarge, girdle and kill tree branches and trunks. Because the root systems are left intact, the chestnut is able to survive by re-sprouting. A cycle of re-growth and re-infection has allowed the species to persist across the original range of the chestnut tree, despite the presence of the blight. There are over 91 sites in southern Ontario where this species has persisted as shrubs or small trees, where giants once stood. Before the blight epidemic, a typical American chestnut tree would reach a height of 35 metres (115 feet). Now, few over 10 metres (33 feet) tall are found. Today, some of the largest American chestnut trees left in the world are found in the Grand River watershed of southern Ontario.

Current Research

Since the discovery of the chestnut blight, enthusiasts have continued their efforts to save the remaining American chestnut trees and aid in population recovery. Several research groups are experimenting with breeding the blight resistant Chinese chestnut with the more susceptible American chestnut to create resistant hybrids capable of living in North America. In the past, crossbreeding efforts have been largely unsuccessful. However, as techniques are refined, this method could prove useful in the future.

Presently researchers at the University of Guelph are focusing on perfecting biological control using a virus naturally occurring in some strains of the fungus. The virus reduces the strength of the fungus so that an infected tree is able to grow a callus over the canker and survive. With help of current research, more effective methods for promoting the recovery of the American chestnut are being developed.

Action Items:

- **Identify existing and potential species at risk habitat in the watershed, especially related to percent forest cover, quality and pattern.**
- **Undertake detailed biological inventories for all GRCA-owned properties with known or potential species at risk occurrences and/or habitat.**
- **Develop long-term reforestation and forest management objectives related to biological inventory findings.**
- **Develop and implement long-term research and monitoring strategies for species at risk.**
- **Create partnership opportunities for data sharing, monitoring and habitat restoration for species at risk.** Find ways to dovetail with or complement existing programs, projects and activities.
- **Increase public awareness of species at risk and their habitat through implementation of education programs and distribution of resource material.**
- **Make species at risk a priority consideration in all watershed activities, programs and projects.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

The following tables contain these statistics:

- listing of all species at risk in the Grand River watershed by category (mammal, bird, fish, amphibian, reptile, mollusc, plant, lepidoptera) and in alphabetical order.
- SRANK - provincial rank used by the Natural Heritage Information Centre to set protection priorities for rare species and natural communities.
- COSSARO - provincial ranking assigned by the Committee on the Status of Species At Risk in Ontario.
- COSEWIC - federal ranking assigned by the Committee on the Status of Endangered Wildlife in Canada.
- Location in Watershed - taken from the Natural Heritage Information Centre (Ontario Ministry of Natural Resources) Element Occurrences database.
- Population Estimate and Trend - identifies population numbers in Ontario and the general state of the population. Taken from the Canadian Wildlife Service 2002 - 2003 Annual Report on the Recovery of Nationally Endangered Wildlife.
- Cause for Concern - identifies management and conservation concerns for the species. Taken from the Canadian Wildlife Service 2002 - 2003 Annual Report on the Recovery of Nationally Endangered Wildlife.
- Jurisdiction - identifies agencies and organizations responsible for conservation and management of the species. Taken from the Canadian Wildlife Service 2002 - 2003 Annual Report on the Recovery of Nationally Endangered Wildlife.
- Status of Recovery Plan - outlines current position of any recovery plan, which may be in place for the species, and any actions taken by the recovery team. Taken from the Canadian

Wildlife Service 2002 - 2003 Annual Report on the Recovery of Nationally Endangered Wildlife.

- Recovery Team Chair - taken from the Canadian Wildlife Service 2002 - 2003 Annual Report on the Recovery of Nationally Endangered Wildlife.
- Progress to Date - presents new information, action items, conservation measures and general achievements made towards the protection and conservation of the species and its habitat. Taken from the Canadian Wildlife Service 2002 - 2003 Annual Report on the Recovery of Nationally Endangered Wildlife

TABLE 1.1. Species at Risk in the Grand River watershed[1].

Species Name	Latin Name	SRANK	COSEWIC	MNR[2]	Location in Watershed
American Badger	*Taxidea taxus jacksoni*	S2	END	END-NR	Brant, Hald-Nor, Waterloo
Grey Fox	*Urocyon cinereoargenteus*	SZB?	THR	THR	Brant, Hald-Nor, , Wellington
Acadian Flycatcher	*Empidonas virescens*	S2B, SZN	END	END-NR	Brant, Waterloo
Bald Eagle	*Haliaeetus leucocephalus*	S4B, SZN	NAR	END-R	Hald-Nor, Waterloo, Wellington
Barn Owl	*Tyto alba*	S1	END	END-NR	Hald-Nor, Ham-Went
Black Tern	*Chlidonias niger*	S3B, SZN	NAR	VUL	Brant, Grey, Hald-Nor, Ham-Went, Perth, Waterloo, Wellington
Cerulean Warbler	*Dendroica cerulea*	S3B, SZN	SC	SC	Brant, Hald-Nor, Halton, Ham-Went, Oxford, Waterloo
Forster's Tern	*Sterna forsteri*	S2S3B, SZN	DD	DD	Hald-Nor
Henslow's Sparrow	*Ammodramus henslowii*	S1B, SZN	END	END-R	Dufferin, Grey, Hald-Nor, Ham-Went, Waterloo, Wellington
Hooded Warbler	*Wilsonia citrina*	S3B, SZN	THR	THR	Hald-Nor, Halton, Ham-Went, Oxford, Waterloo
King Rail	*Rallus elegans*	S2B, SZN	END	END-R	Grey, Hald-Nor, Ham-Went, Oxford
Least Bittern	*Ixobrychus exilis*	S3B, SZN	THR	THR	Dufferin, Grey, Hald-Nor, Ham-Went, Oxford, Waterloo, Wellington
Loggerhead Shrike	*Lanius ludovicianus migrans*	S2B, SZN	END	END-R	Grey, Ham-Went, Oxford, Waterloo, Wellington
Louisiana Waterthrush	*Seiurus motacilla*	S3B, SZN	SC	SC	Brant, Dufferin, Grey, Hald-Nor, Halton, Ham-Went, Waterloo, Wellington
Northern Bobwhite	*Colinus virginianus*	S1S2	END	END-R	Halton, Ham-Went, Perth
Peregrine Falcon (Anatum)	*Falco peregrinus anatum*	S2S3B, SZN	THR	END-R	Grey, Halton, Ham-Went
Piping Plover	*Charadrius melodus*	S1B, SZN	END	END-R	Hald-Nor, Ham-Went
Prothonotary Warbler	*Protonotaria citrea*	S1S2B, SZN	END	END-R	Hald-Nor, Ham-Went
Red-Shouldered Hawk	*Buteo lineatus*	S4B, SZN	SC	SC	Dufferin, Grey, Hald-Nor, Halton, Ham-Went, Oxford, Perth, Waterloo, Wellington
Yellow-breasted Chat (Eastern)	*Icteria virens auricollis*	S2S3B, SZN	SC	SC	Brant, Dufferin, Hald-Nor, Ham-Went, Oxford, Perth, Waterloo, Wellington
Bigmouth Buffalo	*Ictiobus cyprinellus*	SU	SC	NAR	Hald-Nor
Black Redhorse	*Moxostoma duquesnei*	S2	THR	THR	Brant, Oxford, Perth, Waterloo, Wellington
Brindled Madtom	*Noturus miurus*	S2	NAR	NAR	Hald-Nor
Channel Darter	*Percina copelandi*	S2	THR	THR	Hald-Nor
Deepwater Sculpin (Great Lakes)	*Myoxocephalus thompsoni*	S4	THR	THR	Grey
Eastern Sand Darter	*Ammocrypta pellucida*	S2	THR	THR	Brant, Hald-Nor, Oxford
Greenside Darter	*Etheostoma blennioides*	S4	SC	NAR	Brant, Hald-Nor, Oxford, Perth, Waterloo, Wellington
Kiyi	*Coregonus kiyi*	S3?	SC	SC	Grey
Lake Chubsucker	*Erimyzon sucetta*	S2	THR	THR	Hald-Nor

Northern Brook Lamprey	*Icthyomyzon fossor*	S3	SC	SC	Dufferin
Pugnose Shiner	*Notropis anogenus*	S2	END	END-NR	Hald-Nor
Redside Dace	*Clinostomus elongatus*	S3	SC	THR	Grey, Hald-Nor, Halton, Ham-Went, Perth, Wellington
Shortnose Cisco	*Coregonus reighardi*	SX	THR	EXP	Halton
Silver Chub	*Macrhybopsis storeriana*	S2	SC	SC	Hald-Nor
Silver Shiner	*Notopis photogenis*	S2S3	SC	SC	Brant, Hald-Nor, Halton, Oxford, Perth, Waterloo
Spotted Gar	*Lepisosteus oculatus*	S2	THR	THR	Hald-Nor
Fowler's Toad	*Bufo fowleri*	S2	THR	THR	Hald-Nor
Jefferson Salamander	*Ambystoma jeffersonianum*	S2	THR	THR	Brant, Dufferin, Hald-Nor, Halton, Ham-Went, Waterloo, Wellington
Central Rat Snake	*Elaphe spiloides*	S3	THR	THR	Brant, Hald-Nor, Ham-Went
Butler's Garter Snake	*Thamnophis butleri*	S2	THR	THR	Dufferin, Wellington
Eastern Fox Snake	*Elaphe gloydi*	S3	THR	THR	Hald-Nor
Eastern Hognose Snake	*Heterodon platyrhinos*	S3	THR	THR	Brant, Grey, Hald-Nor, Halton, Ham-Went, Oxford
Eastern Massasauga Rattlesnake	*Sistrurus catenatus*	S3	THR	THR	Dufferin, Grey, Hald-Nor, Ham-Went, Oxford, Wellington
Eastern Milksnake	*Lampropeltis triangulum*		SC	SC	All
Five-Lined Skink	*Eumeces fasciatus*	S3	SC	SC	Halton
Queen Snake	*Regina septemvittata*	S2	THR	THR	Brant, Hald-Nor, Waterloo
Spotted Turtle	*Clemmys guttata*	S3	SC	SC	Grey, Hald-Nor, Oxford, Wellington
Timber Rattlesnake	*Crotalus horridus*	SX	EXP	END-R	Halton, Ham-Went
Wavy-Rayed Lampmussel	*Lampsilis fasciola*	S1	END	END-NR	Brant, Hald-Nor, Oxford, Waterloo
Monarch	*Danaus plexippus*	S4	SC	SC	Brant, Hald-Nor, Halton, Ham-Went, Oxford, Waterloo, Wellington
American Chestnut	*Castanea dentata*	S2	THR	THR	Brant, Hald-Nor, Halton, Ham-Went, Oxford, Waterloo, Wellington
American Columbo	*Frasera caroliniensis*	S2	SC	SC	Brant, Hald-Nor, Halton, Ham-Went, Oxford
American Water-Willow	*Justicia americana*	S1	THR	THR	Hald-Nor
Bashful Bulrush	*Trichophorum planifolium*	S1	END	END	Ham-Went
Bird's Foot Violet	*Viola pedata*	S1	END	END-NR	Brant, Hald-Nor
Spring Blue-eyed Mary	*Collinsia verna*	SH	EXP	EXP	Oxford
Broad Beech Fern	*Phegopteris hexagonoptera*	S3	SC	SC	Brant, Hald-Nor, Ham-Went, Waterloo
Butternut	*Juglans cinerea*	S3?	END	END-NR	Brant, Dufferin
Colicroot	*Aletris farinosa*	S2	THR	THR	Hald-Nor
Crooked-Stem Aster	*Symphyotrichum prenantoides*	S2	THR	THR	Hald-Nor, Oxford
Cucumber Tree	*Magnolia acuminata*	S2	END	END-R	Hald-Nor
Eastern Prairie Fringed Orchid	*Plantanthera leucophaea*	S2	END	END-NR	Grey
False Hop Sedge	*Carex lupuliformis*	S1	END	END-NR	Waterloo
False Rue-Anemone	*Enemion biternatum*	S2	SC	SC	Hald-Nor
Goat's-Rue (Virginia)	*Tephrosia virginiana*	S1	END	END-NR	Hald-Nor
Green Dragon	*Arisaema dracontium*	S3	SC	SC	Brant, Hald-Nor, Ham-Went, Oxford, Waterloo
Hill's Pondweed	*Potamogeton killii*	S2	SC	THR	Wellington
Hoary Mountain-Mint	*Pycnanthemum incanum*	S1	END	END-R	Halton, Ham-Went
Common Hop Tree	*Ptelea trifoliata*	S3	THR	THR	Brant, Hald-Nor
Tuberous Indian-plantain	*Arnoglossum plantagineum*	S3	SC	SC	Grey
Kentucky Coffee Tree	*Gymnocladus dioicus*	S2	THR	THR	Oxford
Large Whorled Pogonia	*Isotria verticillata*	S1	END	END-R	Hald-Nor, Oxford
Prickly Pear Cactus (Eastern)	*Opuntia humifusa*	S1	END	END-R	Hald-Nor
Red Mulberry	*Morus rubra*	S2	END	END-NR	Halton
Round-leaved Greenbrier (Common)	*Smilax rotundifolia*	S2	THR	THR	Hald-Nor
Small White Lady's-Slipper Orchid	*Cypripedium candidum*	S1	END	END-R	Hald-Nor

Spotted Wintergreen	*Chimaphila maculata*	S1	END	END-R	Hald-Nor, Ham-Went
Toothcup	*Rotala ramosior*	S1	END	END-NR	Hald-Nor
White Wood Aster	*Eurybia divaricata*	S2	THR	THR	Ham-Went
Willowleaf Aster	*Symphyotrichum praealtum*	S2	THR	THR	Perth
Frosted Elfin	*Incisalia irus*	SX	EXP	END-R	Hald-Nor

[1]Based on breeding and non-breeding populations that have occurred historically

[2]Based on newly proposed MNR status designations

TABLE 1.2. Selected Species At Risk - Population estimates and causes for concern, As of March 2004.

Species Name	Population Estimate and Trend	Causes for Concern
American Badger	The range of the jacksoni subspecies of the American Badger includes the area around the Great Lakes on both sides of the Canada-US border. In Canada, the subspecies has a very restricted range and now occurs in extreme southwestern Ontario south of the Bruce and Niagara peninsulas. The size of the population is estimated at 0 to 200 individuals, and trends are unknown. It is completely isolated from all other badger populations. There may also be a small number of badgers in northwestern Ontario immediately north of the Minnesota border.	Primary limiting factors include isolation of the small population, habitat fragmentation, an increase in agriculture (annual crop production and clearing of residual native vegetation), reduction in prey and roadkills.
Grey Fox	In Canada, the populations of this primarily southern species are very small. Grey Foxes were once abundant in eastern Canada, but disappeared 300 years ago; they reappeared in the 1920's and 1930's. Grey foxes have been seen in southern Quebec, southern Ontario and southern Manitoba.	Climate can be a limiting factor to Grey foxes. Agricultural development can also be a limiting factor, since Grey Foxes do not inhabit agricultural areas. Competition for food and denning sites with Red Foxes, and hunting and trapping by humans, may also be factors limiting Grey Fox populations.
Acadian Flycatcher	32 pairs (2002) - trend appears to be stable	The species is considered to be a forest interior species, meaning that it avoids forest edges and build their nests in areas that are more than 100 meters from the forest edge. Throughout the Carolinian Forest region of Ontario, most of the remaining forest patches are very small (less than three hectares) and only an extremely small percentage of them are large enough to meet the species' requirements. Drastic reduction of habitat to agricultural and other development throughout the Canadian range.
Barn Owl	0 pairs in ON (2000). 2 confirmed sightings in 2000 - has never been widespread or common in Ontario; considered a rare visitor to Quebec	Loss of grassland foraging habitat primarily through the conversion of pastures to row crops; loss of old wooden barns for nesting.
Cerulean Warbler	Estimate of the Canadian population is 700-3000 pairs: 680-2880 pairs in Ontario and about 20 pairs in Quebec. The population trend is tentatively considered stable (2003).	Because of its preference for mesic and wet woods, the Cerulean Warbler is probably susceptible to the effects of drought and drainage or wetlands. Low levels of logging, such as highly selective cutting and small patch cutting, can probably be tolerated, but a significant amount of late successional deciduous forest must remain available as habitat for this species. The major cause of decline of the warbler in the U.S. is believed to be forest fragmentation and degradation, particularly in lowland areas. Habitat losses in the South American wintering areas could also be contributing to population declines. Observed in the U.S., brood parasitism by the Brown-headed Cowbird may be limiting the reproductive success of Cerulean pairs breeding in fragmented forest.
Henslow's Sparrow	2-3 pairs (2003)	Suitable habitat is lost through the conversion of grasslands and pastures to grow crops. It is also lost with the intensive use of land that leaves very little area undisturbed for periods of time. In addition, drainage of wetlands and wet grasslands, successional change to woodland and shrubland where fires are suppressed, and encroaching urbanization, all contribute to the loss of this species' habitat.
Hooded Warbler	144-207 pairs (1998)	Ongoing destruction and fragmentation of suitable forests within the species' breeding range are major factors limiting the Hooded Warbler population in Canada. Other factors include pesticide poisoning and mammalian predation. The Brown-headed cowbird's habitat of laying eggs in the warbler's nests often results in Hooded Warblers raising cowbirds instead of their own young.
King Rail	25 - 50 pairs (2000) - was possibly never common in Canada, but major declines have occurred	Marsh habitat loss and degradation due to activities such as draining, filling and dredging; very low pop. Size
Loggerhead Shrike	38 breeding pairs in five widely separated areas in ON + 11 breeding pairs in one location in SE MB (2000) - declining	Habitat loss and degradation; changes in agricultural practices that impact on short grass habitat; collisions with vehicles; pesticide contamination
Louisiana Waterthrush	150 to 300 breeding pairs in ON (2003). The primary population occurs within the Norfolk Sand Plain, where about 100 pairs occur.	Logging and forest fragmentation are major limiting factors, given the species' preference for mature, shady forests. Both activities are occurring at an alarming rate throughout the bird's Canadian breeding range. Swamp drainage, reservoir development, fluctuating water levels, water pollution and siltation are other factors. Risky migration flight causes many deaths. Brood parasitism by Brown-headed Cowbirds also contributes to the species' decline.

Northern Bobwhite	200 to 400 individuals estimated in ON in 1989.	Harsh winters, habitat loss and increasingly intensive agricultural practices are major factors of decline. Excessive snow and ice crusts are also detrimental, covering seeds necessary for the bird's survival. Pesticides are damaging, since the species also feeds on insects. Predators such as skunks, foxes, owls, raccoons, dogs and snakes, are also contributing factors. Captive-bred, non-native Bobwhites seriously harm genetically distinct wild populations through interbreeding.
Peregrine Falcon (Anatum)	400 pairs in NWT and YT; 162 pairs known across southern Canada (2000) - trend appears stable in northwestern Canada, increasing in southern Canada	Pesticide use throughout migratory range; small pop. In southern Canada; little protection at nest sites; limited protection for prey habitats
Piping Plover	Atlantic: approx. 449 adults (2000); Prairie: 1687 adults (1996) - comparison of 1991 and 1996 census data: Atl. pop. declined; Cdn Prairie portion of Northern Great Plains pop. increased, but overall this pop. declined	Threats to habitat and reproductive success, including human disturbance, artificial water levels, natural beach succession, and unnatural increases in predator numbers
Prothonotary Warbler	25 pairs + 7 unmated males (2000) - some signs of recovery (increase from 20 to 52 adults between 1996 and 2000)	Nesting failure due to competition with house wrens and brood parasitism by Brown-headed Cowbirds; shortage of nesting cavities; destruction of habitat; drought in breeding habitat.
Red-Shouldered Hawk	Canadian population estimated at 2000 to 5000 pairs (2003)	Habitat loss impacts heavily on Red-shouldered Hawks. Conversion of huge expanses of mature forest to other land uses or forest stages has severely limited suitable habitat, hence population sizes. Forest cutting and wetland filling has diminished the numbers of available prey. Competition from Red-tailed Hawks and Great Horned Owls prohibits nesting in smaller woodlots. Both competitors are more able than Red-shouldered Hawks to withstand the changing environmental conditions. Since the Red-tailed Hawk mates earlier in the season, it often usurps nesting sites previously established by Red-shouldered Hawks. Humans have shot the bird, destroyed its nests and killed hatchlings. Effects of chemical poisoning are uncertain. Eggshell thinning and premature breakage have been reported.
Yellow-breasted Chat (Eastern)	Ontario population considered stable at 30-60 pairs.	The Yellow-breasted Chat prefers early successional habitats that become more overgrown, and hence less suitable, over time. Some human activities, such as clearing of forests, have increased the amount of suitable habitat available, but limited habitat availability is likely an important factor in limiting increases of local populations in Ontario. Loss of habitat has resulted from the increasingly intensive use of land for agriculture and other purposes; pesticides may be an additional factor. The Brown-headed Cowbird frequently parasitizes the Yellow-breasted Chat, but the negative effects of this behaviour may not be impacting significantly on the Chat population.
Black Redhorse	There are no estimates on the size of the Canadian pop. In Canada, this fish in found in the Great Lakes basin; it has been seen in Catfish Creek and in the Grand, Thames and Maitland Rivers.	Siltation and drainage associated with agricultural and urban development, dams, preventing migration
Channel Darter	The species has probably always been rare in Canada, where it is at the northern limit of its range. However, it may be more abundant than existing collections indicate, as more intensive surveys occasionally reveal the fish's presence in new locations. Fewer than 100 specimens were captured in Canada prior to 1993; since then, more than 127 specimens have been captured from four new sites in Ontario and 102 specimens from six new sites in Quebec. It is likely that the new records are the result of increased sampling efforts, rather than population growth.	A habitat factor critical to spawning success in this species is access to areas with moderate to rapid flow. Any barriers preventing movement to preferred breeding habitat would limit production. Also, if the stream flow fluctuates below the minimum required for spawning, the fish will terminate spawning activity. The optimal water temperature for spawning must also persist long enough during the spawning season, or that year's recruitment will be low. Competition for spawning territory from another darter species may also be a limiting factor for some Channel Darter populations. Siltation and turbidity may affect the ability of the species to feed and the availability of desired larval prey. In southwestern Ontario, extensive sedimentation from farms and cities has impaired water quality. The loss of habitat quality is occurring in a part of the Channel Darter's range where only very low numbers of the fish are found. Increasing susceptibility to parasites such as trematodes, cestodes and nematodes may indicate deteriorating health in some Channel Darter populations.
Eastern Sand Darter	new sites have been found for Eastern Sand Darter, extending known range for Brantford pop. By 17 km	Siltation and drainage associated with agricultural and urban development, dams, preventing migration
Greenside Darter	In Canada, the Greenside Darter is found in a few river systems of southwestern Ontario. It has disappeared from several locations in Ontario, and its populations seem to be reduced.	Destruction of habitat is a threat to Greenside Darters. Chemical contaminants can endanger Greenside Darter populations either by directly killing the fish or by killing the insect larvae that they eat. An increase in turbidity can also limit Greenside Darter populations.
Lake Chubsucker		Siltation, turbid waters and loss of critical habitat are all limiting factors. Wetland drainage and siltation seem to be leading causes of habitat loss.
Pugnose Shiner		Siltation and changes in the habitat are limiting the Pugnose Shiner.
Redside Dace		The main factors which have adversely affected Redside Dace populations are destruction and degradation of habitat through siltation; removal of bank cover; and water quality deterioration.
Silver Shiner		Climatic conditions may be important in determining winter survival and spawning success for this fish, since the Canadian populations are at the edge of the species' range. Habitat quality should be protected for this species by assessment and restriction, if necessary, of dam construction, channelization, and similar undertakings. Deteriorating water quality (turbidity, pollution and impoundments) has been responsible for population declines in Ohio. Stream gradient appears to have limited this species' distribution in the Grand River watershed to sections with a gradient between 0.3 and 5.7 m/km.
Fowler's Toad		Fowler's toads rely on early-successional shoreline habitats, which are both created and destroyed by severe storms. As a result their populations

		fluctuate substantially, but there is no evidence for an overall declining trend.
Jefferson Salamander		The loss of wetlands and the destruction of forests threaten many salamanders. Many salamanders are also killed on roads every spring during their migration to the breeding ponds. There is no evidence for decline in these species.
Central Rat Snake		Life-history features of the species, such as late age of maturity and biennial reproduction, may predispose the Black Rat Snake to major population fluctuations in response to seemingly insignificant disturbances, such as incidental mortality on roads. Direct disturbances or destruction of hibernacula could eliminate large percentages of local populations. The habitats of Black Rat Snakes in the Carolinian region may have been reduced or degraded to the extent that local populations are no longer viable. On the Frontenac Axis, the mosaic of natural habitats may become less suitable if there is a continued growth in recreational activity and cottage development. Deliberate killing of snakes by humans is also a threat to snake populations.
Butler's Garter Snake	Population sizes were roughly estimated at several sites in Ontario in 1997. Three Windsor sites had an estimated 50, 100 and 250 snakes. An Amherst site had an estimated 900 snakes.	It is thought that the species formerly occupied a much wider range, under previously warmer and drier conditions. This may indicate that the species is presently limited by climate and the reduction of open habitat. Drainage of seasonal wetlands, particularly small ponds and marshes, has probably further reduced its distribution. The species may be susceptible to habitat fragmentation, since these relatively sedentary snakes would be unlikely to cross large stretches of unsuitable terrain in search of suitable habitat. Mortality due to road kills may also inhibit movements of Butler's Garter Snakes.
Eastern Fox Snake	The global distribution of the Eastern Fox Snake is restricted to the Great Lakes Region of North America. Approximately 60-75 % of the subspecies' range is in Ontario, with remnant populations persisting in Michigan and Ohio. In Ontario, the snake has a discontinuous along the Lake Erie-Lake Huron waterway shoreline, including tributaries and several islands. The greatest numbers of records are from Essex and Kent Counties, followed by Haldimand and Norfolk Counties. There are fewer records from Georgian Bay (Muskoka and Perry Sound). There are no reliable estimates of population size for any local population for Eastern Fox Snakes. Anecdotal information suggests that the majority of Ontario populations are in decline.	The distribution of the Eastern Fox Snake overlaps with a region of North America characterized by particularly high-density human populations, intensive urban and agricultural development, and high levels of industrial pollution. Present threats to the subspecies' persistence in Ontario include: habitat loss and fragmentation (e.g. alteration and draining of wetlands, shoreline development), incidental mortality on roads, and human persecution. Illegal collecting and environmental pollution mat also negatively affect local populations of the snake.
Eastern Hognose Snake	Its distribution is widespread in North America south of the Great Lakes and east of the High Plains. It is largely restricted to dry sandy sites in the north and to forested sandy areas, especially along rivers, in the west. It is absent from large areas of Pennsylvania, New York and northern New England. The Canadian range is restricted to southern Ontario north to the southeast end of Lake Nipissing. Individuals are often on their own when found at many Ontario sites. The species has been extirpated from Point Pelee, Pelee Island, and the Greater Toronto Area. Reports from Hastings, Durham, Haliburton, Haldimand and Norfolk Counties indicate population declines.	Insufficient habitat, too few connecting corridors, too little food and competition from other snakes are probably limiting factors for this species. Canadian populations may also be susceptible to climatic fluctuations since they are at the northern limit of their range.
Eastern Massasauga Rattlesnake	250 in Killbear Provincial Park, and probably less than 100 in each of Ojibway and Wainfleet pops. (1998)	Loss of habitat to development (Ojibiway pop.) and natural succession (Wainfleet); population isolation and reduction through habitat fragmentation; mortality on roads; persecution by humans.
Eastern Milksnake		This species is still widespread in Ontario, but anecdotal information indicates that it occurs in small numbers. The species maintains a small but apparently stable population in Quebec. The milksnake is subject to high levels of road kill and is still deliberately killed because of its resemblance to venomous species. Currently, there is only anecdotal information on this species' biology in Canada, with no quantitative data on life history and demographic measures, abundance or trends in abundance.
Eastern Spiny Softshell	Rough estimate is 1000-2000 in southern ON, <100 in QC	Loss of suitable nesting, basking and hibernation sites; isolation of populations due to habitat loss and fragmentation; poaching of nests; predation of nests and fledged young; increase in fly larvae infestation of nests; pollution; introduction of exotics
American Chestnut	approx. 400 trees and root sprouts (1997)	Chestnut blight fungus which appears as cankers on branches and trunk, causing crown of trees to die; habitat loss through forest clearing
Bashful Bulrush	1 plant located in the Rouge Valley (2001); 1400 plants found in Cootes Paradise (2001); total pop. Approx. 2000 plants	Sensitive to disturbance; competition from exotic and native species may be detrimental; limited understanding of threats
Bird's Foot Violet	According to data reported in 2001, there are five populations in Canada; three occur on private land and two on public land. In total, there are fewer than 7000 Bird's-foot Violets, a decline of between 25 and 50% from 1991 to 2001	A species found in rare oak savannah habitats with a highly restricted geographical range of only 5 occurrences. Populations have experienced significant declines.
Crooked-Stem Aster	Crooked-stem Aster is restricted to southwestern Ontario, where it has been found only in Elgin County (multiple populations), and Haldimand-Norfolk Regional Municipality and Oxford County (one population each). A Middlesex County population apparently is extirpated.	A species of restricted geographical range and small population size occupying few scattered forested edges of streams with potential risks of habitat disturbance and losses from roadside maintenance. Significant modifications to stream and river courses, cutting of woodlots, and construction of housing may be the most critical forms of habitat loss for

		this species.
Cucumber Tree	226 trees in 15 natural sites (2001)	Habitat loss due to agricultural development, logging and clearing; low reproductive potential; requirement for forest openings for seedling establishment
Indian-plantain (Tuberous)	approximately 5000 flowering shoots at 13 sites (1998)	Limited occurrences present within 5 shoreline areas of Lake Huron subject to recreational development and use but with some populations in protected areas.
Red Mulberry	-234 in 2002, (all within the Carolinian Zone of southern Ontario) plus numerous red X white mulberry hybrids	Hybridization with white mulberry; small populations; some mortality due to twig blight; habitat loss or degradation.
Spotted Wintergreen	525 individuals (2001)	No legal protection in place; damage from all terrain vehicles; detrimental forest management practices; collection by horticulturists
Toothcup		Habitat destruction and rising or stabilized lake levels are the greatest threat to the existing populations of Toothcup. Both Ontario populations are potentially threatened by cottage development and water level control.

TABLE 1.3. Selected Species at Risk - Recovery plan contacts, status, objectives and progress, As of March 2004.

Species Name	Recovery Team Chair or Contact	Status of Recovery Plan	Plan Goals and Objectives	Progress to Date
American Badger	Ron Gould, *Ministry of Natural Resources*, ron.gould@mnr.gov.on.ca	Recovery plan is in development (2003)		2001: conducted a badger-monitoring project. Ongoing: conducting DNA analysis of hair samples to determine genetic relation to other badger populations and subspecies. Trapping of badgers for fur was closed in Ontario in 2000. In the past few years, areas in northwestern Ontario have seen consistent badger activity.
Acadian Flycatcher	Mike Cadman, *Canadian Wildlife Service*, mike.cadman@ec.gc.ca	Joint recovery plan for Acadian Flycatcher and Hooded Warbler was published in Nov. 2000	To prevent any decline of the existing pop.; to increase the breeding pop. to 250 pairs, with multiple pairs established in approximately 15 core areas	New sites and nests found as a result of surveys; better information on nesting productivity and habitat use; acquisition of core breeding sites; public outreach
Barn Owl	Dave Richards, *Ministry of Natural Resources*, dave.richards@mnr.gov.on.ca; Bernie Solymar, OMAFRA, solymar@nornet.ca	Provincial recovery plan for ON was published in 1998; updating of the plan is underway under the RENEW process	To establish a wild breeding pop. Of approximately 20 pairs in SW Ontario by end of 2003; to create approximately 1000 ha of rough grassland habitat during the same time period that will benefit barn owls and other grasslands-dependent birds; to carry out recovery of the species in cooperation with community groups	300 nest boxes erected and monitored in SW ON (no breeding pairs identified); 8400 grassland habitat posters produced and distributed; annual newsletter produced and distributed. The level of community involvement in recovery efforts for the barn owl remains strong. GIS analysis determined that the most suitable region for barn owl recovery in southern Ontario is the Regional Municipality of Haldimand-Norfolk.
Henslow's Sparrow	Richard Pratt, *CWS*, richard.pratt@ec.gc.ca	Recovery plan was approved in 1994	To establish a stable or increasing breeding pop. Of 500 adults distributed in different colonies across ON (e.g. 50 colonies with approx. 10 birds in each)	Birds may be emigrating to southern Ontario from breeding populations in New York State and Pennsylvania
Hooded Warbler	Mike Cadman, Canadian Wildlife Service, mike.cadman@ec.gc.ca	Joint recovery plan for Acadian Flycatcher and Hooded Warbler was published in Nov. 2000	To prevent any decline of the existing pop.; to increase the breeding pop. To 500 pairs, with multiple pairs established in approximately 15 core areas	New sites and nests found as a result of surveys; better information on nesting productivity and habitat use; acquisition of core breeding sites; public outreach
King Rail	Laurie Maynard, *Canadian Wildlife Service*, laurie.maynard@ec.gc.ca	In 1999 a recovery plan was approved by CWS and conditionally approved by ON; a revision is now nearing completion	To prevent any decline of the existing pop.; to increase the breeding pop. To 250 well-established pairs which are breeding regularly in approx. 10 separate wetlands	Surveys and traditional ecological knowledge have improved knowledge of bird's distribution and abundance; survey protocol has been established; birds have been confirmed in inland wetlands and wetlands on Georgian Bay; species is benefiting from "Wetland Trends Through Time" and other wetlands conservation projects; stewardship options, fact sheets and communications products are in development
Loggerhead Shrike	Robert Wenting, *Canadian Wildlife Service*, robert.wenting@ec.gc.ca	1995 approved recovery plan is being updated	To prevent further pop. Decline; to establish a stable or increasing breeding pop. In ON, QC, and eastern MB with a combined pop. Of approx. 1000 adults	Between 1997 and 1998, the number of breeding pairs increased from 18 to 31 pairs and new sighting locations were noted in 1998. Five birds were produced in captivity in 1998 - 1999.
Peregrine Falcon (Anatum)	Geoff Holroyd, *Canadian Wildlife Service*, geoffrey.holroyd@ec.gc.ca	1988 approved recovery plan is being updated	1988 recovery plan goals and objectives have been met	Conducted a five-year national survey of anatum peregrines in 2000; revised status report for the reassessment of the anatum peregrine by COSEWIC in 2002 Peregrine populations have been re-established in six geographic zones within their historical range in Canada.

Piping Plover	Atlantic: Diane Amirault, *Canadian Wildlife Service*, diane.amirault@ec.gc.ca; Prairie Paul Goossen, *Canadian Wildlife Service*, paul.goossen@ec.gc.ca	Recovery Plan, covering both the circumcinctus and melodus subspecies, was published in 2002.	To prevent further pop. decline; to maintain a self-sustaining pop. Of approx. 1626 adults in the prairie pop.; to increase the Atl. Pop. To 670 adults; to evaluate other pop. Goals in conjunction with habitat carrying capacity analysis; to establish and work towards achieving habitat protection and goals	New sites have been discovered, and extensive efforts are ongoing at local levels to conserve plover habitat and learn more about the species' requirements. Guardianship programs are now operating in all five Atlantic provinces. Contact has been made with all-terrain vehicle user groups, and legal enforcement for protection of the species has been increased on nesting beaches. The melodus subspecies (Atlantic population) is stabilizing.
Prothonotary Warbler	Jon McCracken, *Bird Studies Canada*, jmccraken@bsc-eoc.org	Recovery plan was approved by CWS in Apr. 2000	To reverse the declining pop. Trend and maintain a stable or increasing pop. Averaging approx. 100 pairs annually, in approx. 6 geographically distinct nesting areas, each separated by a distance of approx. 25 km, by 2001	Nest box program has been successful in reducing cowbird parasitism and mammalian predation; over 90% of the Canadian population is now nesting in nest boxes.
Black Redhorse	Shawn Staton, *Department of Fisheries and Oceans*, StatonS@DFO-MPO.GC.CA Erin Dolmage (Co-chair) *Ausable Bayfield Conservation Authority*, edolmage@abca.on.ca	Recovery plan has been drafted	The draft goal for the recovery project is: To prepare a recovery plan (recovery strategy + action plan) that sustains and enhances the native aquatic communities of the Ausable River through an ecosystem approach that focuses on species at risk.	Combining species-specific information into an ecosystem plan that will account for characteristics and traits common and distinctive to each species The recovery team was formed in 2002, no recovery efforts have yet been implemented to date.
Eastern Sand Darter	Shawn Staton, *Department of Fisheries and Oceans*, StatonS@DFO-MPO.GC.CA Erin Dolmage (Co-chair) *Ausable Bayfield Conservation Authority*, edolmage@abca.on.ca	Recovery plan has not yet been drafted	The draft goal for the recovery project is: To prepare a recovery plan (recovery strategy + action plan) that sustains and enhances the native aquatic communities of the Ausable River through an ecosystem approach that focuses on species at risk.	Combining species-specific information into an ecosystem plan that will account for characteristics and traits common and distinctive to each species The recovery team was formed in 2002, no recovery efforts have yet been implemented to date.
Greenside Darter	Shawn Staton, *Department of Fisheries and Oceans*, StatonS@DFO-MPO.GC.CA Erin Dolmage (Co-chair) *Ausable Bayfield Conservation Authority*, edolmage@abca.on.ca	Recovery plan has not yet been drafted	The draft goal for the recovery project is: To prepare a recovery plan (recovery strategy + action plan) that sustains and enhances the native aquatic communities of the Ausable River through an ecosystem approach that focuses on species at risk.	Combining species-specific information into an ecosystem plan that will account for characteristics and traits common and distinctive to each species The recovery team was formed in 2002, no recovery efforts have yet been implemented to date.
Pugnose Shiner	Shawn Staton, *Department of Fisheries and Oceans*, StatonS@DFO-MPO.GC.CA Erin Dolmage (Co-chair) *Ausable Bayfield Conservation Authority*, edolmage@abca.on.ca	Recovery plan has not yet been drafted	The draft goal for the recovery project is: To prepare a recovery plan (recovery strategy + action plan) that sustains and enhances the native aquatic communities of the Ausable River through an ecosystem approach that focuses on species at risk.	Combining species-specific information into an ecosystem plan that will account for characteristics and traits common and distinctive to each species The recovery team was formed in 2002, no recovery efforts have yet been implemented to date.
Central Rat Snake	Shaun Thompson, *Ministry of Natural Resources*, shaun.thompson@mnr.gov.on.ca	Draft recovery plan is nearing completion	Interim goals: - for Frontenac Axis pop.: to retain the current distribution and connectivity among extant pops. In this region - for Carolinian pop.: to achieve self-sustaining level, with no further local extinctions, to restore connectivity between currently isolated pops.	Movement patterns, habitat use and pop. Ecology of the snake are better understood; development of a brochure for public information; landowner contact and formation of a volunteer community group; new hibernacula discovered on private land
Eastern Massasauga Rattlesnake	Darlene Upton, Parks, darlene_upton@pch.gc.ca	Recovery plan is being updated	To achieve viable tall-grass prairie and peatland pops of Massasaugas; to retain the current distribution, connectivty amoung local pops throughout the Bruce Peninsula and Georgian Bay regions	Assessment of movements, habitat use; protecting habitat through stewardship agreements; production of snake identification guide and posters; reached over 2000 students in school workshops; held community workshops (approx. 150 landowners contacted); restored 28.5 ha and enhanced 237 ha of habitat
Eastern Spiny Softshell	ON: Scott Gillingwater, indotestudo@yahoo.com	ON portion of the recovery plan is in draft, QC portion has been completed; intend to merge the two parts	ON: to be determined - QC: to protect the key habitat on Lake Champlain; to establish a new pop. Outside the Lake Champlain area; to achieve a viable and self-sustaining pop. level	ON: specific research and protection underway at Rondeau Provincial Park; research on fly larvae predation; public outreach - QC: identification of key habitat (using telemetry); surveys in historical areas; habitat protection initiatives; stewardship; public awareness
American Chestnut	John Ambrose, cercis@sentex.ca, and Greg Borland, *University of Guelph*, gboland@uoguelph.ca	Recovery plan has been drafted	To identify and implement management actions required to establish self-sustaining pops; to have resistant line(s) ready for planting in 2010-2015	Site surveys; research on chestnut blight fungus

Bashful Bulrush	Tyler Smith, *Royal Botanical Gardens*, tsmith@rbg.ca	First draft of recovery plan has been drafted, is undergoing review	To ensure the persistence of all existing pops; to collect seed from all existing pops for creation of ex situ pops; to conduct research to support recovery	First draft of recovery plan; habitat description and demographic study were initiated; searched for additional pops in Halton Region in 2001, but found none; seed was successfully germinated ex situ
Cucumber Tree	Donald Kirk, *ON-MNR*, donald.kirk@mnr.gov.on.ca	The recovery strategy was drafted in March 2003. Peer review and public consultation through the Ontario Environmental Bill of Rights Registry is underway.	To protect existing pops and habitats; to increase pop. Size to 50 in approx. 2 sites in each of 2 regions; to conduct research; to develop and implement a landscape restoration plan	Have initiated contacting landowners to enlist their support; are exploring opportunities for landowner stewardship and community participation
Red Mulberry	John Ambrose, cercis@sentex.net	Recovery plan has been drafted	To conserve and, if necessary, restore functioning of pops to long-term stability in 2 regions in southern ON	Site surveys; white mulberry culling to reduce hybridization; genetics studies; searches for new individuals, continuation of pop. Viability analyses; experimental transplanting
Spotted Wintergreen	Melinda Thompson, *ON-MNR*, melinda.thompson@mnr.gov.on.ca	Recovery plan has been drafted	To prevent extirpation of small pops; to initiate research projects to assess pop. Biology, genetics and ecology of the species	

Information in these tables was taken from the following sources; *(2000-2001 Annual Report, Recovery of Nationally Endangered Wildlife, Rescuing Species from Extinction. Canadian Wildlife Service.) (2002-2003 Annual Report, Recovery of Nationally Endangered Wildlife, Rescuing Species from Extinction. Canadian Wildlife Service.)*

2.5 Significant Natural Areas

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Introduction

Today, the remaining natural areas in our settled landscape give us glimpses of what the undeveloped land of southern Ontario was like in the past. They are environmental baselines, allowing us to document change over time. They also provide important guides for efforts to re-establish regional natural landscapes, connect gaps between isolated natural areas as well as restore degraded ones. We see them as very important remnants of once more extensive natural ecosystems; home to a diversity of life adapted to the local conditions. They also provide us with opportunities for encounters of wilderness within our settled and modified landscape; they give us a chance to get away from everyday preoccupations and experience the serenity of nature in balance.

Natural areas provide unspoiled habitat, high biodiversity and a sense of place.

The efforts by community groups to designate these areas for protection are a collective response to the loss of natural heritage in our midst. As we understand more about the biology and ecology of ecosystem function and species in jeopardy of being lost, there is the concern that we are left with an inadequate patchwork of habitats due to their small size and isolation. Continuing efforts are needed to both ensure that we don't lose more important natural areas and to find ways to improve the well being of those that are protected. Some of the significant natural areas have been made secure by public ownership (e.g., provincial parks and nature reserves, GRCA conservation areas, municipal parks), others by conservation organizations (e.g., the

Nature Conservancy of Canada, Federation of Ontario Naturalists, local land trusts) or individual landowners with stewardship agreements or conservation easements. However, we also need to find better ways to integrate our economic and social use of the land with its natural values and functions that we ultimately depend on. Creative land management can both improve the quality of natural habitats and the ecological services that support our use and enjoyment of the land.

Patterns of remnant nature

When European settlers first came to southern Ontario, a large effort went into surveying the land for future farms and roads. As the farms developed from clearings in the forest, a distinct pattern of retained forest emerged in the landscape in many areas, with forest blocks lined up between the concession roads. In other areas where the topography or river systems had a bigger influence on the development of the land, the pattern reflects the contours of the land more than our superimposed road system. In both examples, even though the forests were considered important for the pioneer farm economy for the various essential resources they provided, less concern was given to the overall forest landscape. Forests tended to be individual blocks in each farm with not a lot of continuity between farms, except where a floodplain or swamp occurred and was not seen as suitable to clear for cultivation or pasture.

Today the forests of southern Ontario are mostly quite fragmented. In regions of especially valuable farmland, remaining forests tend to be scarcer than elsewhere. Forests certainly are collectively valuable for moderating the farm environment and providing homes to native fauna and flora, but we as a society have been less than successful in protecting these collective values. As a result, natural forests and other ecosystems are under threat due to smaller and smaller remaining blocks, often not well connected to similar habitats. In the Grand watershed we still have the opportunity to avoid the extreme deforestation seen in the Niagara tender fruit area and Essex and Kent counties, and avert the resulting environmental problems detrimental to farming, such as excessive wind, exaggerated seasonal flooding and drought, and loss of pollinator habitat.

Efforts to protect natural areas

In the late 1960s to the early 1980s there was a concerted effort to evaluate and document the best of the remnants. The provincial biologists surveyed and mapped what are known as Areas of Scientific and Natural Interest (ANSIs). Each county or region produced an Environmental Sensitive (or Significant) Areas (ESA) report based on biological diversity and rarity as well as special landforms and processes or cultural features. The studies and surveys for these reports were typically conducted under the supervision of a local conservation authority, county planning office or university. In some cases these reports were used in planning decisions, but often there was no certainty that designated ESAs would be protected, and many were at least partially developed or degraded due to nearby activities.

At the same time that these special areas were being surveyed and documented, various organizations, such as the Federation of Ontario Naturalists, Nature Conservancy of Canada, and local clubs or community groups were taking action to secure them for their natural heritage values. Many were purchased as nature reserves. The Ontario government acquired some of the smaller sites as nature reserves, in addition to the system of larger provincial parks. Conservation authorities also were active in acquiring natural lands, although many were in flood zones and hazard areas due to the mandate to reduce flood hazards in their respective watersheds. In addition to outright acquisition, a major effort of stewardship of private lands was also underway at the same time, using various tools such as landowner agreements and conservation easements.

In the southern reaches of the Grand River is the Carolinian Zone (the climatically mild region north of Lake Erie, extending north approximately to a line through Grand Bend to London and on to Toronto). This is noted for its high biological diversity, including a high number of southern

species that reach their northern limits of distribution in this zone. Carolinian Canada was founded in 1984 as a cooperative effort of concerned organizations to identify the most significant unprotected natural areas in the zone (38 in total) and seek means to acquire or protect them through its partner organizations. Carolinian Canada continues to pursue conservation issues in this zone. It has recently launched a new initiative called the "Big Picture" project. First important core natural areas are identified, many now protected, as central to the project. Then landscape level restoration opportunities are identified to maximize opportunities to improve waterway quality and connections to other core areas. These connections can be restored by volunteer tree planting efforts on land of willing owners. There are similar small projects already existing, such as the Natural Heritage Restoration Program in Essex County and a restoration program in the Long Point Biosphere Reserve. On a continental basis, there is the Wildlands Project, which has proposed a wilderness recovery strategy for North America with direction from a board of distinguished American and Canadian conservation biologists.

Landscape level thinking

While the earlier efforts were focussed on protecting "islands of green", it was soon becoming apparent that isolated protected areas in an otherwise inhospitable landscape were not going to be effective for the long term conservation of species in jeopardy, or for maintaining a diversity of common species. Thus, it is not only a concern of large carnivores but also the ability of small forest dwellers such as salamanders, shrews, birds and insects, along with maples, oaks and other plant species, to produce enough genetically suited offspring and move through the changing landscape. In isolation, populations of each species run the risk of dipping below a sustainable level and being lost, diminishing the overall well being of the forest community. Ecosystems detached from their natural continuity are also less able to contribute ecological functioning and processes to the larger landscape. Lessons from conservation biology suggest that buffering and connecting the isolated natural areas with similar vegetation will improve their functioning--and ability to provide services such as water recharge and processing--and better protect their natural level of biological diversity.

Although some wildlife, such as birds, are capable of moving across a fragmented forest landscape, the large majority of forest dependent species of animals and plants are not.

This does not mean that farms, or other economically important land use must be given up to help nature. Rather, we need to look at means to incorporate buffers which can both promote economic use of the land and the natural landscape, such as multi-species wind breaks to increase productivity on farm land, provide habitat for crop pollinators, and connect isolated natural areas. Industrial areas, roadsides and utility corridors offer similar opportunities. A healthier natural landscape will also provide numerous services to the economic use of the land, as well as be a more pleasant place to live!

Natural areas, with their populations of common and rare native species, are of central importance to any effort to improve the regional landscape. Forests that have never been cleared have populations of plant and animal species that do not migrate easily or quickly. There are insects that have been identified as unique to old growth forests and birds that only nest in large blocks of "interior" forest. Many plants of the forest floor appear very slow to colonize disturbed or re-established forests. Thus, these natural forests are essential focal points for efforts to create links or corridors between different natural areas, in an attempt to form a better connected natural landscape.

Ecological restoration—the restoring of the vegetation and other species native to the region as well as ecological functioning—is an important ecosystem-healing tool to bring about an enhanced health of the significant natural areas we chose to protect and the landscape that they are a part of. Tree planting with appropriate species, in the context of a landscape level restoration plan, is an important starting action to begin the process of forest restoration.

Conclusion

The pre-settlement forests provide a context for setting out goals and objectives for the **desired future forest condition in the Grand River watershed.** Obviously, we will not be able to (or even want to) recreate pre-settlement conditions across the entire watershed. However, we can use pre-settlement forest conditions as a benchmark against which to determine trends and measure our success in restoration activities. For example:

Table 2.1. Desired future forest condition of Grand River watershed.

Now-Year 2004	Future- Year 2100[1]
Relatively low forest cover- 10-12% in some sub-watersheds	30% forest cover on a watershed basis minimum 20% on sub-watershed basis
low representation of pre-settlement forest types/ prevalence of plantations	representation of all forest types based on pre-settlement forest composition
prevalence of young forests	greater proportion of older/ mature forest 10% of forest cover meet criteria for "old-growth"
prevalence of small isolated patches of forest (forest fragmentation)	larger forests with at least one patch of 200 ha or greater per sub watershed, 10% of watershed in forest cover 100 meters or more from edge, 5 % of watershed with forest cover 200 meters from edge forests connected by corridors that are at least 100 meters wide and of the same composition as the forests they connect disconnected forests not separated by more than 2 km
lack of critical level of forest cover to allow natural disturbance to maintain representation of mid-tolerants, forest management that favours shade tolerant species	management of some tolerant hardwood stands to ensure representation of mid-tolerant species to mimic pre-settlement disturbance patterns
planting of available sites without a landscape context	Strategic planting sites based on priority of headwaters, riparian zones, corridors to connect forests fragments, expansion of existing forest fragments to create larger forest patches, increase in forest cover of sub-watershed to minimum 20%

Information for future forest extracted from Great Lakes Fact Sheet- How Much Habitat is Enough produced by Environment Canada.

Conservation and restoration of biological diversity within the Grand River Watershed at the genetic, species and ecosystem level are all important to a healthy functioning landscape that will

provide a multitude of environmental, economic and social values for the current generation and the generations to come.

What you can do

There are many significant natural areas that are unprotected. Those that are protected through acquisition by conservation organizations or landowner agreements may need management for such problems as invasive exotic plants, help in developing a protective buffer planting or linking to nearby similar habitats through corridor planting on land of willing landowners. There are many opportunities to create or link natural habitats, even in urban areas and one's own back yard.

Action Items:

- **Seek active roles in learning about the surrounding environment by volunteering or taking part in local conservation initiatives.** Find out what organizations, such as local land trusts or naturalists clubs, or the Nature Conservancy of Canada are doing in your area. Check with the Ontario Nature Trust Alliance and the Federation of Ontario Naturalists for organizations in your area. Ask what help they need. Check with these organizations to see what management they have organized for volunteers. Some have schedules of management field days; they are excellent opportunities to learn about natural area management.
- **Improve natural habitats in local parks, schoolyards and other urban areas, providing a better habitat for native species as well as an enriched experience for community members.**
- **Recognize the importance of private land at the landscape level and take steps to ensure that significant features are preserved.** Some regions have developed conceptual management or restoration plans on a landscape level. There will be opportunities to work with willing landowners for creating linking corridors between protected areas, or buffers around them. If you are a landowner, find out where your property lies in the regional landscape, what important habitats may occur on or near your land and how it could be better connected into the regional context. If your land is only a small urban property, there still are significant projects you can do with neighbours to create a natural urban zone, connecting with nearby rivers or parks.
- **Adopt new and creative management approaches toward improving and restoring significant natural areas.**
- **Create one "big block" forest (>400 ha) per ecoregion by connecting existing forest patches through artificial and natural regeneration.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

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PART 3:

MANAGING THE WATERSHED LANDSCAPE AND FOREST

Summary

Part 3 and this summary cover Sections 3.1 through 3.6, exploring the way we shape the landscape and manage the various types of forest.

Municipal Official Plans and Zoning Bylaws are two of the strongest tools we have in directing the future landscape (Section 3.1), and are, during the urbanization process, part of the transition to the urban forest (Section 3.2) from the rural forest (Section 3.3, Agroforestry; and Section 3.4, Silviculture). Tree-related bylaws (Section 3.5) are used to minimize unscrupulous harvesting or destruction in forests. Forest-related economics in a manufacturing economy are explored briefly (Section 3.6).

The pattern of land use in the watershed is influenced by many factors, including the following: topography, soil texture and stoniness, soil drainage, stream networks, survey patterns during European settlement, major transportation lines (rail, then road), the broader economy and the economics of farming, proximity to Toronto, and more. Many of these factors are completely or partially beyond our influence, but setting policies for the use, subdivision, and development of land is completely within Provincial and Municipal control. The innovative and progressive "Pathfinder" policies provide a window to future land use.

In the Grand River watershed, as in Canada as a whole, 4 in 5 residents live in urban areas. The urban forest is the forest most of us live within and experience from day to day. Consequently, the urban forest is the forest with the greatest potential to provide social, microclimate, energy saving, and local air quality benefits. The challenge is to find space for trees to grow a long time and to a big size in good health. Urban forests also need to be more widely recognized and understood, as the concept is only vaguely, or not at all, understood by many people.

Agroforestry is the economic and operational integration of farming with the growing of trees and tree crops. Windbreaks, streamside buffers, and fragile or marginal land retirement plantings are the most common agroforestry practices involving tree planting. Maple syrup, timber, and firewood production are the main agroforestry activities in woodlands (aspects of which are covered in the Silviculture section). Intercropping and Silvopasture are less common, but hold potential in certain circumstances. As most of the watershed land is managed as farmland, this integration of tree cover into farming operations holds huge potential for watershed forest improvement. Helping rural landowners adopt the tree planting agroforestry practices is a strong program area for the Grand River Conservation Authority.

Silviculture is the art and science of manipulating stand or forest establishment, stocking or density, composition and growth, throughout its life, and implementing programs to eventually guide its evolution into the next forest, if this is to occur. Tolerance of species to growing in shade, among other aspects of silvics, helps determine the appropriate conditions for successful regeneration. This in turn determines the nature of the forest resulting from various harvesting techniques and intensities. Important ecological and economic consequences flow from silvicultural action, inaction, or misguided action.

Tree cutting by-laws are an attempt to prevent the most misguided or destructive activities in the forest, but they are not "good forestry practice". Rather, they are an enforceable, minimal standard. The bylaws require that trees not be harvested or destroyed until they reach a certain

size (varying between species and jurisdictions), and some stipulate a certain residual density of forest. The challenge is to raise that minimum standard closer to "good forestry practices without impinging unacceptably on the rights of landowners.

Forests provide goods and services. Traditionally, the goods are the measurable economic output, but in a settled landscape, the economic value of services probably outweighs the goods. The goods produced in local forests include timber, firewood, pulp, posts, poles, and maple syrup. The services include air cleansing, water cleansing, carbon sequestering, streamflow moderation, and others, all of which can, with some difficulty, have dollar values put to them. When these products and services are subject to full accounting, a true picture of the economic value of the watershed forest will emerge.

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3.1 Municipal Planning, Land Use, and the Forest

Municipalities in the Grand River watershed have acted responsibly to maintain the benefits of trees and woodlands. Policies, targets, objectives and planning processes are often part of municipal planning to ensure sound decisions about development, land use and natural resources. Municipal Official Policy Plans provide the framework for decision-making about acceptable land uses such as new development within or adjacent to a large woodland, severance of a farm retirement lot within or adjacent to a woodland, saving and protecting trees on a development site, and everything in between.

Development, agriculture, water and forests all play an equally important role in maintaining economic and ecosystem health

In spite of these actions, substantial forests have been lost due to many different types of projects. Fragmentation and intrusions into the edges of woodlots have frequently occurred due to land severances, land drainage projects, golf course development, land reclamation for agricultural use etc. Clearly, the big picture of the watershed forest and its contribution to the quality of life, the economy and the ecosystem health must be considered in municipal planning. Each time that Official Plan Policies and Zoning By-laws are reviewed, opportunities arise for improvements to be made to these official documents. The watershed forest plan provides a context for these changes, and sets the stage for more detailed data to support these municipal plans.

Municipal planning is administered under the Provincial Planning Act. Provincial Policy Statements are issued under Section 3 of the Act to provide policy direction on matters of provincial interest related to land use planning and development. All planning authorities and

recognized plan input and review agencies "shall have regard" to these policy statements. In 1997 the Province issued a Policy Statement with a focus on key provincial interests related to land use planning. This set of policies promotes the wise use and protection of the agricultural land base, mineral resources, natural hazards, natural heritage resources, water supply, and cultural heritage resources while guiding wisely managed economic growth. Nothing in the Provincial Policy Statement is intended to prevent local planning authorities from generating policies regarding matters of local interest.

Provincial Policy Statements

One of the important functions of the Provincial Policy Statement is to provide official definitions of terms used in municipal planning. Definitions of the terms *"agricultural use, areas of natural and scientific interest, ecological functions, woodlands, wetlands, wildlife habitat, significant, adverse effects, development, and valleylands"* are included in the Glossary of Terms.

Natural heritage policies

Forest resource protection and management issues are addressed in the set of Natural Heritage Policies in Section 2.3 of the Provincial Statement, shown below:

- **2.3 Natural Heritage**

  2.3.1 Natural heritage features will be protected from incompatible development.

  Development and *site alteration* will not be permitted in:

  – *significant wetlands* south and east of the Canadian Shield;

  – and *significant* portions of the habitat of *endangered and threatened species.*

  Development and *site alteration* may be permitted in:

  – fish habitat;

  – *significant wetlands* in the Canadian Shield;

  – *significant woodlands* south and east of the Canadian Shield;

  – *significant valleylands* south and east of the Canadian Shield;

  – *significant wildlife habitat;* and

  – *significant areas of natural and scientific interest*

if it has been demonstrated that there will be no *negative impacts* on the natural features or the *ecological functions* for which the area is identified.

2.3.2 *Development* and *site alteration* may be [permitted on *adjacent lands* to a) and b) if it has been demonstrated that there will be no *negative impacts* on the natural features or on the *ecological functions* for which an area is identified.

The diversity of natural features in an area, and the natural connections between them should be maintained, and improved where possible.

Nothing in policy 2.3 is intended to limit the ability of *agricultural uses* to continue.

Technical Support to the Provincial Policy Statement

In June 1999, the Ministry of Natural Resources published a Natural Heritage Reference Manual. The manual states "the identification and evaluation of significant woodlands is a planning authority responsibility. Approaches to compiling and assessing woodland information will vary

depending upon the resources of the planning authority, availability of information, development pressures and the nature and extent of the woodlands present in the planning authority." The manual offers a recommended approach for the evaluation of significant woodlands.

A more detailed technical manual that provides information on the identification, description, and prioritization of significant wildlife habitat was completed and circulated by the Ministry of Natural Resources in a draft report in January, 2000. The Significant Wildlife Habitat Technical Guide published by the Ministry of Natural Resources in October 2001, provides a wealth of information on forest habitat types and functions.

Wetlands and forests

There are overlapping designations and considerations in municipal policy development with respect to forested wetlands such as swamps and bogs. Development in Provincially Significant Wetlands is discouraged in the Provincial Policy Statement passed under the Planning Act. While extraction of aggregate resources is controlled under provincial legislation, peat extraction is not currently controlled. Areas of forest are being lost, for at least a temporary period on many peat extraction sites. Refer to the definitions in the Provincial Policy Statement.

Policies of Regional Municipalities and Counties

All or portions of 12 regions and counties lie within the Grand River watershed and the methods and policies, through which Provincial Policies and the watershed forest resources are addressed, vary in their Official Plans. These *upper tier* municipalities must have regard to the Natural Heritage policies. The Official Plan will set out the context for the policies for forest areas in their municipality. The towns, townships and cities, as *lower tier or local* municipalities are required to show regard for policies contained in the Official Plans of the upper tier municipalities. There are 28 lower tier or local municipalities involved with the Grand River watershed.

Table 3.1. Status of woodland policies in Official Plans of Grand River watershed municipalities, As of March 2004.

County/Region/Municipality	Official Plan (Date)	Zoning By-Law (Date)	Sample Policies (Y/N)
Regional Municipality of Waterloo	Y - 1998	N/A	Y
Township of North Dumfries	Y - 1997	N- 1997	Y/N
City of Cambridge	Y - 1999	N - 2001	Y/N
City of Kitchener	Y - 1998	N - 1985	Y/N
City of Waterloo	Y - 1994	N - 1974	N/N
Township of Wilmot	Y - 2003	N - 1983	N/N
Township of Wellesley	Y - 2003	N - 1992	N/N
Township of Woolwich	Y - 2001	N - 1986	Y/N
City of Hamilton	Y - 1998	-	Y
Haldimand County	IN PROGRESS 2003	N - 1988	Y/N
County of Norfolk	In progress 2003	N - 2000	Y/N
County of Brant	Y - 2000	Y - 2001	N
City of Brantford	Y - 1998	N - 1999	Y/N
City of Guelph	2002	Y - 1995	Y

County/Region/Municipality	Official Plan (Date)	Zoning By-Law (Date)	Sample Policies (Y/N)
Oxford	Y - 1995		Y
Township of Norwich	2003	N - 1984	N
Township of East Zorra-Tavistock	-	2003	N
Township of Blandford-Blenheim	2002	N – 2001	N
County of Dufferin			
Township of East Garafraxa	In Progress 2003	N - 1982	N/N
Township of Amaranth	In Progress 2003	Y - 1989	N/Y
Township of East Luther/Grand Valley	In Progress 2003	N	N/N
Township of Melancthon	In Progress 2003	N	N/N
Wellington County	Y - 1999		Y
Township of Centre Wellington	1999 Urban in progress 2003)		
Township of Puslinch	1999	Y - 1985	Y
Guelph/Eramosa	1999	N - 1999	N
Town of Erin	In progress 2003	In progress 2003	Y
Township of Mapleton	1999	In Progress 2000	
North Wellington	1999	In Progress 2000	
Six Nations	N	N	N/N
Region of Halton	In Progress 2003		Y
Town of Milton	Y - 1996	In Progress 1999	Y/Y
Town of Halton Hills	In Progress 2003	N - 1992	Y/N
County of Perth	Y - 1998		
Township of Perth East		Y - 1999	Y
Township of Perth North			
County of Grey	N - 1996		N
Township of Southgate	In progress		

A study completed in 1999 by a research team brought together by World Wildlife Fund Canada, the County of Simcoe and the Province of Ontario prepared a report entitled Natural Heritage Planning in Ontario – A Review of County and Regional Official Plans (August 1999). In their review of the Official Plan Policies of regions and counties, this team, referred to as the Best Policies working Group, found as many as 82 policy types and a wide range of terms applying to natural environment and natural heritage. They classified the policies in three categories: Basic Policies, Enhanced Policies, and Pathfinder Policies. The "Basic" policies meet the minimum requirements of the Provincial Policy Statement. "Enhanced" policies provide for strong controls over development and site alteration within both provincially and locally significant natural heritage areas. They also address the natural connections between the significant natural areas. The "Pathfinder" policy category recognizes innovative approaches, beyond the first two categories, which address natural heritage protection and management. This set of policies addresses forest resources in a more comprehensive manner than those in the first two categories.

The "Pathfinder Policies" best serve forest conservation and demonstrate what can be done today to plan for tomorrow's forests. Advancements and improvements to these policies may come from the "big picture" provided by the watershed forest plan and its implementation. Taken

together, these Pathfinder Policies provide a framework for those advancing the cause of the forest through municipal planning.

It was not surprising to find that Regions and Counties working under "Pathfinder" policies have partnered with the Grand River Conservation Authority and helped make the Grand one of the world's best-managed rivers. The County of Oxford and THE city of Hamilton (former Regional Municipalities of Hamilton-Wentworth) and Region of Waterloo have Official Plans, which were adopted in 1995-1996 and provide a good policy framework to protect and enhance the watershed forest.

In November 2000, the County of Brant adopted its first Official Plan. This County's approach is consistent or compatible with the above stated policies.

Improvement and innovative extensions of the policy framework in updates to the Official Plans of the upper tier watershed municipalities are possible. The big picture presented in this watershed forest plan may facilitate this activity.

The relevant "Pathfinder" policies are described below:

Regional Municipality of Hamilton-Wentworth, 1995

"[The Regional Natural Heritage System is] an interrelated system of natural areas and features of varying ecological significance within the …Region (now the New City of Hamilton). Areas or features included in the system may be designated or regulated by Provincial or Regional Policy. The areas fall into one of the following categories.

Core Natural Areas —are the most significant areas within the Natural Heritage System in terms of biodiversity, productivity and hydrological functions. They are given priority in terms of conservation policy and management.

Linkages—are watercourses or naturally vegetated areas that border or connect Core Natural Areas and provide ecological functions such as passage, feeding, shelter, hydrological flow, or buffering from adjacent impacts. Their conservation will protect and enhance Core Natural Areas.

Restoration Opportunities—are vacant or available lands or watercourses where natural habitat is altered, degraded or destroyed. With proper habitat restoration and conservation management these areas may function as Linkages".

Regional Municipality of Waterloo, 1995

"The Region will, where appropriate encourage the conservation and enhancement of the region's native biodiversity.

Regional Council will adopt and from time to time update a list of significant species native to the region.

The Region will co-ordinate the development and maintenance of an environmental database, in co-operation with the Province, Area Municipalities, the …Conservation Authority, other government agencies, the private sector, and the community, to document the occurrence and distribution of significant species and other features.

The Region encourages individuals and agencies to use native species appropriate to the locality when planting within or contiguous to elements of the Natural Habitat Network. To provide guidance in maintaining the native biodiversity of the Natural Habitat Network the Region will prepare a list of native trees and shrubs suitable for such use.

The Region discourages individuals and agencies from using non-native species considered invasive and unsuitable for planting within or adjacent/contiguous to elements of the Natural

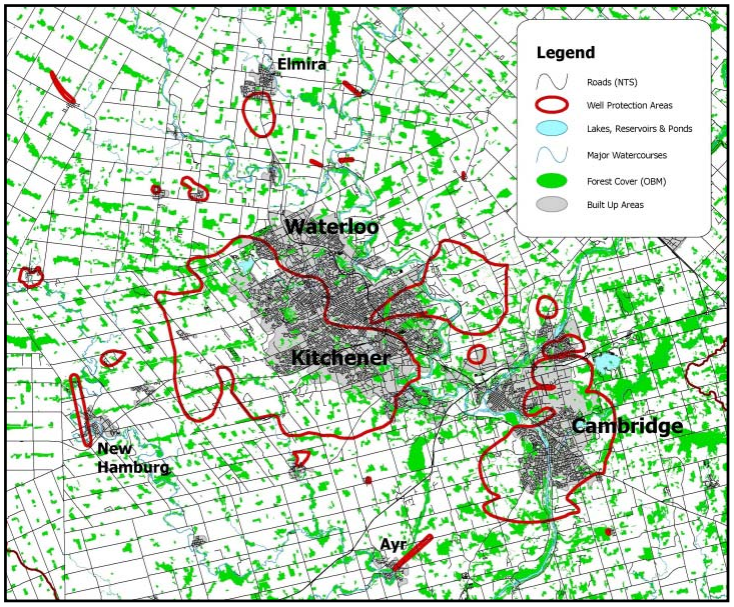
Habitat Network. To provide guidance, the Region will prepare a list of non-native species considered invasive and unsuitable for such use."

"Area Municipalities are encouraged to establish policies in their Official Plans to conserve, protect and enhance woodlands through the following means:

- prioritizing woodlands for protection and possible acquisition;
- including woodlands, where appropriate, in park and other open space dedications;
- minimizing the impact of development on productive or potentially productive woodlands by selecting alternative locations for proposed uses, or through the implementation of appropriate mitigation measures;
- conservation and enhancement of hedgerows, and their integration into urban design, to preserve natural linkages among woodlands for wildlife movement and migration; and
- encouraging collective ownership of woodlands where appropriate.

The Region will consider the importance of woodlands management during its review of development applications for land containing woodlots as defined in the Regional Tree-Cutting By-law. In accordance with the Regional Tree-Cutting By-law, consideration will be given to:

- the potential impact of the proposed use on the productive or potentially productive woodlot; and
- opportunities to restore or re-establish productive forest habitats consisting of native species following the development of the proposed use.



Waterloo Region is active in promoting and supporting increased forest cover in areas that protect water quality and quantity for public wells.

The Region encourages and supports the Ministry of Natural Resources in its efforts to identify, protect and enhance woodlands. The Region encourages the owners of woodlands to … manage their woodlands in accordance with sustainable forest management practices.

The Ministry of Natural Resources and the owners of woodlands within Environmentally Sensitive Policy Areas are encouraged to take the significant features and ecosystem functions of those woodlands into account in the development and implementation of forest management plans.

The Region will continue to acquire woodlands as finances permit, or to accept donations of woodland tracts to be managed as Regional Agreement Forests.

The objectives for managing Regional Agreement Forests will be accorded the following order of priority:

- the conservation or enhancement of significant natural features and functions, particularly where Regional Agreement Forest lie within the Natural Habitat Network or exhibit "Carolinian forest", old growth, or interior habitat attributes;
- passive recreation including trails for nature appreciation, hiking and cross-country skiing;
- outdoor education and research;
- timber production according to sustainable forest management practices;
- hunting, fishing, horseback riding and mountain biking where expressly permitted.

Notwithstanding the above, it is recognized that trees and other vegetation may be removed, or destroyed by authorized cutting or burning to achieve the above objectives.

The Region will encourage good stewardship practices to manage public and private woodlands on an ecosystem basis, which not only recognizes the economic value of the timber, but also acknowledges the importance of woodlands as groundwater recharge areas and habitat for wildlife and vegetation."

County of Oxford, 1996

"It is estimated that forest cover is just under 12 percent. County Council adopts a target of increasing forest cover in the County to at least 15 percent over the life of this Plan. The emphasis shall be on woodlot preservation in the rural areas through consideration of woodlots as an integral component of farming operations and by discouraging incompatible development, which has permanent long-term impacts on woodlots. In the settlement areas, the emphasis will be on woodlot and tree preservation and enhancement.

Where provincially significant woodlands are identified by the Province on the basis of:

- the size of the feature; and
- the occurrence of the provincially significant features; and
- the provision of important ecological functions such as linkage, buffering, or water quality; or
- the composition, age, or site quality results in a feature which is uncommon to the County,
- new development and site alteration within and on lands contiguous to the provincially significant woodland will require the preparation of an Environmental Impact Study …which demonstrates that the proposal will not negatively affect the natural features or the ecological functions of the area.[14]

Notwithstanding the above, the creation of lots, which extend into the provincially significant woodland may be permitted where:

the severance is for the purpose of creating new farm parcels; …and
the zoning by-law or other development controls prohibit the establishment of buildings and structures within the heritage feature or on that portion of the contiguous lands where such development could affect significant features or functions.
County Council will encourage the retention and enhancement of locally significant woodlots in both the settlement areas and rural areas of the County.

In rural areas, non-farm development will not be permitted within a woodlot. Woodlots are to be maintained as part of a farm parcel and severance of a woodlot will comply with [the Natural

Resource Management Policies of this plan]. Development, which is proposed contiguous to a woodlot, may require an Environmental Impact Study …to ensure no harmful effect to the woodlot and its associated ecosystems.

The County …and/or Area Municipalities will consult with the Ministry of Natural Resources and/or the Conservation Authority with jurisdiction in this regard.

In order to increase tree cover in the County …County Council or Area Council shall consider, as a condition of approval to development, requiring measures to preserve, protect and enhance tree cover in the designated settlements including the following:

- requiring the preparation of a baseline inventory and tree saving plans indicating trees to be maintained, removed and relocated in the course of development as well as trees to be planted;
- requiring site plan control to address the layout and siting of buildings and structures on individual lots to maximize tree-saving;
- establishing requirements for the use of deciduous and coniferous native plant species in any required tree plantings;
- requiring new tree planting on boulevards and on lands to be dedicated as parkland;
- restrictions to site alterations prior to final plan registration to ensure tree saving measures are complied with.

Area Councils may, as a means of encouraging innovative site design and planning approaches which work to enhance tree-preservation during the course of, and subsequent to development, permit density bonusing, zoning variances and such other measures as may create some flexibility in approach to site design and planning.

Where acceptable to the Area Council, an existing wooded area may be accepted as a portion of the parkland dedication requirements of the Planning Act. Where an existing wooded area is accepted as parkland dedication, Area Councils are encouraged to retain such area in a naturalized state.

Opportunities for tree-planting on County-owned lands such as parks, open space and Agreement Forests, using a variety of native species, shall be identified and implemented in co-operation with relevant government agencies and local interest groups. Where vegetation is planted on County-owned lands, monoculture planting shall be avoided.

Plans for the construction and/or widening of County roads shall include the planting of trees on abutting properties where such planting will not interfere with road safety or maintenance and where the land owners permission is given. Where road reconstruction and maintenance is proposed, the County shall consider alternative road and pavement widths and standards so as to minimize the cutting of trees. Where tree cutting is necessary, tree replacement shall be a minimum ratio of two trees for each tree lost in connection with the widening or construction of County roads. The County will strive to replace trees in the general vicinity where tree cutting has occurred except where the road configuration, topography or other factors make this impractical."

Improvements Beyond "Pathfinder" Policies

County of Brant, 2000

"*Woodlands Designation"*

Woodlands are treed areas that provide environmental and economic benefits such as erosion prevention, water retention, provision of habitat, recreation, and sustainable harvest of woodland

products. The County of Brant currently has 13% woodland or forest coverage. Over 25% of all woodland is found in 5 forests. Most of the woodland is found in association with other natural environmental features such as the Oakland Swamp, the Hatchley Swamp or the various wetland complexes of South Dumfries.

Woodlands greater than 4 hectares in size *(often including plantations)*designated as Woodlands on Schedules “A” and “B”.

Policies

Development proposals involving Woodland designations or lands adjacent to a Woodland designation shall first evaluate and determine whether or not the Woodlands identified on Schedules “A” or “B” are significant, as defined by the Provincial Policy Statement and its implementing guidelines.

If the Woodland is not a significant natural heritage feature, as determined by the Environmental Impact Study in accordance with Section 2.5, the adjacent land use designation and all applicable policies will apply.

On adjacent lands which are defined in the Provincial Policy Statement as those lands contiguous to the Woodland, where it is determined that development or site alteration would have a negative impact on the feature or area, no development shall be permitted.

Development and site alteration may be permitted if it can be demonstrated that there will be no negative impact on the natural feature or on the ecological functions of the Woodlands.

Woodlands may be accepted as part of the parkland dedication and innovative zoning may be applied to assist in increasing the number of trees saved by bonusing development to enhance the natural features of the site.

Lower Tier Municipalities

Official Plans of the counties and regions encourage their lower tier municipalities to develop and implement local policies to address local resources and related issues in a manner that is consistent and compatible with the upper tier policies. This is the provincial planning hierarchy.

There are noteworthy lower tier municipal policies, by-laws, guidelines and functions that complement and support the regional/county level policies. City of Kitchener and (former) Town of Ancaster documents that address tree protection and management are summarized below. These site-specific guidelines are comparable to the “pathfinder” category of planning documents.

City of Kitchener, 1994

“Tree Management Policy or new Plans of Subdivision and Site Development state that in cases where tree cover exists on lands being subdivided, applicants shall submit a General Vegetation Overview to the Department of Planning and Development at the time application is made to the Regional Municipality for draft subdivision approval. The City of Kitchener shall not commence its local review process until such submission is made.

A General Vegetation Overview shall provide an environmental evaluation of the site, providing early identification of those areas with trees worth or not worth retaining. A Detailed Vegetation Plan is required when the General Vegetation Overview indicates that there are vegetation communities worth retaining. The Detailed Vegetation Plan shall be submitted for approval by the Department of Planning and Development, prior to any area grading. The Detailed Vegetation Plan shall provide information on those isolated trees, clusters or woodlands identified as vegetation communities with trees to be retained, in the approved General Vegetation Overview. This information shall include an analysis of impacts and overall tree management/grading plan,

an outline of protection measures to be implemented, site preparation recommendations and planting/thinning/transplanting recommendations, if any.

The Detailed Vegetation Plan readily identifies those lots and blocks containing trees intended to be retained. Some of these lots and blocks will require a Tree Preservation and/or Enhancement Plan prior to the issuance of a building permit.

A Tree Preservation/Enhancement Plan will only be required for:

- site development under Section 41 of the Planning Act
- corner lots (where site service locations and building type has not been pre-
- determined)
- interior lots greater than 13.7 m (45 feet) of street frontage
- lots on which the Developer/Builder requests to build a structure that is deeper on the lot than that approved on the Detailed Vegetation Plan and/or the revised grading and drainage will have an adverse effect on the Detailed Vegetation Plan.

The Tree Preservation/ Enhancement Plan shall show all ecological data and tree protection measures as specifically transferred from the approved Detailed Vegetation Plan, together with the location and dimensions of all site development features including grading, cut and fill areas, drainage, and proposed stockpile locations.

The maximization of tree preservation is a valuable and reasonable goal in itself, however this goal cannot be looked at in isolation and it must be recognized, that in many circumstances, other planning and engineering concerns may take precedence over the tree preservation goal where relevant constraints exist.

The policy represents the intended achievement of the City of Kitchener, however, there may be unusual, impractical and special circumstances where the policy can only represent guidelines for both staff and developers to use, and discretionary exceptions may have to be made."

Town of Ancaster, 2000 (City of Hamilton 2001)

Upper tier municipalities have traditionally taken responsibility for developing, administering and enforcing by-laws that apply to the protection of trees in tracts of forested land 0.81 ha or 2 acres in area. Lower tier municipalities take responsibility for treed areas of lesser extent under the Municipal Act.

Ancaster's Tree Protection By-law is one of the first of its kind in that it regulates the protection of specified classes of trees on private as well as public lands…..This By-law is also unique in that it protects trees in woodlands as well as individual Heritage Trees, thereby recognizing the important contribution of both woodlands and mature individual trees to Ancaster's urban forest.

Municipal Act 2003

New tree by-law provisions are contained in the new Municipal Act, which came into effect January 1, 2003. Municipalities are now empowered to prepare a new tree by-law under the Municipal Act. This Act enables municipalities to increase fines, issue stop work orders and make violations ticketable offences.

Smart Growth and the Oak Ridges Moraine, 2001

Urban growth has created tremendous pressure on the forests and other natural areas in south-central Ontario. In 2000 and 2001 provincial government embarked on development of a long-

term strategy for promoting and managing growth in ways that promote a healthy environment while sustaining a strong economy and building strong communities. This *Smart Growth* makes sure that decisions involving the integration of new infrastructure and the environment are environmentally sound. The Central Ontario Smart Growth Panel was established in February of 2002 and in April of 2003 produced the *Shape the Future* report, setting out a common vision for growth in central Ontario in 2035 and establishing a list of recommendations for achieving *Smart Growth*. A focal area for the development and implementation of this strategy is the Oak Ridges Moraine. That landscape has forest management issues which are comparable to the moraines in the Grand River watershed.

The strategy for the Oak Ridges Moraine is outlined in the provincial government publication Share Your Vision for the Oak Ridges Moraine, 2001. The long-term plan is guided by the vision of a protected moraine and its ecological functions and ensured continuous natural environment for future generations, while providing for compatible social and economic activities. It is recognized that the moraine has the vital role of linking important Greenland systems in southern Ontario and that linkages within the moraine are equally important. The strategy for community growth and natural area protection recommends that the lands of the moraine be classified into four broad land use designations and that municipal official plans, zoning and regulatory by-laws be updated to complement or enhance the principles and policies of the provincial moraine plan.

According to this plan, lands classified and designated as *Natural Core Areas* contain large concentrations of key natural features, significant hydrological areas and complex landforms. Permitted uses within this designated area include existing uses, passive recreation, forestry, wildlife and fisheries management, conservation and flood control, agriculture, and other uses as approved in planning applications. Woodlands, valleylands and rural lands that link core areas, within the moraine or externally to other core areas and natural corridors are designated as *Natural Linkage Areas.* Their uses include all of those listed for the core areas, expansions to existing mineral aggregate operations and also new wayside aggregate extraction operations. *Countryside Area* designations are applied to rural and agricultural use areas while *Settlement Area* designations are applied to lands approved for urban development. All uses listed above are permitted in these areas. Uses in the *Countryside Area* also include active recreation and rural residential as approved in the municipal official plans. The full range of land uses are permitted within a designated *Settlement Area.*

According to this strategy permitted uses in the four designated areas are subject to ecological constraints that ensure the protection of features and functions of significant natural and hydrological areas. Development projects are required to maintain and enhance natural area, the quality and quantity of surface and ground water, baseflow to streams, water balance and the hydrological integrity of watersheds. Special development design approaches have to be followed.

The strategy for the Oak Ridges Moraine in this publication could serve as a good model for conservation of the forest and habitat of the Grand River watershed.

Action Items:

- **Require that developers use stock grown from appropriately sourced certified seed of native species when devising tree planting projects on development sites.**
- **Employ satellite imagery to monitor land use in the watershed and the subsequent impact of those land uses on the watershed forest. Use the data to develop appropriate management objectives.**

- **Produce annual State of the Watershed Forest reports. Make these resources available to decision-makers and the public.**
- **Promote the adoption of the "Pathfinder" municipal policies at the county, regional or municipal level for all watershed partners.** The "Pathfinder" policies can best advance the watershed forest when widely adopted, and the next wave of "Pathfinder" policies must be developed and adopted to continue to improve the situation.
- **Provide continued and improved scientific and technical support, especially silvicultural, to municipal planners and managers of all public lands.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

3.2 Urban Forests

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What is an urban forest?

Dunster and Dunster (1996) define urban forestry as "...a specialized form of forest management concerned with the cultivation and management of trees in the entire area influenced and/or utilized by the urban population. It includes trees on streets, in parks, on private property, as well as watersheds".

Based on the last census (1996), 78% of Canadians lived in urban areas, or centres with minimum population concentrations of 1,000, and a population density of at least 400 per square kilometre, (Statistics Canada 1996). The urban forest is the day-to-day interface between these Canadians and their natural environment. This forest provides many environmental, economic and social benefits to these people but it is only relatively recently that these benefits have begun to be recognized. Communities within the Grand River watershed also have valuable and vibrant urban forests. By considering these forests of the watershed, this plan moves one step closer to forest management at the landscape level.

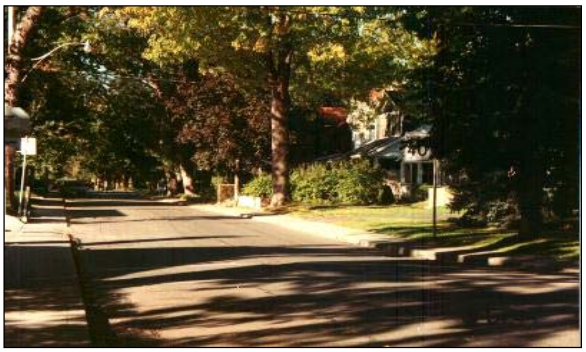
The urban forest provides a long list of benefits including energy conservation, improved water quality and increased property values.

One possible misconception about urban forests is that they are "owned and managed by the municipality". In fact, 80 to 90% percent of the urban forest is located on private property. This creates some significant challenges for the management of this resource. These challenges can only be overcome by incorporating a strong program of public education and awareness of the importance of the urban forest resource and need for some measure of planning.

What benefits are derived from urban forests?

Some of the benefits that we derive from the urban forest are:

- **The removal of air pollutants and dust particles from the air**. Gaseous pollutants like sulphur dioxide, nitrous oxide, carbon dioxide and ozone. The pollutants are absorbed through the stomata in the leaves and dissolved in the moisture in the leaf tissue. Particulates (dust) are trapped by the leaf surfaces and bark removing them from the air. These particulates may be subsequently re-suspended back into the air. While individual trees may remove only small amounts of pollutants from the air, the urban forest as a whole can have a significant effect on air quality. (Klaus *et al.* 1998; McPherson 1991; Nowak 1994; Smith 1990; Von Stulpnagel *et al.* 1990);
- **Energy conservation** through the evaporation of water from the surface of leaves, shade, and wind reduction. Moisture from the surface of leaves and from within the plant creates a cooling effect when it is evaporated, much as happens in a refrigerator or air conditioner. The shade provided by trees reduces the amount of energy absorbed by hard surfaces like the soil, sidewalks or buildings. This energy would otherwise be reradiated into the local environment, increasing the discomfort level. Winter winds can cause substantial energy loss from buildings, but strategically planted trees and shrubs can act as windbreaks to lessen these effects (Akbari and Taha 1992; McPherson 1994; Brown and Gillespie 1995);
- **Reduced storm-water run-off and improved water quality**. The high percentage of hard surfaces in the urban environment reduce the ability of storm water to infiltrate the soil increasing the level of runoff in to storm sewers. Rainwater intercepted by tree crowns can be re-evaporated back in to the air. Depending on the intensity and duration of the storm, the crowns of the urban forest may eventually become saturated and water will begin to fall through to the ground, but with less energy than would be the case if trees were not present. Some water may also flow from the tree crowns along the stem and can infiltrate the soil following roots. The combined effects will reduce erosion, retain water "on the site" to be used by the vegetation, and reduce the washing of pollutants from the hard surfaces in to the storm sewer system (Sanders 1984; Xiao *et al.* 1998);
- **Noise buffering.** Substantial treed buffers (greater than 30 metres wide) along highways or industrial sites can absorb or mask noise (Huang *et al.* 1992: Long-Sheng *et al. 1993*);
- **Provision of wildlife habitat**. Trees and shrubs along streets, in parks and in our yards provide crucial nesting and perching habitat for resident bird populations as well as for migratory birds passing through the area (DeGraaf 1985). Fruit and seed bearing plants can provide food for birds and small mammals. A diversity of plants in the urban forest may contribute to increased predation on problem insects;
- **Increased property value.** Evidence from Canada and the United States suggests that residential properties with substantial tree cover may sell for between 5% to 25% more than similar properties without trees. Similarly, homes in well-treed communities tend to sell more quickly (Petit *et al.* 1995);
- **Improved appearance of communities**. A diverse urban forest can break up the hard lines of buildings and other



A beautiful, and cool shady street…thanks to the trees!

structures, reduce glare from hard surfaces and simply provide a more pleasing "natural' appearance (Schroeder and Cannon 1987); and

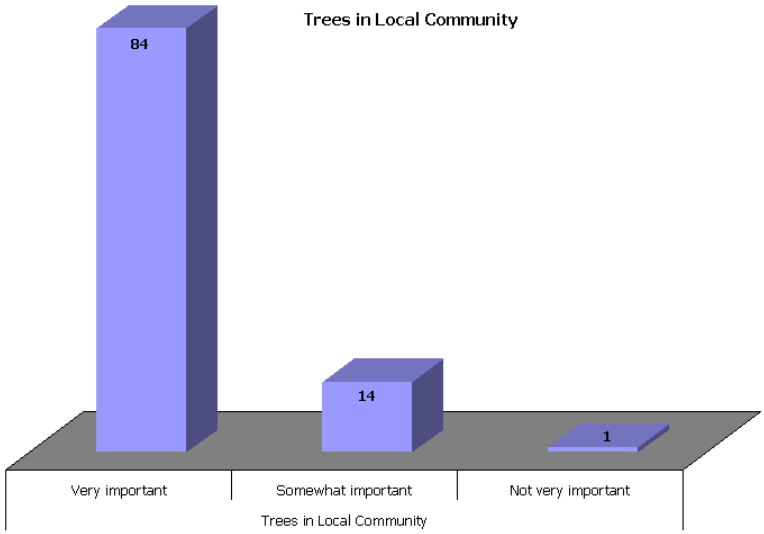
- **Improved psychological well-being by reducing stress.** Research in hospitals has shown that patients in rooms that overlook green space tend to recover more quickly than those with rooms that overlook hard surfaces. Physiological measures recorded as test subjects view photographs of vegetation and park-like settings indicate lower stress levels than those of people viewing photographs depicting harsher urban settings lacking trees and other vegetation (Ulrich *et al.* 1991; Schroeder and Lewis 1991).

Some challenges

All of the benefits mentioned above add to the community as a whole and not just to the owner of the tree or trees. The benefits in this partial list are mostly a result of the combined value of the trees that make up the forest in a neighbourhood or community rather than that of a single tree. For example the removal of air pollutants by individual trees may only be a few grams to a few kilograms per year. However, the urban forest of a larger community could remove tonnes of pollutants on an annual basis. Similarly, the aesthetic and monetary value of a property will be influenced by the urban forest of the community more than by the impact of a single tree, or the trees on the lot in question. This illustrates one of the reasons why we must consider the urban forest at the ecosystem level and not simply as a collection of single-tree issues.

Most of these benefits increase with an increase in the amount of the community area covered by the canopy or crowns of trees (% crown cover). Since the leaves provide many of the benefits, it makes sense to try to increase the area of the leaves in our cities. The structure of the canopy is also important. As well as increasing the leaf-area of the canopy, having an urban forest comprised of different sizes of trees (vertical structure) will provide more diversity of habitat for birds and other wildlife.

The leaf-area of a tree increases exponentially with the diameter of the tree. For this reason, to get the maximum benefits from urban trees, we must ensure that we plant species that have the potential to become large and that the trees live for a long time. We must plant species that can live for many decades and we must also provide an environment that permits them to live to a healthy maturity. Many of our current design and construction practices tend to prevent the development of an urban forest that contains a good proportion of trees that have the potential to become large. The loss of available growing space through in-fill construction, front yard parking, etc. limit the growing space (above and below ground) for tree species that can become large. Consequently, there is a tendency to plant more species and cultivars that are short-lived and small-statured. Soil compaction, root trenching, and



"How important is the presence of trees that you see in your local community?" - DRAFT REPORT, Attitudes of Urban Residents toward Urban Forests and Woodlands Issues, Environics Research Group, August 2001 –

other construction procedures damage root systems and reduce tree longevity, so that even trees that have the genetic potential to become large fail to reach this potential. The lack of effective, proactive planning for tree maintenance will also reduce the likelihood that trees will reach their potential.

Much has been said lately about the importance of biodiversity to healthy ecosystems. The urban forest is no different in this regard. Because of the difficult growing conditions in most urban environments, there has been a tendency in the past to plant relatively few species that are known to be able to withstand these conditions. Perhaps American elm provides the best example of the danger associated with planting too many trees of a single species. Because of its suitability to urban environments and its dramatic crown form, this species was planted extensively in communities from the east coast to the Rockies. Many people are aware of the devastation that Dutch Elm Disease created when many spectacular tree-lined streets were left with little or no vegetation. Today, many communities rely heavily on species like Norway maple. If we consider that most of the trees that are planted in our communities are produced as clones (individual trees such as Crimson King Norway maple are genetically identical to each other), then the need to consider the genetic diversity of the urban forest becomes even more apparent.

The Watershed Forest Plan has identified the spread of invasive vegetation as an important concern. Again, Norway maple, one of the most common tree species in our urban forests, serves as an excellent example. Aside from the issue of the over-use of this species and the clonal nature as described above, the species is also a significant invader in natural areas. Norway maple produces large quantities of seed almost every year. Aggressive growth of the species in natural areas can virtually eliminate the regeneration of other more desirable native plants.

Unlike most expenditures, the value of trees in the urban environment will increase as they get older. However, at some point, the condition of trees will decline and they may become a hazard. The timing of this shift from being a benefit to a liability, and the extent of this liability, will depend, to a large part, on the management of that tree over its lifetime.

In summary, a community could adopt the following goal for the management of its urban forest.

To maximize the leaf area of the urban forest by establishing and maintaining a canopy of genetically appropriate (adapted & diverse) trees (and shrubs) with minimum risk to the public.

To achieve this goal, the community must have a comprehensive management plan for its urban forest. While the larger communities within the Grand River watershed have plans in place to manage the trees under their jurisdiction, many smaller municipalities do not. Because of the limited resources available to many smaller cities and towns, the management of their urban forest may be considered low priority. However, the value of the resource to the community may be under-estimated.

If we assume a conservative value of one street tree for every six residents (Kenney and Idziak 2000), then a community of 6,000 people could expect to have approximately 1,000 street trees. The Council of Tree and Landscape Appraisers (CTLA 1992) has developed a process for placing a dollar value on urban trees. It should be kept in mind that this system is a modified replacement value for trees and does not directly incorporate the financial value associated with property value, environmental benefits, etc. Based on detailed street tree inventories from approximately 40,000 trees, an average value of $700 per tree has been estimated using the stem formula method (CTLA 1992) (Kenney and Idziak 2000). The reader is reminded that this should be considered an extremely conservative value. At an average value of $700 per tree, this would mean that a community of 6,000 people could have a street tree population estimated to be worth well in excess of $700,000. A community of 50,000 people could similarly expect the value of their street tree population to be nearly $6 million dollars. Imagine a small community with a fleet of

trucks worth $700,000 (say 35 to 40 pickup trucks, a substantial fleet for a small town), but it had no idea if these vehicles were appropriate for the work they are used for, there was no program to control vehicle maintenance, and no-one was sure if the trucks were safe to drive on the streets of the community until a citizen called to report a defect. If we expand this example to include the 80-90% of the forest privately owned and incorporate the monetary benefits associated with environmental improvement etc, this disparity becomes even more dramatic. While it is unlikely that any town manager would allow such a situation to exist in their motor pool, this is the situation with respect to the level of urban forest management in most communities across the country (Kenney and Idziak 2000), and presumably within the Grand River watershed.

What opportunities exist?

While the current level of urban forest management in many of the communities within the watershed may be at an embryonic level, many opportunities exist to expand and enhance the resource.

Urban green space planning is often the last consideration of municipal planners and developers and regarded in many cases as an "add-on" after the hard surface and utilities are accommodated. However, the health of the urban areas in the Grand River watershed and the sustainability of the water resources are linked inextricably with watershed forests, whether they are urban or in the landscape surrounding the urban area (peri-urban). By incorporating urban forests into the municipal planning and management structure we have an opportunity to reach the broader goals of environmental health and gain the enormous benefits of urban forests. To achieve this, our planning principles and urban forestry perspective must be revisited. The urban forest canopy must be considered as an equal partner in the community infrastructure at the time of planning and not as an "add-on". The existing urban forest resource must be inventoried and incorporated into the strategic plan for the community.

Since 80-90% of the urban forest is privately owned, the involvement of landowners in the planning process is, perhaps, even more crucial to the urban forest than to the forests of the rural areas of the watershed. Community-wide urban forestry plans should include a vision based on clearly defined goals and objectives, an inventory describing the forest at a level appropriate for the plan, and an educational component. As noted above, the urban forest is the most direct connection that many people have to their natural environment. By involving them more directly in the planning and management of the forest in their neighbourhood, they will have a better appreciation for the forests in the rest of the watershed.

Most communities have some structure already in place, which could initiate an inventory of the urban forest resource in their area and to use this information to develop a strategic urban forestry plan. The Urban Forest Network is a non-governmental organization established in 2000 with the goal of linking community groups interested in sharing information on urban forestry issues. The UFN can be contacted through LEAF in Toronto at (416) 413-9244 or at www.leaftoronto.org Neighbour*woods* is a community-based urban forest inventory procedure developed by Kenney and Puric-Mladenovic (1998) to assist lay people to collect meaningful data that can be used to summarize the urban forest resource within a neighbourhood or small town (for further information contact a.kenney@utoronto.ca). Armed with the information provided by the summary report from Neighbour*woods*, a community can begin to develop a strategic plan to bridge the gap between the current state of their urban forest and that envisioned by the community. Such a plan must begin with a clear vision and set of goals for the forest that have been identified by the community. Through a twenty-year strategic plan with nested five-year management plans and annual operating plans, the community can move from a reactive to a proactive level of management.

By recognizing that urban forests are a vital part of the landscape of the watershed, this plan can encourage communities of all sizes to increase the role this important resource plays in providing residents with clean air and water, and an improved quality of life.

Action Items:

- **Further integrate urban forests in to the municipal planning and management strategy.**
- **Assign urban forests infrastructure status during the planning process.**
- **Inventory and monitor the existing urban forest resource. Use this information to maintain a healthy forest canopy and direct appropriate management practices.**
- **Develop a community-wide vision with defined goals and objectives for managing urban forest resources. Encourage the participation of private landowners in this process, since 80-90% of the urban forest lies in their hands.**
- **Promote existing and new urban forest networks, with the goal of sharing information and experiences about urban forestry issues.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

3.3 Agroforestry

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The relationship between forests and agriculture has always been somewhat strained. During the settlement period, most of the forest in the watershed was cleared for agriculture, whether the soils could sustain farming or not. Problems with broad-scale clearing became obvious through declining productivity, severe land erosion, and the harsh windy climate (without trees). The Agreement Forest Program started in the 1920's and helped bring the most degraded property into public ownership for restoration. Later programs helped to re-establish private-land forests on marginal or

Windbreaks are an effective Best Management Practice for controlling erosion in farm fields.

fragile farmland. These programs were very successful in bringing properties degraded by agriculture back into productive forests and now form the foundation of an industry based on the wood from plantation thinning.

Shifts to and from forest (i.e., abandoning or planting forests, and clearing forests) were often set in motion by technological, economic or policy changes that often determined the profitability of farming certain lands. For example, when tractors took over from horses, it was less practical to farm some steep slopes but more practical to farm larger level areas. After World War II bigger equipment, cheap fertilizers, herbicides and policy support encouraged farmers to buy larger and larger equipment and to cultivate larger and larger fields. Prices for grain, milk or meat and input costs determine the profitability of farming and influence whether land is cleared, drained or abandoned. Often these changes occur without planning or have unforeseen environmental impacts. Subsequent degradation can result in policy changes that encourage conservation practices. The most successful programs are where conservation practices help to improve environmental conditions and help to maintain or improve the profitability of farming.

There seems to be a cycle where periods of worsening degradation are followed by conservation programs that try to improve the situation. People see better times and interest in conservation declines until problems develop to a new critical level. Early programs in the 1920's helped to reclaim agricultural “wastelands”; Conservation Authorities were established to manage river systems in the 1950's following a number of serious floods; pollution and erosion in the 60's and 70's resulted in conservation and reforestation programs in the 1980's. Now, most support for conservation activities has been cut to reduce budgets, limiting the potential for landowners to retire lands to forest or to implement complicated practices.

Agroforestry includes all of the ways that trees are used in agriculture where there are ecological or economic relationships. Tree components of farming include windbreaks, orchards, woodlots, wetlands and sugarbushes; and agroforestry includes many practices that require different knowledge than for crop or livestock production. Generally farmers need some extra information or assistance to use agroforestry systems successfully.

While there is broad support in rural communities for some agroforestry practices and limited support for others, they generally require experience or some outside expertise for best results. The existing climate of budget cuts has reduced support for technical assistance and activities to the point where farmers are undertaking only those practices that they are familiar with and that have some funding and technical support. For example, the Rural Water Quality Program is responsible for an upswing in the establishment of two agroforestry practices: streamside buffers and windbreaks. However, in other cases, farmers may perceive the cost to be higher than the perceived benefit, or may not feel confident that they have the time or knowledge to successfully start an agroforestry project.

Most farmers know a lot about growing crops and livestock. They are subject to economic pressures beyond their control, work long hours and have far more work to do than can ever get done. So when people suggest that farmers do things that add to their workload, there is a natural resistance. For farmers to change practices or use a new one, they have to believe that it will work and they must be able to get help (to answer their questions). The success of conservation tillage programs in 1980's is an excellent example where technical assistance and equipment loans were provided along with the new ideas. Fact sheets or the Internet only provide a starting place when dealing with new practices; users will still have questions and need moral support. If answers aren’t there, the practice won’t be used.

Agroforestry systems try to accomplish two things; improve productivity (increase yields or reduce costs) and/or environmental protection. Any of the practices will do both to some extent, and will provide different benefits depending on how and where they are used. For example, a

conifer plantation can be used to keep a steep slope from eroding and to rejuvenate the soil. This rejuvenates the site itself and keeps the soil out of streams, but provides little hope of earning money from forestry because of low productivity imposed by the site conditions. When a plantation is established on a marginal field that is difficult to work, it may be exceptionally productive so that growing trees may be more profitable than crops.

While Agroforestry includes forestry activities like farm woodlot management, managing established plantations, maple syrup production and some other practices, some of these traditional "forestry" aspects will be discussed in the Silviculture section of the Watershed Forest Plan. The Agroforestry Section will focus on practices that directly interact with farm practices; including windbreaks, reforestation of marginal and fragile lands, buffer plantings, intercropping and Silvopasture.

Reforestation and marginal/fragile land retirement

Fragile agricultural lands (such as the lighter areas on the tops of the hills in this field) should be taken out of production and reforested.

Provincial programs through the 1900's have brought thousands of acres of degraded or abandoned agricultural land back into mostly-productive forest cover and provided most of the public forest land in southern Ontario. However, the Ontario Ministry of Natural Resources redirected its programs in the mid-90's divesting itself of its tree nurseries, forestry field staff, financial support for planting programs, and cut the funding of Conservation Authorities that subsidized planting services. The Ministry of Natural Resources is exploring possibilities to once again be a catalyst to increase tree planting efforts, including the up-take of these practices. One hopeful area is the funding that is expected to become available related to tree planting to counteract global climate change.

Some landowners will pay the full cost of larger plantings. The reality, however, is that significant reforestation will not occur without some cost-sharing arrangement to ease the financial burden on landowners, and to recognize the environmental benefits that these new forests on private land provide to the whole community. Throughout the century, the significant gains in forest establishment resulted from subsidy programs. Generally, it is just too expensive for the average landowner with relatively short-term goals.

While the current policies suggest that planting trees on idle, marginal or fragile lands is not in the public interest, industries based on the wood from conifer plantations suggest that the investment in tree planting is paying off. In addition to the environmental benefits of increased forest cover, the plantations are providing employment, investments in equipment and supplies and tax revenues.

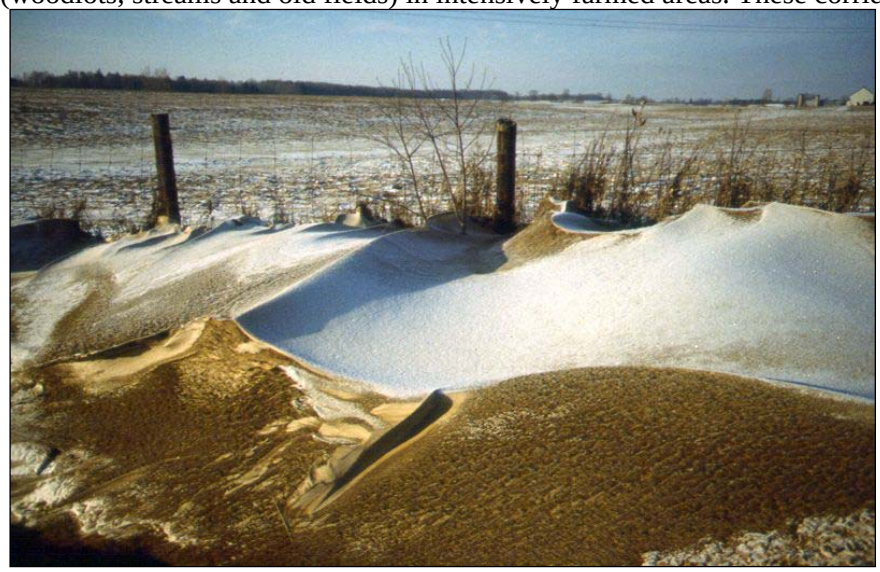
Opportunities for plantation establishment are found throughout the watershed, but less so where the agricultural industry is most dynamic. The Nith watershed, north Waterloo and north Wellington have the most intensive agricultural sectors and in these areas large plantation establishment is less likely. While targeted buffer strip and windbreak plantings will provide significant benefits, they occupy small areas and will not have a great impact on the percent forest cover in an area. Gains in the percent forest cover will come from changes in land use as idle or abandoned farmland is reforested or left to natural succession.

Unfortunately, the periods where idle agricultural land is available for reforestation may be only temporary. If these opportunities are missed, the land may go back to agriculture as socio-economic factors shift. A good example of this is in the Hillsburg area in Erin Township. Sandy soils became uneconomical to farm in the 1960s and many fields and farms were planted to trees in the 1970s through the Ministry of Natural Resources or Conservation Authority programs. These plantations, combined with the existing patches of wetlands and upland forest, now form significant blocks of natural habitat and provide a significant increase in the percent forest cover. Since then horse farms have established themselves in areas where mixed- or cash crop farming was not a profitable option. Had there been no support for tree planting in the 1970s, it is likely that several thousand acres would now be going back to agriculture.

Another concern is that plantations bigger than a couple acres should be established with practical economic considerations in mind. Consider 30 years after planting when one plantation is a valuable forest asset beginning to provide economic returns and another that may not provide any returns for another 30 years or more. This latter case is has been used successfully by landowners to argue in support of clearing lands for agriculture (sometimes in advance of development), or apply for severances.

Windbreaks

Windbreaks and shelterbelts are used to protect crops, soil, buildings, roads and livestock from the effects of strong winds and are the most commonly used agroforestry practice in the area. They have been especially important to protect soils and crops in the sandy, tobacco-growing areas of the watershed (e.g., near Princeton) and in the north towards Dundalk, where they have been commonly used to protect roads from windblown snow. Windbreaks, shelterbelts and fencerows also provide important linear corridors that connect remaining bits of natural habitat (woodlots, streams and old fields) in intensively farmed areas. These corridors allow for movement of wildlife through the landscape, making a significant contribution to the sustainability of the natural systems.



Unprotected farm fields can lose tonnes of fertile topsoil from wind erosion in a single year.

Despite the fact that their economic and conservation value has been widely documented, most farmers require some encouragement to invest in windbreaks. This is likely because the real benefits from windbreaks come ten, twenty or thirty years down the road and many farmers feel they have other shorter-term issues that require their time and capital.

The Ministry of Natural Resources has historically supported windbreak establishment either directly, or through Conservation Authorities. While they have always been used to varying degrees, like plantations, their establishment or removal has often been related to support for

conservation programs and shifts in farming technology. The removal of windbreaks and natural fencerows was subsidized in the 1970's by the Ministry of Agriculture and Food, likely to encourage farmers to expand fields and use bigger equipment. Ten years later Ministry of Agriculture and Food land stewardship programs were supporting windbreak planting for conservation purposes. In 2003, windbreak establishment is supported watershed-wide by the Rural Water Quality Program (in its various forms). Also, a citizens' group in old Peel Township in Wellington County has made some funding available for farmers to establish windbreaks in this intensively-farmed area.

Reducing soil erosion is central to maintaining a healthy watershed, and therefore the Grand River Conservation Authority has helped landowners to establish windbreaks for the past five decades. The advantage that windbreaks have over plantations is that they are smaller plantings with a significant targeted benefit to landowners that have a vested interest in the outcome. Programs supporting windbreaks will have significant benefits at a low cost compared to reforestation plantings. The Grand River Conservation Authority should maintain its support for windbreak establishment, providing technical and financial assistance within its means. This support should include encouraging partner support (the former Peel Township).

Riparian (streamside) buffer plantings

Buffer plantings along streams, wetlands and forests are designed to protect areas from degradation or enhance natural features, by expanding or connecting habitats. Because they occupy small acreage and have obvious benefits to water and wildlife they provide the best opportunity to improve the environment for the least total investment. However, they are relatively expensive on a per-acre basis because the plantings tend to be complicated, involving small numbers of numerous tree species on irregular areas with variable site conditions. Because of the very positive multiple benefits, these plantings enjoy broad community support and targeted financial support for local projects from the provincial and federal governments, Conservation Authorities, municipalities or community interest groups.

The Grand River Conservation Authority maintains an active program in this area, helping to deliver programs for various agencies (e.g., Ministry of Agriculture and Food, and watershed municipalities). The Authority's involvement in these programs helps to achieve their core mandate of managing the flow of water and improving water quality. As with windbreaks, the Authority's budget and the various agencies supporting this sort of work change over time, but it is likely that support for these plantings will be maintained because they fulfill many goals at a relatively low total cost. However, the piecemeal funding (e.g., within a municipality) can leave good projects in other areas without adequate support.

Washington Creek after restoration

Intercropping

Intercropping involves growing trees and farm crops together in the same field. This includes the practices of growing vegetables in fruit orchards, growing walnut or other trees in grain fields, and many other variations. From a watershed management viewpoint, the technologies are most useful as a mechanism to sustainably farm or

retire fragile or marginal lands; to reduce erosion from cropping, reduce crop inputs, and store greenhouse gasses; and to improve wildlife habitat/local biodiversity.

While these systems are economically productive and have the potential to be very useful, there has been little adoption. Intercropping systems require some experience and more attention than producing a single crop. Some farmers are interested in using the systems, but with the limited extension support available, there will be little adoption in the foreseeable future. Should positive technical support become available there would likely be limited but steadily increasing adoption.

Silvopasture

Silvopasture is the intentional production of livestock and trees in the same area, managing for both products. This is not to be confused with the poor practice of allowing livestock free access to forests and plantations. One of the more useful applications of this system in watershed management would be its potential use in riparian zone management. Using a “flash” grazing strategy, farmers could utilize forage produced in riparian zones while keeping livestock away from streams most of the time. This would provide many of the benefits of a riparian buffer while contributing to farm productivity.

In general, Silvopasture has not been considered useful by most farmers because they are unfamiliar with the concepts and/or are not likely to try the system without technical support. As with intercropping, it is unlikely that there will be any significant use of Silvopasture systems without positive and consistent technical support.

Agroforestry in the watershed

Forest cover in the watershed averages 19%, ranging from 24% in eastern and southern Wellington to less than 10% in most of the Nith and Conestogo watersheds, and some areas of the lower Grand. The areas with higher forest cover are associated with the rolling, glacial-moraine topography that occupies an arc from the Belwood area through Erin, Eramosa, Milton, Puslinch, and North Dumfries Townships, and with the lands of the Six Nations of the Grand River. The areas with low forest cover are associated with more level areas where soils are more amenable to agriculture and larger fields.

The areas with low percentages of forest cover include areas that are farmed intensively (the Nith and Conestogo watersheds, parts of Brant, and north Wellington) and where agriculture has been declining (generally in the northern and southern extremes of the watershed). In the northern and southern extremes of the watershed, the historic low forest cover has been changing where many fields in clayey, wetter soils or dry, sandy soils have been idled in the last 40 years and left to natural succession. This has been combined with rising land values as non-farm landowners move into some areas.

In the north many wetter areas develop in to brushy, scattered mixed-lowland forest with poor forestry potential for the foreseeable future. Early planting will bring some of the better-drained parts of this area into forest much faster. This happened in Amaranth Township on a number of Grand River Conservation Authority properties that were planted in the 1950s and 60s. They now form a mosaic of conifer plantations and early-successional wetlands and forests. In the southern end of the watershed, poor soil conditions combined with increasing non-farm land ownership have contributed to more recent reductions in the area farmed.

An objective of the Watershed Plan is that the average forest cover over the watershed should be increased from 19% to 30%. This is a very ambitious objective that is only achievable over the very long term (e.g. a century) and with large-scale reforestation programs. The smaller targeted agroforestry practices like windbreaks, riparian plantings and intercropping provide local environmental benefits and can connect patches of natural habitat, but do not cover much area.

Significant shifts in the percent forest cover will be determined by socio-economic factors that affect the profitability of farming and the influence of non-farm landowners. These shifts can be left to fate or if society desires more forests, society will have to direct the shifts by offering cost-sharing (subsidies) for reforestation on private land, and by structuring land use and related economics such that they support increased forest cover.

Making progress

Making progress in agroforestry on a watershed scale takes two general directions; improving the environment with small-targeted projects and increasing the amount forest cover with larger-scale reforestation programs. The smaller projects include riparian buffers, planting areas that link forests or wetlands, windbreaks and other naturalization projects. These projects tend to be small, but do a lot of good and lend themselves to work by individuals and groups. A few people can make an effort and see the good results in just a few years.

The second strategy is maintaining and increasing the amount of forest cover and natural habitat in the watershed. If this is to be done in a planned, significant and hopefully permanent way, some sort of meaningful financial support for planting trees will be necessary. Specific programs have targeted certain types of land (e.g., erodible farmland) in the past; future programs may or may not have these limitations. Hope may lie in reforestation programs that are being proposed to reduce greenhouse gases by tying up carbon dioxide in tree biomass.

The philosophy of “think globally, act locally” means that the little actions that individuals and groups make can be considered together to make a significant impact. A few ideas on how individuals and different groups can act to improve things are given below.

Individual actions

Individuals can help actively by joining groups that implement projects (e.g., Trees for the Grand) and helping with projects like tree planting, seed collection or rehabilitation projects. At the political level it can be important to let agency staff and politicians know your feelings about conservation programs and the importance of supporting tree planting and other environmental programs. Look for opportunities to suggest projects to neighbours, or groups etc.

Individuals could watch out for problem areas (e.g., like collapsing streambanks) and approach the landowner to see if they are aware of the problem. They may tell you to mind your own business, take action to correct it themselves, or allow a group to help fix it up.

Contributions of time from professionals in resource fields who work for agencies or as consultants can play a critical role in community projects. Many individuals and groups have good ideas and lots of enthusiasm, but sometimes need technical support to make their project successful. Some advice from a knowledgeable professional will often help make a project successful.

Landowner actions

Landowners can assess their property to see if there are opportunities to improve wildlife habitat, establish buffers or corridors, or establish plantations. They can start working on “projects” within their means, planting a few trees or shrubs every year. They can consult with experienced people in the area—Agency staff, Ministry of Natural Resources, Conservation Authorities, Ministry of Agriculture, Food and Rural Affairs, Consultants and interest groups. The Environmental Farm Plan program, Best Management Practice Guides and fact sheets have excellent ideas on conservation practices and for planting/rehabilitation projects. Landowners should watch for new subsidy programs that may help reduce the cost or make larger projects possible, and can lobby agency staff and politicians about the importance of supporting tree planting and other environmental programs.

Community interest groups

Community interest groups can undertake political lobbying and conservation projects as action items and communicate with other groups and agencies to pool resources. Several smaller organizations can take on larger projects than isolated groups. Often a group may have ideas for projects that may be supported by staff, funding or guidance from agencies like the Conservation Authority, Ministry of Natural Resources Or Ministry of Agriculture, Food and Rural Affairs.

It is particularly important that young people get involved in conservation projects. Schools, Scouts and Guides can provide helpers for projects and give young people valuable exposure to environmental issues and the outdoors.

Stewardship Councils can be particularly helpful in bringing partners together and be a catalyst in getting projects started. Groups with project ideas can approach their county Stewardship Council. The Council may provide start-up money, fund the project and/or identify other partners for the project. Stewardship Councils tend to be made up of knowledgeable citizens, concerned professionals and professional staff from different agencies. This membership makes them a valuable resource in providing technical review, identifying partners and rallying support for projects.

An example of how Councils can help with communication is the Wellington County Stewardship Forum sponsored by the Wellington County Stewardship Council. This annual event brings together representatives of many local interest groups who describe their interests and activities and discuss how they can work together.

Agencies

It is important for agencies to maintain their in-house expertise as a resource base to help meet the agency and public objectives. There will be a critical level of staff need to keep the "institutional memory" alive so that programs can be initiated or restarted when funding or program opportunities come available. In the meantime, agencies will need to locate contract-funding sources and form partnerships within the community to continue making progress in conservation efforts. They should also encourage staff to be involved with community projects and initiatives.

Agroforestry and the Grand River Conservation Authority

The Grand River Conservation Authority has been active in some aspects of agroforestry since it was formed in 1942. Up through the 1980's they provided subsidized tree-planting services for water benefits, soil conservation, reforestation and general conservation purposes. While the cost of planting through Conservation Authorities was higher than through the Ministry of Natural Resources (because of lower subsidies), the Conservation Authorities usually planted smaller areas with more targeted objectives. The Authority has been a leader in establishing riparian buffers through its own programs and contract programs of other agencies. They have also encouraged private landowners to adopt innovative agroforestry practices such as intercropping to receptive landowners, with some success.

Since 1990, provincial tree-planting subsidies (for nursery stock and planting) and general support for Conservation Authorities has been virtually eliminated and most tree planting by

Conservation Authorities has been with full cost-recovery or subsidized by local funding initiatives. The withdrawal of provincial support for tree planting has had a dramatic effect on the scale of tree planting activities throughout southern Ontario including those of the Grand River Conservation Authority. From 1987 to 2003, the number of trees planted on private land by the Grand River Conservation Authority has dropped from 742,000 to 72,300**.** Thanks to local funding initiatives such as the Rural Water Quality Program, Trees for Peel, and the Brant Millennium Grow Green program, planting is now building again.

Through a difficult financial period, the Authority has continued to deliver and seek support for tree-planting and agroforestry programs. They have been successful in helping to develop and deliver a number of provincial, federal and municipal programs that have supported targeted plantings like buffer strips, windbreaks and other naturalization projects.

The Authority tree nursery is proving to be an invaluable resource to the watershed and community. The nursery grows seedling and larger stock of many species for its own use, in planting programs, for sale to the public, and to support community groups. The nursery also grows trees for/with a number of partners, including the Ontario Soil and Crop Improvement Association (Chestnut Demonstration Project), Six Nations of the Grand River, and the Haldimand Community Forest Initiative.

Action Items:

- **Continue to provide support to established programs that target linking and increasing forested areas by establishing windbreaks, riparian buffers and working with the rural community.**

Bold text indicates item is included in Part 5: Watershed Forest Plan Action Items summary.

3.4 Silviculture

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The role of silviculture is to tie forest management and silvics together. Silviculture is the art and science of manipulating stand or forest establishment, stocking or density, composition and growth, throughout its life, and implementing programs to eventually guide its evolution into the next forest, if this is to occur. The purpose of a silvicultural system is, therefore, to use the silvics of the particular species to develop a silvicultural system for the forest that will meet the forest management objectives. The silvicultural system can be very intrusive into the natural forest evolution or development, or less intrusive, based on the species silvics and the particular objectives to be achieved.

A proper thinning operation releases the remaining trees and encourages a healthy understory

A discussion of silviculture in any forest plan must start with a discussion of what it is and what it is intended to accomplish. Firstly, it must not be confused with forest management. Forest management addresses the derivation of objectives for a forest. It answers the questions of why and how a forest will be managed and to what purpose. It is perfectly reasonable, in a forested area, to have forest management objectives that

encompass everything from economic development to protection or no actual management, simply monitoring. Part of the planning process for a forest is to reconcile the various objectives for an area, resolve any conflicting objectives, and to integrate the objectives for varying uses. If forest management objectives are reached that include the purpose of deriving income, then forest management can include the application of business principles, as well as technical forestry principles, to the management of the forest. The term forest management can be applied to an individual woodlot, or the forests of a geographic area such as a large tract of Crown land, or a watershed.

It must be remembered, that forest management cannot be carried out and objectives cannot be achieved, without an understanding of silvics of the species in the forest. Silvics encompasses how trees grow, including:

- soil, site, moisture and nutrient requirements;
- flowering, fruiting, seeding and regeneration characteristics;
- early stand growth and development, longevity;
- response to competition for water and nutrients, light, and physical and chemical competition with other species, and within its own species;
- pathogens and insects, and predation from mammals.

It should be understood as well, that silvics is a science that is founded on ecological principles and the understanding of forest ecology, and how ecology influences forest establishment, development and decline. One key to the interrelationship between forest management and silvics, is that forest management objectives cannot be met that are inconsistent with the silvics of the species or the forest. For instance, to expect red pine to grow to "old growth" status on a calcareous site, like most parts of the Grand River watershed, is inconsistent with the silvics of the species and will result in a declining forest, long before even normal stand maturity.

One guiding principle of forestry is that management, and hence silvicultural systems, should have objectives whose achievement can be measured over the period of management. Forestry also has the advantage, when compared to other ecological sciences, that there is considerable economic return possible from forestry. This has resulted in the funding of extensive research over the years that has added to the wealth of knowledge concerning silvics and silviculture. Federal and provincial governments, as well as private industry have conducted this research.

History of Silviculture

Silviculture is a science that has been around for hundreds of years. In the fifteenth through eighteenth centuries, the great empires that were dependent on their navies; England, Spain and France, knew the importance of their forests for ship building timbers. In the New Forest in England, standard practice was to create earthen berms topped by wooden palisades. These would enclose areas to be regenerated to oak seedlings. The purpose of these structures was to exclude deer that would destroy the young trees. Trees were not only harvested, but also pollarded, cutting off only the larger limbs, to produce wood for ships, primarily ribs, without cutting the entire tree. Later, the tree itself would be harvested for planks.

In the new world, things were different. Early native populations in the areas in and near the Grand River watershed, primarily the Neutrals and Hurons, were agricultural societies who used fire, girdling, and other forest clearing, to maintain their fields and settlements. Stories are told of the large fields that were created, and that the original game of lacrosse was played on huge fields several miles wide. This was a period during which large prairies occurred, maintained by periodic fire. Silviculturally, this disturbance had the effect of maintaining forest in various stages

of maturity, from young regeneration, suitable for browsing of ungulates, to mature forest. The heavy use by the native peoples of local game also served to keep vegetation predators in check, an alternative to the berms and palisades of medieval Britain. Although these peoples were not intentionally practicing silviculture, the result was silvicultural, and resulted in positive effects to the forests in terms of maintaining the diversity of species, forest types and age classes.

In the mid seventeenth century, due to the conflict between France and England, the Iroquois, allied with the British, were encouraged to war against the Hurons, allied with the French. When the Hurons were displaced from southern Ontario, and the Iroquois returned to their home further south, the forests of Ontario began to recover and to encroach on the fields and prairies. This is the unbroken forest that was found by the early surveyors and settlers one or two centuries later, (depending on the location in the watershed) which had matured undisturbed and uncharacteristically during the intervening time. A forest of this nature had probably not existed for centuries before this time. It was an anomaly created by the absence of people and the absence of their "silvicultural" practices.

This native disturbance, as well as the original clearing by settlers, including clear-cutting and burning for charcoal, ash and other forest products, resulted in the southern Ontario forests that we have today. The severe disturbance allowed trees that require disturbance and full or partial light to regenerate: poplar, pine, oak, hickory, cherry, red and silver maple, and ash, to maintain themselves in the landscape. Subsequent logging has not always considered the effect of the logging on the retention of these species. Our modern impact on forests has been exploitive rather than silvicultural, and not planned to result in positive effects on the forests. In addition, our pattern of land clearing has resulted in a ballooning population of deer and other wildlife that can preclude the regeneration of some species, particularly the oaks, which are a preferred browse species for deer. The result is that some species are being removed from our forests in logging, and are being replaced by other more shade tolerant species such as sugar maple and beech. We are losing some of the forest types that were once the more common forests in our area. We have not yet learned the lessons from the fifteenth, sixteenth and seventeenth centuries.

Silviculture today

In order to provide standards for managing the forests of southern Ontario, the Ministry of Natural Resources produced "A Silvicultural Guide to Managing Southern Ontario Forests" in 2000. A considerable body of silvicultural knowledge and research exists in the United States, in similar forest types, on similar sites, that is not entirely recognized or included in the Ontario document, but which provides additional information on which to base forestry decisions. Although some of our forests are called Carolinian, foresters and environmentalists do not necessarily look to the U.S. for answers, and unfortunately, much of the Ontario research into hardwoods has been conducted on Crown Land in Central Ontario, not on private land in the south. Much of our current effort is focused on surveying "sensitive areas" and documenting the sensitive features, whether plants or animals. Our first response, the politically correct one, is to preserve these areas from impacts of activities that in many cases produced the richness of the flora and fauna in the first place. This could be viewed as a response based on the fear of causing some irreparable harm, rather than assuming the risk of a silvicultural intervention that would produce a positive affect on the forest or landscape.

An example of our current forest management dilemma is illustrated by the problems that arise between shade intolerants or mid-tolerants, and shade tolerant species. Firstly, shade tolerant species such as sugar maple are prolific seeders, in seed years, and the seed and seedlings are not heavily preyed upon by wildlife to the point that seed and seedlings are not available for regeneration after a harvest. On the other hand, in normal years, a species such as oak can have up to ninety percent of its seed rendered non viable by weevils. Only in a bumper seed year does

enough seed survive to have any chance of germinating. However, predation by birds and mammals; jays, squirrels, mice, chipmunks, deer, turkeys, can also take a significant toll. In addition, when the seed germinates, deer and rabbits prey upon the seedlings. Consequently, some of the mid to shade intolerants are classed as trees with low regeneration potential. Even if the proper silvicultural harvesting system is implemented, the other seed and seedling problems can thwart regeneration efforts. The problem in a nutshell, is that the more productive the site, the less likelihood of maintaining species such as oak. In Ontario, we may want to leave an oak, or oak—hickory forest, unmanaged, but depending on the site, the stand may shift on its own to more shade tolerant species.

Similarly, silvicultural compromising, by implementing a system such as selection of individual trees for harvesting, or harvesting trees in small groups, on too productive a site, is doomed to failure if perpetuating the oak is a management objective.

A further problem is that where shade tolerants do not overcome the site, shrub understories such as dogwood, witch hazel, blue beech, and buckthorn may preclude stand replacement. Those who argue that this succession is a natural phenomenon and should be allowed to occur, must be prepared to accept the loss or a large reduction of this forest type in our landscape. It has been recognized in forestry circles for centuries that managing and regenerating mid tolerants and intolerants such as oak and pine, is very time consuming, costly, and fraught with controversy and disappointments. Expensive and controversial treatments such as shelterwood cutting, clear cutting, herbicide applications, and prescribed fire, are the norm. Spending money on these treatments, without controlling wildlife predation of the trees, is similarly a waste of time and effort.

The subject of forest diversity often clouds this whole issue of stand replacement. Forest diversity can refer to an individual forest species, or diversity or species richness, i.e., the number of species present. It can also include structural diversity; the number of canopy layers, size class distribution, and forest floor structure, or distribution of dead and downed trees. Forest diversity in a landscape context normally includes some consideration of forest and site types and their distribution. This can include the percentage of forest cover represented by individual forest types, their age classes and conditions. In a silvical context, one must consider the species associations in which tree species and forest types normally occur. For instance, many people are opposed to monocultures. However, this is the normal stand type in which some species, notably shade intolerants and some mid tolerants, occur. If some monocultures are lost through management or succession, then these species may be lost in the landscape. The lesson is, that in order to maintain some species or stand types in the landscape, it may be necessary to narrow the richness of the species in a local area, in order to maintain, silviculturally, a particular stand type that is in danger of loss in a regional context. For instance, in managing for oak and hickory, other species such as maple and ash, with a higher regeneration potential and therefore a competitive advantage, are discouraged in the silvicultural program. If all or most of these forests are in a mature age class, and in danger of loss through succession, then new, younger forests must be silviculturally re-established. This can only be successful on specific site types, and the trick is to know where these sites occur and why, to have the best chance of retaining these species associations in the watershed. Alternately, if a species type, such as pine, is normally lost over time through conversion or succession to hardwoods, then silvicultural programs must be adopted to discourage these hardwoods, or new pine stands must be constantly established. On the other hand, species richness should be encouraged in tolerant hardwood forests. In some cases, species richness has been reduced by removal of non-commercial species such as beech, ironwood or hemlock, resulting in increased stress amongst the remaining trees.

Silviculture in the watershed

The implications of silviculture to the watershed can be summarized very simply. Acting on these implications is the hard part. Firstly, one must know what type of forests occur, where in the watershed, why, and what has caused them to be there and in their current form and condition, and how they are evolving. The forests, as they exist, are a result of past management and mismanagement. Some forests, due to past history, are not the most appropriate forests for the sites on which they occur. Underlying this history of management is the history of glaciation and the surficial geology of the watershed that has resulted in the current soils and drainage. This physical and social history has resulted in broad forest types (previously described) that occur on features such as the Stratford till plain, the Waterloo Moraine, the Horseshoe moraines, the Guelph Drumlin Field, the glacial spillways and isolated kames and eskers, aeolian deposits, and lake sediments and beaches of old glacial lakes. Compounding these simple landforms are many areas where the original materials overly something else, which changes the normal growing conditions that might be expected on a particular site. Past history, including topography and disturbance has resulted in the forests of the watershed as we see them today.

We must see where our forests have been and where they are going, in order to determine our most appropriate actions. The natural tendency to replacement of shade intolerants and mid tolerants by shade tolerants must be recognized as a natural phenomenon, often aided by misguided management practices. By understanding the history and underlying soil strata, and the normal processes of succession, silvicultural systems must be chosen carefully, to meet management objectives that will not result in deterioration of the quality and quantity of the forests of the watershed. In some cases, what is currently needed are silvicultural programs that will result in forest restoration, and one must not make the mistake of discounting the quality of a forest based on its current degraded condition, if the site and species are conducive to natural or man-made restoration. Forests have been intentionally degraded by excessive harvesting and mismanagement, in order to remove barriers to residential development of these forests. This artificially degraded condition, which would only be temporary, facilitates permanent loss of the forest.

Based on this assessment of the forests and forest sites of the watershed, management objectives could be developed, in a forest plan, which would identify targets for the representation of various forest types, as well as for forest cover as a whole. This would include identifying where in the watershed these forest types are normally found, and what pressures exist in the area that affect their quantity and quality. Potentials could be identified for various management regimes in terms of economics and environmental quality. Goals for maintenance, restoration, replacement and management, could be set for the watershed as a whole, which could be recognized and incorporated into local plans. Recommended silvicultural systems and options, for each forest type, could be identified to meet various objectives. These would in effect become Best Management Practices.

Years ago, local landowners, through groups like the Huron District Woodlot Owners Association, convinced the Ministry of Natural Resources to implement the Woodlands Improvement Act (W.I.A.) program, and to fund agencies such as conservation authorities in forest management efforts. It is noteworthy that initial funding for this program came from the Agricultural Rehabilitation and Development Agreement between the federal and provincial governments. Under this program, these two levels of government assumed some of the cost of the more expensive silvicultural treatments: tree growing and planting, early tending and thinning (often by girdling), rehabilitation of deteriorated stands such as Scotch pine jungles, and expensive regeneration treatments in mid tolerant oak and pine stands. The W.I.A. program no longer operates, leaving landowners with few resources to carry out these treatments that were formerly subsidized. The implications are that older shade intolerant and mid tolerant stands are being harvested or are naturally succeeding to shade tolerants, and funding for establishing new forests, such as pine, has been reduced. Funding for expensive treatments in existing stands, such as underplanting, herbicide applications, or prescribed fire for regeneration or for control of invasive exotics, has similarly been reduced. Consequently, through lack of resources, we are in danger of losing some important forest types.

Plantations are designed to receive intensive silvicultural care, starting when the land is prepared for planting. This is followed by tree establishment, pruning (sometimes), regular thinning, and eventually replacement harvest or transition to a more natural forest.

In southern Ontario, plantations are often considered a temporary forest type, leading to a species composition more representative of a natural forest. The most common scenario involves pine and spruce nurturing an understorey of naturally or artificially seeded native hardwoods. Ash is the most common such understory species, but sugar maple, black cherry, basswood, and oak are often included, as well as various shrubs. In this sense, the conifer plantation is a “pioneer” or nurse species in the process of “succession”, and are really only planted to kick start the land’s conversion to forest. The greater difficulty in establishing hardwoods in fields explains the predominance of conifers in plantations.

Conversion of conifer plantations to a more naturalistic forest can be hastened through appropriate thinning of the forest, releasing the existing regeneration, or creating the light conditions conducive to recruiting such regeneration. An unfortunate possibility is that instead of these native hardwoods, sometimes non-native buckthorns dominate the understory and are released by thinning, and control measures are needed to avoid promoting the buckthorn component.

Many plantations receive inadequate silvicultural treatment for one or more of the following reasons: the owner or manager is not sufficiently aware of the need; the cost is too high because the parcel is too small or too diverse to be attractive to a logger, or, the landowners have insufficient time to do the work themselves.

Opportunities and Initiatives

We should take advantage of the research and experience from the northeastern United States that is applicable to southern Ontario for answers to some of our problems. The Ontario Ministry of Natural Resources has recently completed “A Silvicultural Guide to Managing Southern Ontario Forests”. When taken in conjunction with the American experience, this publication provides standards to be applied by the professional community. The Extension Notes produced by the Ministry of Natural Resources have in the past addressed some silvicultural issues, but because they are targeted to the layman, they tend to be over-simplified and in some cases create false expectations. What is needed is a series of good silvicultural guides or best management

practices, with a fairly high content of technical material, aimed at the professional landowner, whether that is a non-farming rural or urban landowner, or a farmer. This was done in the U.S. over twenty years ago, when the U.S. Department of Agriculture produced a series of management handbooks for the major forest types of the northeastern U.S. Nothing similar has been produced in Ontario. The opportunity exists to take publications such as "A Silvicultural Guide to Managing Southern Ontario Forests", break it into its individual cover types and add the material that is relevant to a landowner, and develop a series of comprehensive silvicultural guides for each of those stand types. The landowner would then have access to a "Best Management Practices" guide, with the specific information that applied to his property, to guide his decision-making and his silvicultural efforts.

Over the years, many landowners have managed their properties conscientiously and have kept records of their successes and failures. Some of these have been documented in the Land Stewardship Demonstration Areas Catalogue for southwestern Ontario, which is available on a CD and on the Internet. The availability of this type of information should be promoted through landowner associations, with perhaps self-guided driving tours being set up so landowners could talk to their neighbours about their experiences. Some of the lessons that should be highlighted in demonstration sites are:

- Side by side comparison of a woodlot managed for production vs., one managed for old growth;
- Various thinning regimes for hardwoods and conifer plantations;
- Plantation design and species mixtures;
- Plantation successes and failures;
- Sugar bush management;
- Dollar returns for various management regimes;
- Prescribed burning for regeneration of shade intolerant species;
- Prescribed burning for control of invasive exotics;
- Naturalization efforts;
- Logging practices;
- Site history and potential;
- Insects and diseases;
- Windbreaks and shelterbelts;
- Invasive exotics.

Action Items:

- **Ensure availability of assistance to apply silvicultural systems that meet landowner objectives and recognize the forest's place and importance in the landscape context.** The concept of best management practices with respect to forests is more comprehensive than for some other land uses, as what happens in an individual forest has wider landscape implications, both from a landscape diversity perspective, potential loss of tree and other species, and for other implications such as for water recharge. These wider implications must be borne in mind during the setting of management objectives for the

watershed and for individual properties, in the making of land use decisions, and as a basis for the adopting of appropriate silvicultural systems.

- **Discourage land clearing, over-cutting, high recreational use, encroachment and invasive exotics to protect forest conservation and health.**
- **Develop a series of thorough, informative and localized extension materials and silvicultural guides for landowners both urban and rural.**
- **Profile demonstration projects through landowner associations, workshops and self-guided tours.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

3.5 Tree-Related Bylaws

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Background

Sawmilling in Ontario began almost 200 years ago, and associated harvesting continues to play a major role in stabilizing and diversifying local rural economies.

Since the turn of the century, municipal and provincial governments have recognized the importance of private woodlands through a variety of programs directed at landowners. The abandonment of degraded agricultural land led to the establishment of the Agreement Forest on severely eroded lands. In the 1940's, widespread clear cutting for firewood and charcoal led to the enactment of the Trees Conservation Act, (then the Trees Act, now the Forestry Act) to protect future wood and water supplies.

About 15% of Ontario's forest is in private ownership (representing 34% of the hardwood forest). These private woodlands are the key to the provision of environmental benefits in southern Ontario because Crown forests are virtually non-existent, and other publicly-owned forests are only a fraction of the total. Yet, economic pressures on landowners associated with escalating land values have resulted in the loss of large areas of woodland in southwestern Ontario. From 1961 to 1986, for example, in (one) County, there was a 73% decline in the area of farm woodlands.

One of the reasons municipalities hesitate to enact tree bylaws is because of the potential to infringe upon the property rights of an individual. Official plans, zoning bylaws and building permits are examples of some current mechanisms that influence the activities of property owners to provide for public health and safety, and the protection of environmental resources on private property.

"Seven in ten urban residents support the passing of local by-laws that would restrict the cutting of trees on private property in their communities and an equal portion support by-laws restricting the cutting of trees on private woodlots in rural areas of Southern Ontario"

- DRAFT REPORT, Attitudes of Urban Residents toward Urban Forests and Woodlands Issues, Environics Research Group, August 2001 –

The enacting of tree bylaws is inevitable as an end result of society's need for environmental quality. Where possible, bylaws should assist the landowner in meeting their objectives while protecting the legitimate right of the public now and into the future to enjoy the environmental, social and economic benefits provided by the land.

Unfortunately, our approach to woodlots is often to exploit them. Early settlers were faced with the absolute necessity of clearing wooded areas to create farmland, and hence forests were the enemy, preventing them from achieving their objectives of settlement and agriculture. The forest that remains, in many cases, is reflective of those areas that were unsuitable for agriculture. In areas of poor agricultural capability, or where agriculture was limited by stoniness or topography, such as steepness or wetness, forest cover tends to be higher. In areas that were flatter plains with fewer impediments to ploughing, forest cover is lower. Some farms retained ten to fifteen acres of forest to serve the farm's needs, usually at the rear of the farm. These areas provided a source of revenue when times were tough, but usually very little thought went into their long-term management. Logging generally removed all that was merchantable at a particular time, and unlike the other practices on the farm, little thought was given to the next crop. Consequently, the logging had negative impacts both to the current stand and the next stand. A further modern-day problem is that corridors for highways, power lines and pipelines are concentrated at the rear of the farm properties so as not to split up the farms. This results in an exaggerated impact to the forested areas that are concentrated at the rear of the farms. These transportation and energy corridors further fragment the few remaining large forested areas.

Forests face a number of fragmentation impacts, including roads, powerlines, pipelines, development and agriculture

The tree-cutting bylaw is not intended to be the sole method of preserving woodlands in the watershed. Planning controls under the Planning Act are still the primary method of resolving the use of land. For instance, for a utility corridor, a housing development, a gravel pit or a golf course, planning controls govern the development process. The only time tree bylaws come into play is when an owner wants to clear a wooded area to square up a field, or prior to planning controls or a building permit being in place, to regulate such things as a golf course clearing a fairway. In these cases, a minor exception would have to be gained to exempt the operation from the tree-cutting bylaw. The tree bylaws are primarily aimed at tree conservation within existing woodlands used for “forestry purposes”. “Forestry Purposes” from the old Forestry Act, which used to govern municipal and conservation agreement forests, includes*: the production of wood and wood products, the provision of proper environmental conditions for wildlife, protection against floods and erosion, recreation, and protection and production of water supplies.*

The Forestry Act

Bylaws were formerly passed under the Trees Act. This act has now been combined with the old Forestry Act and Woodlands Improvement Act into a new Forestry Act through the Red Tape Reduction Act of 1997. This new Forestry Act is legislation administered by the Ministry of Natural Resources. It empowers municipalities, Counties and Regional Municipalities, to pass

bylaws “restricting and regulating the destruction of trees by cutting, burning or other means” but does not allow the prevention of tree cutting entirely. Townships, towns, or villages are not allowed to pass bylaws under this act, but may pass similar bylaws under the Municipal Act. Bylaws must be approved by the Ministry and signed by the Minister of Natural Resources. This is primarily to ensure that the bylaws are structured in such a way as to protect them from being challenged and overturned in court. The Forestry Act sets out the framework of the bylaws by stipulating what constitutes a woodland, who can enforce the bylaws, and sets out exemptions and exceptions to the bylaws. The Ministry of Natural Resources does not enforce the bylaw, but is available to advise the municipality in their enforcement.

Tree cutting bylaws under this act do not prohibit the removal of individual or isolated trees such as street trees, windbreaks or shade trees on private residential lots. This is the jurisdiction of the Municipal Act.

General Application and Intent

Bylaws under the Forestry Act do not set standards and specifications to ensure proper forest management. Initially, bylaws were drawn up to set minimum diameters for trees that were to be cut. This is not the same as a silvicultural system that has as its intent, to control stand composition, quality, growth and regeneration. A diameter cut can result in fairly low impact, or complete destruction of the stand. The tree diameter or circumference is to be measured at the stump, i.e., at the height above the ground as stipulated in the bylaw as “point of measurement”. This facilitates enforcement, as a bylaw officer can ensure compliance with the bylaw by measuring the stump height as the “point of measurement” and comparing the stump diameter or circumference with that stipulated in the bylaw for the species of tree cut. The municipality sets the minimum size of a woodlot to which the bylaw applies.

In addition, despite the size requirements for diameter cutting, some of the newer bylaws specify that a minimum stocking, measured as basal area in square metres per hectare, must be maintained in the forest stand. This goes farther than the diameter limits to ensure the stand that remains is healthier and can regenerate properly, and allows for a shorter interval between harvests. It also requires some basic forestry knowledge to calculate the basal area, and hence, to comply with the bylaw.

Some bylaws also have additional provisions that apply in "sensitive natural areas" as defined in the bylaw. These areas are identified in the municipal official plan, and may include environmentally sensitive or significant areas, hazard lands, and lands designated as provincially significant. For instance, in these areas, harvesting could be required to be carried out using “good forestry practices” only, and require a silvicultural marking program.

"...poor operating procedures and road construction can cause serious environmental damage such as soil erosion and compaction, stream siltation and damage to associated fish, wildlife and flora populations, and a decline in the overall vigour of the woodlot."

Final Report of the Tree Bylaw Advisory Committee, June 1991

A clause is included in the bylaw to address unnecessary damage to remaining small trees occurring in the stand when trees are removed. Although it is realistic to expect some damage to remaining trees while skidding logs and firewood, responsible loggers should use: directional felling, minimal numbers of skid trails, use of “swing trees”, winching of logs rather than backing the skidding machine to each log, no skidding of full “tree lengths” and no skidding of full width tops, to minimize damage to remaining trees. Season of logging can also affect damage to soils and vegetation within the woodlot. Logging should be avoided during spring when soils are saturated, and in early summer when trees are actively adding diameter growth and bark is easily knocked off.

In order to address silvicultural standards, as a basis for determining what constitutes “good forestry practices”, including logging damage, the Ministry of Natural Resources produced in 2000, “A Silvicultural Guide to Managing Southern Ontario Forests”. This describes accepted silvicultural practice for managing the major stand types of Southern Ontario. Because of its technical nature, it may not be useful to a layperson, unless assisted by a competent professional forester. A considerable body of knowledge and research also exists in the United States, in similar forest types, on similar sites, that may not be fully reflected in the Ontario document, but which provides additional information on which to base forestry standards. A professional forester should be aware of this additional information and research.

Exemptions

The Forestry Act sets out cases where the bylaw does not apply. One of these is use on the farm by the owner, for their "own use", such as for building materials on the farm, or for fuelwood. Tree destruction is also exempt from the bylaw if carried out: (a) under the Municipal Act, (b) by Ontario Hydro or any agency, board or commission that is performing work on behalf of the Crown (provincial government), (c) on a highway or unopened road allowance, (d) done in accordance with a building permit, (e) for the production of Christmas trees, (f) by an Ontario Land Surveyor registered under the Surveys Act. Furthermore, the bylaw does not apply on land described in a licence for a pit or quarry or a permit for a wayside pit or wayside quarry, which has been issued under the Aggregates Act. The Site Plan, which is on file at the local Ministry office, may have provisions concerning tree destruction on the licensed area.

Good Forestry Practices Exemption

The bylaw allows trees to be cut in accordance with “good forestry practices" as defined in the Forestry Act:

“Good Forestry Practices” means the proper implementation of harvest, renewal and maintenance activities known to be appropriate for the forest and environmental conditions under which they are being applied and that minimize detriments to forest values including significant ecosystems, important fish and wildlife habitat, soil and water quality and quantity, forest productivity and health and the aesthetics and recreational opportunities of the landscape.

The Red Tape Reduction Act, 1997

Poor harvesting practices associated with either a lack of forestry expertise or unscrupulous operators results in a dramatic decline in the ability of the woodlot to provide environmental and social benefits, and also to produce future harvests. In most cases, tolerant hardwood stands which have been “hi-graded”, taking the best and leaving the poorest timber, will require decades of remedial management before economically viable operations will again be possible. Currently, Trees Act bylaws commonly use tree diameter restrictions to regulate cutting. This does not prevent poor harvesting practices. Bylaws should be constructed to promote good forestry practices based on the application of sound scientific and technical forest management principles, under the guidance of a professional forester.

Final Report of the Tree Bylaw Advisory Committee, June 1991

In ideal circumstances, tree harvesting should be carried out as part of a silvicultural system, which is appropriate for the forest and the species being managed. Rather than simply focusing on the trees to be removed, the silvicultural system prescribes the characteristics of the stand, which is to remain after harvesting, and the purpose of the harvest is to control the growth, composition and health of the remaining stand. The “good forestry practices” exemption is allowed to recognize these accepted silvicultural systems and other forest management practices, particularly in sensitive natural areas. Proper silvicultural systems prescribe proper harvesting other than by

the minimum size restrictions of the bylaw. For determining what constitutes "good forestry practices", forest managers should seek guidance from the publication “A Silvicultural Guide to Managing Southern Ontario Forests”, other relevant manuals, references and research, or a qualified professional forester.

Enforcement

Municipal Council appoints enforcement officers. These officers and those persons acting on their behalf are granted right of entry onto private land for the purposes of enforcing the bylaw. These officers are available and should be contacted by those contemplating cutting trees in woodlots. They will gladly give practical advice and assist with the proper application of the Tree Cutting By-law. For the name and address of the Tree Enforcement Officer in your area, contact the municipal clerk's office. Penalties are set out in the Forestry Act and copied into the municipal bylaws. In 1997, the penalties were raised to a maximum of $20,000, and may include imprisonment for a term of not more than three months. If a conviction is secured, orders may be made to require replanting of areas destroyed.

The future of bylaws

In the past, many municipalities have been dissatisfied with their ability to enforce tree-cutting bylaws. Most particularly, many fines have been of such a small amount that they are basically only an annoyance to the loggers, yet cost considerable sums on the part of the municipality to gain a conviction. Some of the enforcement needs that have been identified are:

- the ability to issue cutting permits with prescribed conditions for logging, such as timing of operations for protection of certain features of the property;
- the ability to issue cutting permits which can be denied to troublesome operators;
- the ability to issue "stop work" orders, or the ability to cancel a logging permit, to stop a logging operation that is causing damage, or to stop one being conducted contrary to a bylaw;
- the ability to issue "tickets" on site for certain infractions;
- an appeal process for people convicted of infractions;
- fines that are more reflective of the values of the timber and the forests.

Many of these concerns were addressed through the addition of new tree by-law provisions contained in the new Municipal Act, which came into effect January of 2003. These provisions included granting authority to municipalities to increase fines, issue stop work orders and make violations ticketable offences. The Municipal Act of 2003 also designates power to the municipalities to regulate harvesting operations with regards to timing, method and residual basal area. However, it must not be misconstrued that the intent of changes in bylaws is to increase their restrictions to landowners. Most of those enforcing the bylaws are mainly concerned about the landowner receiving fair value for his timber sales, and to ensure that the health and productivity of the woodland is maintained. The hope is that enforcement can be proactive and educational rather than reacting to situations after the damage has been done.

Action Items:

- **Encourage elected officials to support enforcement staff and ensure tree by-laws are improved and updated with current legislation and enforcement provisions.**
- **Promote good forestry practices to reduce the frequency of exploitive harvesting in the watershed.**

- Be aware of forest management's place in the landscape. Some of the best quality logs come out of the Grand River Watershed. There are many sawmills and wood using industries in the area that are dependent on forest harvesting. The watershed is known for its quality and workmanship in furniture and other forest-based products. This can continue, with little negative impact to forests, provided that it is done properly.
- The public should be aware of the current move toward the certification of woodlands as sustainable. This is commonly referred to as “Green Certification”. It assures the buyer of wood products that the products have come from a forest managed as a sustainable forest, and management considers not only the health of the forest, but wildlife, social and environmental benefits.
- **Develop a consistent approach to tree by-laws including the necessary application of good forestry practices and the retention of a minimum residual basal area.** Some bylaws have initiated this requirement in specific areas such as Environmentally Sensitive Areas.

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

Table 4.1. Summary of tree by-law requirements for selected jurisdictions, As of March 2004.

Jurisdiction	By-law Year	Basal Area	M2/ha	NOI	NOI Days	GFP	M/E Fee	Replant Required	NOIs 1998	Inspect Rate	M/Es1998	M/Es Acres	Woodlot Assoc.	Logger Assoc.
Brant	1997	YES	15	YES	7	01/02	$0	YES	?	?	?	?	YES	
Dufferin	1996	YES	15	YES	7		$0	NO	30	80%			YES	YES
Elgin	1987			YES	5		$0	YES		90%			YES	
Grey	1996	NO	-	YES	1	02	$0		300	95%				
Haldimand and Norfolk	2000	YES	14	YES	5	01/02	$200	YES	296	95%	14		YES	YES
Haliburton	1998	YES	15	YES	5	01/02	$200		30	100%			YES	YES
Halton	2003 (in progress)	YES	20	YES	30	01/02	$100	YES		100%				
Hamilton	2000	NO	-	YES	20		$600	YES						
Huron	1984			YES	5	02	$75	YES	319	30%	8	10	YES	
Lambton	1991			YES	5	01/02	$200	YES		10%			YES	
Middlesex	1986			YES	5	02	$50	YES	130	80%	12	15	YES	
Niagara	1996	YES	20	YES	10	01	$0	YES		10%			YES	
Oxford	2003 (in progress)													
Perth	1999			YES	5	01/02	$0		150	100%	3	0	YES	
Pickering	1991	YES	15	YES			$0	YES	7	100%	2	25		
Simcoe	1997	YES	16	YES	5	01/02	$0		156	60%			YES	YES
Waterloo	1999	YES	15	YES	10	01/02	?	YES			4	?	YES	
Wellington South	1993			YES	10	01/02	$0	YES	36	90%			YES	
York	1991	YES	15	NO	n/a	01/04	$0	YES	est. 300	50%				YES

NOI Codes:

1. Stand marked
2. Pre- Inspection
3. Managed Forest Plan
4. RPF approved

General Abbreviations:

NOI - Notice of Intent

GFP - Good Forestry Practice

M/E - Minor Exemption

3.6 Economics

It would take a major study to determine the economic impact of the Grand River watershed forest. The Ministry of Natural Resources is currently (2004) studying the economic impact of the forests of southern Ontario, the results of which will give a broad context for consideration of the economic impact of the Grand River watershed forest. However, the study will probably not quantify the economics on a watershed basis, so that will take either some extrapolative work, or further study.

The economy of southern Ontario does not rely heavily on primary industries, such as forestry, but rather on manufacturing, service, and financial enterprise. Chief among the manufacturing sectors is automotive. The economic impact of these sectors dwarfs forest products so much that the average person probably would see no immediate link between the local economy and forestry.

It is interesting to note, however, that on a per square kilometre basis, our watershed may have as much employment in primary and secondary forest-related industry as places in boreal Canada where forestry is the economy. This is only an observation, but such a study (as noted above) would allow us to quantify such things.

The economic impact should be considered in terms of products produced from the forest and services provided by the forest.

The main products that are harvested from the forests of the Grand River watershed are as follows: hardwood forests - sawlogs, veneer, firewood, maple syrup; softwood forests and plantations - posts, poles, pulp and Christmas trees. There is no major activity in harvesting food, pharmaceuticals, mushrooms, fur, foliage, or other products, as may be the case in other parts of the world.

Pulpwood is a valuable forest commodity

Timber can be a widely travelled commodity after harvest. The trees that are harvested in this watershed may be processed in a mill as distant as Sault Ste. Marie, in the case of spruce pulp, for example, and mills in and near the watershed import veneer logs from the United States. The map showing sawmills in the Grand River watershed in the Appendix therefore is intended to show only that there is significant timber processing employment in and near the watershed – not all of the associated employment could be said to be based on the forests of the Grand River watershed. Clearly, though, sawmills, logging, and related employment are a significant contributor to economic diversity in the rural areas of the watershed, where other employment tends to be related to agriculture, the service sector, or the cities.

This is particularly true in the Wallenstein area, where there is a cluster of sawmills, and also many woodworking shops using the sawn lumber. Much of the timber feeding these sawmills is cut in local woodlots, often by Mennonites on Mennonite lands. This is certainly the part of the watershed where forestry products from watershed forests are the most significant part of the overall local economy. This is also the part of the watershed where most farm families make maple syrup from their own woodlot, making the forest even more economically important in the area.

An informal survey done in the summer of 2000 by Grand River Conservation Authority, in support of the watershed forest plan process, found that as many as 400 people are directly employed in sawmills and logging firms in and near the Grand River watershed. This survey only contacted companies, so the individual efforts of landowners and one-person operations are not included. This suggests that the total direct and secondary economic impact from forest products might financially sustain, conceptually at least, the very rough equivalent of a small town. If you imagine the disappearance of a small town, the somewhat invisible contribution of forest products to the watershed economy seems suddenly more clear.

Economic impact from products is not limited to employment. Many rural landowners save hundreds of dollars per year replacing other expensive energy forms with renewable firewood.

“Services” provided by the forests – the many benefits outlined in the introduction to this plan – are even harder to quantify than forest products. It is almost certain, though, that the services have a greater economic impact than forest products in this watershed. Services include the cleansing of air and water; sheltering crops, livestock, and buildings; moderating streamflow; carbon sequestration; and others. There is even an argument that can be made that the “quality of life” benefits that trees and forests bestow on a community make it more attractive as a place to live and work, and therefore could be the basis for attracting employers to the area.

A 1999 CITYGreen analysis by American Forests of a 975,000-acre area including Canton-Akron, Ohio found that the annual value of the air cleansing service alone was (US) $43 million. Capital investments unneeded because the trees provided stormwater retention services saved $1.1 billion dollars (one time savings). This study was in an area about half the size of the Grand River watershed with roughly comparable population. The values of many services were not quantified in this study, but it nevertheless gives a clear sense that the value of forest services is enormous.

The maple syrup industry in Ontario generates approximately $25,000,000 per year in revenue

The economics of the watershed forest need to be better understood than they currently are. It is recommended that this issue receive sufficient study to offer such understanding, perhaps through an analysis program such as CITYGreen.

The public and decision-makers need to view forests as a necessary and integral part of the infrastructure supporting a healthy, liveable, sustainable community. The services provided by an urban forest (or green infrastructure) are just as important as the services provided by conventional infrastructure. When forests are seen in this light, their value, and the necessity of investing in their upkeep, becomes a parallel to investing in any other infrastructure. Some would

argue that forests are so much more than infrastructure could ever be, and rightly so, but achieving even that status would be a big step forward.

Woodlot owners associations and other stakeholders should advocate for additional processing and market opportunities so that landowners in this watershed have more possibilities of generating revenues from their forests. For instance, a black walnut nut processing plant in Ontario would offer the possibility of income diversification for the owners of walnut trees, and it would make walnut plantations and walnut intercropping far more financially attractive.

Woodlot owners associations and other stakeholders should encourage landowners to "cluster" their timber operations for the sake of greater efficiency for the operator and more opportunity for the landowner. The Grand River Conservation Authority, as the largest forest owner in the watershed, has helped draw plantation thinning contractors to the watershed, thus benefiting other landowners whose forests would not be large enough to attract the contractor on their own. A woodlot owners' cooperative organization could potentially be very helpful in advancing such solutions.

Action Items:

- **Study the economics of the watershed forest with an analysis program (such as CITYGreen of American Forests).**
- **Encourage landowners to "cluster" harvesting operations to improve efficiency and provide greater opportunity for the landowner.**
- **Seek additional processing and marketing opportunities for landowners.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

PART 4:

THE COMMUNITY AND ITS FOREST

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Summary

Part 4 and this summary cover Sections 4.1 through 4.6, exploring the relationship between the community and the watershed forest at a more personal level.

Raising the general level of awareness (Section 4.1, Education and Communications) leads to personal action, often in the form of tree planting (Section 4.2), or recreation (Section 4.3), or wildlife monitoring programs (Section 4.4). There are many opportunities at all levels for direct involvement, and various groups within the community will probably have different roles (Section 4.5).

Awareness and understanding lead to action. Awareness levels of the issues and opportunities can be raised within the school system and in the community. Although there is a general awareness that forests are important, the specifics and local opportunities are not as well known, and the first step from awareness to action is a big one that has to be made as easy as possible for the average citizen.

One of the easiest ways to convert awareness to action is by involving people in tree planting. It is also one of the great hopes for improvement of the watershed forest. It is widely perceived as a rewarding experience and a positive action. On an individual level, urban, and especially rural, landowners can plant trees on their own property. Technical support, availability of appropriate stock, and a supporting framework, such as the "big picture" provided by this plan, are important elements in making it easy to take action.

Tourism and recreation are important aspects of the watershed forest, as most people gravitate toward treed areas for these activities. The ever-increasing population puts pressure on available natural areas, and it will be a challenge to maintain sustainability in recreational use of the forest. Forests help make this a desirable tourism destination, and are at the root of some of the biggest tourism "draws".

Wildlife monitoring programs are an excellent way for people to get involved in the watershed forest. These observations allow the gauging of trends in ecosystem quality. More intimate and more frequent monitoring will support more informed action.

This Watershed Forest Plan is not a "plan" in the traditional forest management plan mode. It is a primer on the current issues and opportunities, and how we got where we are, as perceived by a group of representatives from the community, including experts in many fields. It is not a prescriptive plan, dictating what must be done. After all, many individuals, all with their own objectives and ideas, own the forests. However, there is clearly a societal interest in enhancing the watershed forest.

During the process of creating the plan with the community, many project and program ideas were put forward for consideration. These ideas are listed in the order that they appear in the text. There are also many other ideas that are not listed, or haven't been thought of yet. However, any one of the listed ideas can be traced back to the context and justification in the text, and this will allow groups and individuals to decide whether or not they wish to undertake a certain project, and it helps potential funding agencies to see the value and the justification for a project.

4.1 Education and Communication

"A person begins to learn the meaning of life when they plant a tree in whose shade they know they will never sit" (unknown)

All citizens of the Grand River Watershed enjoy the privilege of experiencing the rich, inviting diversity of our watershed forests. This is evident by the heavy use of our conservation areas and local parks by all sectors of society. Few are fully aware of the issues and opportunities related to a healthy watershed and watershed forest. As the scale of our "ecological footprint", or impact on the environment expands, we see increasing pressure toward fragmentation and degradation of watershed forests, mainly due to an ever-increasing population. The present approach we practice globally will lead to an unknown but clearly compromised future for future generations. Some problems are global and will need to be addressed on a cooperative global scale. Our responsibility is to do our part locally and hope that others will do the same.

"You can judge the country's real wealth by its forest cover."

(Richard St. Barbe Baker)."

Deeper understanding and a higher valuation of nature in the citizens of the watershed will encourage positive action. One of the best ways to do this is through action-oriented environmental education and direct, clear communication; not just for schools but also aimed at the public at large. Education and the promotion of related public projects can foster naturalization and contribute to personal health and well being of the community. It can inspire an ethic of caring and commitment to a healthy, sustainable forest, and motivate people to take action. All stakeholders such as landowners, service clubs, schools, corporations and related agencies need to be involved. Against the backdrop of escalating pressure on the environment, such as shrinking forests, global warming, growing population, thinning ozone layer, ground water contamination and a growing air pollution problem, no single action can turn the tide. Yet, if the citizens of the watershed can be inspired to do even one single local action, we can begin to change values and attitudes, and hence, improve our watershed. At the present time there is very little coordinated effort in watershed forestry education in our schools or the public sector. This section of the watershed forest plan is split into school-related considerations, and then ideas related to the general public.

Sunoco Earth Day 2002 community event

In School

Students must believe they can make a difference and can control their own environmental destiny.

"Never doubt that a small group of concerned people can change the world. Indeed, it's the only thing that ever has." (Margaret Mead)

To only be aware and understand the problems through educational programs is not enough. We must empower and guide students through a process that leads to action. Students must be nurtured from an awareness stage through to an action stage. Only then will they feel the full satisfaction of realistic learning. A process of values development such as the following 5 R's is a natural cyclic problem-solving formula that could be applied to school curriculum or public education.

1. Recognition (awareness) of importance and motivation to act, identify goals, target groups and set objectives.
2. Research (understanding) of all sides to the issue, gather data, needs assessment and materials, design possible programs.
3. Resolution (decision-making) of how to best solve the problem by examining alternatives and consequences. Creates a sense of ownership.
4. Responsibility (action) to put your decision into action. Learn new action skills such as persuasion, consumerism, political, legal and eco-management.
5. Revision (evaluate) of the process for changes and adaptations in light of experience and new information.

"All the beautiful sentiments in the world weigh less than one single, lovely action"

(James Russell Lowell)

We should celebrate our success of projects through the media and informative presentations. These Five R's (Glew 1987) steps are a values changing process that has proven very effective for changing environmental attitudes in past educational projects and can be used as a plan of action for schools or the public in general. In the past decades we have had very strong commitments and leadership from the provincial government. During the 1970's and 1980's environmental curriculum was a priority and present at every level of education. Students were taught respect and responsibility for life and habitat. This teaching was reflected in the habits and attitudes of the general public as well. Outdoor education was offered in every school board. High school and university education specifically included environmental science courses at many levels. Recycling became popular. The Blue Box was born. Environmental grants and staff in the schools were plentiful. In recent years, however, environmental programs and projects have received less support. The environmental strand has been eliminated from all elementary science education. Environmental science courses have been eliminated from the high school and university course calendars. The teaching of ordinary values

Outdoor education should be a priority for every generation

has been taken out of the curriculum in favour of mere content. The emphasis in our school curriculums is on economic growth and high technology jobs. Policy makers must realize that the health of the economy is directly related to the health of the natural resources. We are part of nature. We need to teach environmental education explicitly at all grade levels. Many teachers realize this fact and do their best to incorporate environmental education into lessons despite the curriculum change. Students find environmental education more interesting and learn better when they can apply science concepts to the real world.

Despite the present reduced emphasis on the environment we can find windows of opportunity scattered through the curriculum. Teachers must teach the present curriculum because students are evaluated on its content. They do not have time or funds at present to search for these windows of opportunity, write curriculum and purchase resources to back them up. But with the help of outside agencies, environmental objectives can be met. This was proven recently by the development of a resource kit and curriculum called, "Watershed Wanders". This grade four kit, valued at $400, free of charge to every school in the watershed, is a hands on teacher-friendly resource developed by funds from ten (now) TD Friends of the Environment chapters in the Grand River watershed. It is now a compulsory part of the grade four science and geography curriculum based on the habitat section of the new provincial science curriculum. Its main mission is to create a sense of place for everyone in the watershed, to teach the biology of forest habitats and to develop respect for the Grand River as a heritage river. The unit highly involves the parents in the learning process. Parents learn through their children. They are encouraged to participate in follow-up events by visiting interesting areas of the watershed researched and explained by the students through a student made eco-tour brochure.

This approach has been highly successful. In general, one could find a topic relating to the forest at all levels but there are specific curriculum topics found at the grade one, three, [soil and plants] four, six [diversity of living things] and seven levels based on specific provincial science topics. It is also found at the grade 12 level in high school based on the geography course, Environment and Resource Management. It is possible to maintain an environmental presence in the school curriculums but teachers need much help.

There are several nature centres throughout the watershed, run by school boards and Grand River Conservation Authority. There is also a new facility at the Onondaga Farms Tim Horton's Camp. These facilities and their staff are an important resource for enhancing in-school environmental learning. They should be supplied with copies of *A Watershed Forest Plan for the Grand River*, and related support maps and posters to assist them in integrating the watershed forest into their lessons. They should also be informed, by means of on-site workshops and "bulletins", about current and historic forest issues in the Grand River watershed.

School Curriculum Entry Points:

School Grade	Associated Activities
Kindergarten	Explore local forest
Grade One	Needs of plants (trees), factors affecting balance, needs of people in community, human effects and food chains
Grade Two	Food and shelter for animals, roles of trees and the food web, life in the community, carbon and water cycle
Grade Three	Requirements of plants, ecological succession, study of local plants, how ecosystems change, importance of plants and pioneer life, challenges of pioneers, land use in the community, resources and conflicts, soils in the environment
Grade Four	Habitats and communities, cell processes and reproduction, relationships of plants and animals, settlement patterns and sites, adaptation of plants, forest industry and conflicts, classification of trees

Grade Five	Trees as a food source, environment and resources, weather management
Grade Six	Classification system, plant plot study for diversity, export of goods
Grade Seven	Interactions within ecosystems
Grade Eight	Plants cells structure and function, impact of forest cover on river systems (earth and space systems strand)
Grade Ten	Ecology unit in science
Grade Eleven	Physical geography, factors affecting plants, designing your future, interdependence of plants, biology and science, identification of plants
Grade Twelve	Environment and Resource Management Course, Earth and space science, St. Lawrence Lowland, food and nutrition science

In grades Kindergarten through to grade 6 a positive, holistic, integrated approach is needed. Science, utilizing the schoolyard, neighbourhood, local parks, nature centres and conservation areas should be an integral part of all learning at this level. All students should have the opportunity to explore the wonders of the watershed using a hands-on, cooperative, problem solving, experiential, inspirational, multi-sensory approach. The element of fun should never be overlooked as a motivational tool. Every opportunity should be made to involve the parents, elders, and native people, as participants in order to tap into the rich informative community resources. Higher grades are very prescriptive, making it more difficult to integrate and vary from the curriculum. One of the most important overriding messages, that should prevail in all education, be it the public or schools, is the promotion of positive and beneficial attributes of trees not only to humans but to all connected organisms on this planet.

There is a need to reinstate the environmental education component back into the school curriculum. The general public claims that the environment should be a major concern in elections, yet may fail to carry that concern with them when voting. When it comes to choosing between economic growth and the environment, the environment tends to lose. This situation cannot go on indefinitely without impairment of the watershed forest.

We must act now and do what is right. We must teach the universal values of respect and responsibility for life and habitat for the sake of future generations. We must create a positive a sense of place so that our grandchildren and great grandchildren can enjoy the wonders of our watershed as much as we have. Developing relevant educational programs and curriculum through an innovative educational module would be one important step forward.

"In the end, we will conserve only what we love,

we will love only what we understand,

we understand only what we are taught."

(Baba Diauor)

In the community

Do people in the Grand River watershed understand the issues and support action to improve the situation? For the watershed forest, what is the role of “Education and Communication” outside the classroom?

To help answer these questions, two surveys are referred to here: a May 2001 survey by Environics Research Group entitled *"Attitudes of (Ontario) Urban Residents Toward Urban Forests and Woodlands Issues"*, and a Grand River Conservation Authority survey from the fall of 1999 done as background for the watershed forest plan. Both surveys had several hundred respondents. Although the Environics survey focused on urbanites all across Ontario, it is the most current comprehensive gauge of opinions. Where questions were similar enough in the two surveys to allow comparison, the Environics survey results were similar to the watershed-wide survey that included the rural population. The following statistics are from Environics, unless stated otherwise.

People consider the environment to be one of the important issues facing their community, but marginally more people consider education and traffic/transportation as important. Health care, taxes, cost of living/lack of government services, crime/safety, and development issues weigh about equally with urbanites. The important point here is that in a complex world where many things vie for people's attention, the environment is only one. Any of these issues may be elevated "above the crowd" occasionally on account of a crisis or tragedy. The rest of the time, competing issues work against a single-minded focus on any one issue by the general population.

The two most important environmental issues cited were air quality and water quality (33% and 17% of respondents). People are right to be concerned about air quality, considering that Ontario does have the worst air quality in Canada, and that "poor air quality alerts" in Ontario hit record levels in the summer of 2002. Interestingly, trees are effective mitigating measures for both these two top concerns, although planting trees should not replace emissions reduction. Almost all respondents recognized as very important or somewhat important the role trees play in improving air quality (98%). Likewise, most felt the same way about trees' role in water quality (85%), climate change (85%), and energy conservation (87%). Most people have a general sense that trees and forests provide important services that improve their lives, but perhaps they are not fully aware of the measure of those services.

Seven of ten are at least somewhat concerned about the condition of trees/forests, and development was considered to be the greatest threat to the forest by the most respondents. Residents of the Grand River watershed were asked the same question by Grand River Conservation Authority, and the top four answers were identical and in the same order: development, pollution, tree maintenance/forest management, and insects and disease.

Eight-three percent in the Environics poll believed that logging could be done carefully enough to avoid compromising the ecological value of the forest. Two-thirds of respondents agreed that rural landowners should be compensated for taking land out of production in order to grow more trees.

This generally high awareness of forest-related benefits, issues/causes, and partial solutions, does not seem to translate directly to actions that improve the situation. Perhaps paradoxically, the 1999 survey in the Grand River watershed showed that (yet more) "Education and Awareness" were considered to have the most potential to help derive greater benefit from the watershed forest. How can more awareness be needed when such a high percentage seem to already have the information? The answer may lie in the difference between a vague acceptance of "motherhood" positions and a clear understanding of the nature and extent of the benefits, issues, and remedies. There is also a big step from knowing these things at a generic level and understanding the specifics for your own community or your own watershed. Further, understanding is somewhat impotent without action, and so this is a crucial step: helping people channel their knowledge and passion in constructive and strategic ways.

The Grand River survey offers some clues as to what the education and awareness ought to focus on. The top five most important aspects of local forests/trees were considered to be soil, water,

and air benefits, habitat, and forest health. These were followed by a group of seven aspects: recreation, climate change, beauty, property value, energy savings, timber, and tourism. The top five opportunities for deriving greater benefit from the watershed forest (after "Education and Awareness) were considered to be proper forest management, restoration/planting, recreation/tourism/trails, protective legislation, and land use planning. The next most cited opportunity was the creation of this watershed forest plan. All of these forest aspects and opportunities are addressed to varying degrees in this plan, and so the plan is a first step in the next phase of education and communication.

In fact, all of the stated purposes of this plan (see Introduction) support this need to move the awareness to a deeper, more specific and local level, and to help that increased awareness translate to constructive and strategic action. The watershed forest plan in this full format will be distributed to schools, libraries, governments, municipalities, and interest groups. It will reach relatively few people directly, and will be read by even fewer, so although it is an important step, it will have little impact unless other steps follow.

One important subsequent step is to reach as many people as possible with a simple distillation of this plan – an executive summary for all. This could take the form of a poster-map distributed through newspapers. The Environics poll found that 77% turned to newspapers and magazines for information, higher than any other category. Such a distribution method would therefore reach most watershed households, and hopefully by it's clarity and visual appeal will cause many to peruse it. The surveys suggest that the task is not to persuade people of the basics, but to localize their existing awareness with details about issues and opportunities. This could be partially done readily with a poster-map.

Again, since so many turn to newspapers and magazines for information, it would seem productive to have a section of local newspapers reserved for regular related articles.

There is a glut of information on the Internet, but many people may not have the time to sift through this avalanche of great and mediocre material. The Grand River Conservation Authority, as the most obvious host of a watershed forest webpage, should provide a concise summary of current, local issues and opportunities, coupled with links to the best related Internet sites. This should include specific local links to examples of *Best Management Practices* in the watershed from the Land Stewardship Demonstration Areas Catalogue website.

The cities in the watershed have done some great awareness work around urban forestry. The opportunity exists for the urban communities, in collaboration with Grand River Conservation Authority and others, to promote a greater understanding of the role, issues, and opportunities related to urban forests in the Grand River watershed. This is the part of the watershed forest to which the experiences of 80% of watershed residents are limited, most of the time. There needs to be deeper understanding of the forest in that generic "backyard".

Forestry consultants and landscape designers in the Grand River watershed should be supplied with a brochure or factsheets that helps them to help their clients understand their watershed context. Examples of how this might be useful would include a watershed landscape description that could be part of the landowners managed forest plan, or reference lists of indigenous plants, or conversely, invasive exotic plants, that should or should not be used in certain situations in this watershed.

As the lead agency in promoting and facilitating tree planting with rural landowners, municipalities and groups, the Grand River Conservation Authority needs to bring additional information resources to their forestry extension efforts. In addition to having the above-noted materials on its website, there should also be nursery stock availability and program guidelines, as

well as localized factsheets and links to generic factsheets. The watershed forest context should become more apparent in the discussions with these clients.

County-based woodlot owners associations and community-based naturalists groups throughout the Grand River watershed are important in the area of education and communication. They are eager to share their advanced expertise, and eager to learn more from "experts" and pass that on to their others. Tours and demonstration days are a common way for these groups to share information, and these events need support from the relevant agencies and consultants.

One or more self-guided tours could be developed (based on brochures, audio tapes, or the internet) to allow those that do not attend these events to conduct their own tour, on their own schedule.

Action Items:

- **Integrate environmental education into the school curriculum at all grade levels.**
- **Provide teachers, schools and nature centre staff with expertise, educational tools, and program opportunities to support environmental learning.**
- **Develop environmental education and action programs that outline local issues and allow residents to channel their passion for the environment in a constructive way at the community level and develop a local sense of environmental responsibility.**
- **Create a website listing current and local issues and opportunities related to the watershed forest and provide specific links to local initiatives and successes.**
- **Develop self-guided tours in the form of brochures, cd's, or internet tours to allow individuals and organizations to view demonstration areas and areas of special interest on their own schedule.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

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4.2 Tree Planting

Tree planting programs have a strong history in the Grand River watershed, as evidenced by the following "firsts" in the tree-planting field:

Date	First…	By	Location
~1875	One of the earliest tree planting projects with over 1,000 sugar maples on roadsides and farmstead	Bill Hunter	"The Maples"
~1890	Perhaps the first gravel pit rehabilitation planting in Ontario – Brown's Woods	Ontario Agricultural College (OAC)	Guelph
1904	First forestry program and forest tree nursery in Ontario – Ontario Agriculture College (OAC)	OAC	Guelph
~1911	First tree planting to protect municipal water supply in Canada	City of Guelph	Arkell
1941	First reforestation associated with a multi-purpose water control reservoir in Canada	Grand River Conservation Commission	Belwood
1946	First tree planting machine built in Canada	Grand River Conservation Commission	Belwood

1965?	First Woodlands Improvement Agreement (private land) in the province - at Norm Drynen's	Ontario Department of Lands and Forests	North Dumfries
~1986?	First intercropping research planting	Agroforestry group – University of Guelph	Guelph

The earliest large-scale, systematic planting efforts date back 130 years. The Ontario Legislature passed an act in 1871 to encourage the planting of trees on "highways". Municipalities were to pay landowners up to $0.25 per tree for trees planted along the roads. The province was to cost-share with the municipalities, but a quarter century later, only ten percent of the money had been spent and the act was repealed. Although this would suggest failure of the program, trees from this era (or soon after) line many of our roads today.

In 1904, the province established a forest tree nursery at the Ontario Agricultural College, in Guelph. Ten thousand trees were given out by E. J. Zavitz the following year. E. J. Zavitz was at that time the newly appointed Lecturer in Forestry at the Ontario Agricultural College. He later became the provincial forester and is known as "the father of reforestation in Ontario".

The 1909 report by Zavitz entitled "Reforestation of Waste Lands in Southern Ontario" laid the groundwork for "agreement" forests (first public, and eventually private) and the network of provincial tree nurseries. Agreement forests are so-called because they were managed by the province under agreement with the owner. The map showing "Sandy Areas Unfit For Agriculture" showed the regional scale "blowsand" priority areas for reforestation across the province. These priority areas were the first to be planted under the (public) agreement forest program. No areas were identified within the Grand River watershed. On a local scale, however, small areas did exist that had some of the same characteristics of eroding sandy soils and steep slopes. These would later become candidates for agreement forests and reforestation.

The first agreement forest in the province was planted in 1922 in Simcoe County.

Unbelievable as it is…most of the vast acreages of agreement forests in Ontario were planted by hand

The Grand River Conservation Commission planted trees around newly formed reservoirs and other properties beginning in 1941. The then-separate Grand Valley Conservation Authority began planting on private lands in 1953. Under an agreement with the Grand River Conservation Commission, with which it amalgamated in 1966, the Conservation Authority set out to plant about a million trees per year over 19 years as an initiative complementary to the construction of the Conestogo Reservoir. This would have seen 77.7 square kilometres (7,770 hectares) reforested. In some years the Conservation Authority did plant a million trees, but the 19 million target was not achieved until a few years after the end of the 19 years.

Up till the amalgamation, the Commission conducted tree planting on its lands, while the Authority planted on private land. The Commission had its own nursery for producing stock for its purposes, located at Belwood Lake Conservation Area.

The Department of Lands and Forests (later Ministry of Natural Resources) planted on private land under the "Woodlands Improvement Act" beginning in 1965 on the North Dumfries property

of Norm Drynen. This program focused on large areas (4 hectares and up) with timber-producing potential. It augmented the on-going agreement forest program for publicly owned lands, and used the subsidized trees made available for private land planting by the province.

During the 1960's and 70's, the province and the Conservation Authority ran somewhat parallel programs. The situation evolved such that in the 1980's the Conservation Authority was focused on stream buffers, windbreaks, and other plantings under four hectares. The Ministry of Natural Resources trended toward ever-larger projects within an ever-shrinking program. As the Ministry of Natural Resources first reduced its planting activity, the Grand River Conservation Authority stepped in to satisfy the demand that went un-serviced. This was an intensive period of reforestation. Landowners being assisted by these two programs planted well over a million trees per year in the Grand River watershed during the 1980's.

Eventually, the heavy subsidies were stripped away from the programs, and demand fell away in equal measure. No new plantings have been done since the early nineties under the Woodlands Improvement Act, and the Conservation Authority program on private land fell to less than 100,000 trees per year. The year 2001 marks a resurgence of demand as cost-sharing programs revive interest.

Whatever the success rate of that first program enacted back in 1871, it represents the beginning of a long history of programs designed to encourage tree planting. Since then, private land reforestation in Ontario has been heavily subsidized by the taxpayer, until the 1980's, when subsidies were systematically reduced. Reforestation was presumably subsidized because of societal recognition of the societal benefits of having more forests on private land. The general subsidies were virtually gone by 2000, and were replaced with targeted subsidies. This allowed a more focused spending of public funds. Unfortunately, it also introduced substantial inconsistency to tree planting efforts, as funding programs generally lasted from one to several years before being replaced by another program. The total number of trees being planted in the watershed also dropped significantly as the general subsidies were eroded. It is unclear whether the current lack of public investment in private land reforestation refutes the previous societal perspective, or simply reflects a desire to trim government expenditures.

In the 1980s, park naturalization planting became an important activity, and since then has grown steadily. The City of Kitchener was a pioneer in this area, with other cities in the watershed also being "early adopters".

Comprehensive tallies of tree planting efforts are difficult because there are no records for how many trees are planted outside of formal programs. However, an informed guess would put current rural reforestation efforts at between five and ten percent of traditional levels pre-1990. Our current estimate of total percent forest cover in the watershed is 19%. If we were to set a relatively modest goal of a two percentage point increase to 20% it would take almost fifty years to do the job at one million trees per year. At the current low planting rates it would take hundreds of years. (This assumes no net gain or loss to percent forest cover when forest loss is balanced against natural regeneration.)

Considering that some experts have suggested a minimum of 30% forest cover is required to ensure a healthy ecosystem, these time lines could be daunting. However, it is instructive to consider that forest cover has increased from about 5-10% to 19% (to the best of our knowledge) during the last century. It is unclear what percentage of this increase can be attributed to tree planting and how much has resulted from natural regeneration.

Current state of tree planting programs

"Two-thirds of residents agree that rural private landowners should be compensated for taking land out of agriculture production in order to grow more trees."

- DRAFT REPORT, Attitudes of Urban Residents toward Urban Forests and Woodlands Issues, Environics Research Group, August 2001 –

The current state of tree planting programs in the Grand River watershed can be described as a patchwork of varied funding sources, delivery mechanisms, and approaches. Citizens of the watershed may be more involved than ever before. Individuals acting outside formal programs make very significant contributions to the effort.

Fewer trees are being planted now than has been the case in decades. In co-operation with Grand River Conservation Authority and the Ministry of Natural Resources (MNR), landowners in the Grand River watershed formerly planted over one million trees per year. Scouts and other groups planted large numbers, and many landowners planted MNR-grown trees without agency assistance. Accurate figures for total trees planted are not available, but for decades the annual total number of trees being planted in the watershed probably fell between two and three million. Today, planting has been reduced to about ten percent of that number.

Why has planting been so much reduced? Tree planting is one of the most easily deferred budget decisions that landowners face. If the cost is too high, or the procurement process too obscure, or the delivery mechanism too complex, or the messages too confusing, or the service too poor, then the landowner (or group) may simply cancel, defer, or reduce the intended planting.

The Ministry of Natural Resources' departure from nursery production was unfortunately not accompanied by a successful transition plan to ensure the availability of appropriate nursery stock. Whereas the Ministry of Natural Resources was growing twenty or thirty million trees per year for all of southern Ontario, today between three and eight million are sold into southern Ontario for reforestation. Although the commercial growers have the skills and capacity to grow more trees, they lack confidence in this segment of their market.

Additionally, availability of "source-identified stock" is even more problematic. Such stock allows buyers to make informed decisions ensuring that their stock is genetically adapted to their planting site. Source-identified stock was a cornerstone of the Ministry of Natural Resources nursery production system.

Some progressive responses to this current scenario will be highlighted here. The Community Forestry Initiative, the Rural Water Quality Program, Trees for Guelph's Environmental Neutrality program, and the Forest Gene Conservation Association's Seed Certification Program are programs that point the way for the future. It is not enough to have increased interest or demand, or even better programs. It is imperative for commercial growers to gain confidence in the demand for trees, so that they will grow the necessary trees. Without this confidence, tree planting efforts will be plagued by uncertainty and lack of supply of appropriate nursery stock.

The Community Forestry Initiative

Ron Thayer and the Haldimand Area Community Stewardship Program, the Haldimand and Area Woodlot Owners Association, and the Haldimand Association pioneered this program for the Developmentally Challenged. It is a holistic program of volunteer seed collecting, in-school growing, and community restoration projects. The Ministry of Natural Resources' Ontario Tree Seed Plant and

Highschool students get involved in every aspect of tree production with the Community Forest Initiative

Grand River Conservation Authority's Burford tree nursery provide in-kind support and expertise and accept seed and/or seedlings in exchange. It is a very effective educational program that gets locally adapted tree seedlings planted in restoration projects.
The Haldimand group has recently produced a manual to support participants in their program, and for the use of others outside Haldimand. A co-ordinator is now on staff for two years thanks to recently approved Trillium funding.

The Waterloo Stewardship Network has begun a pilot project based on the same model, and at least two other stewardship councils in the watershed (Brant and Wellington) are at discussion or planning stages of adopting a similar program.

This is an exceptionally strong model that ties together education, community awareness and involvement, appropriate stock, and restoration plantings. The appropriate restoration stock made available via this program is very important, but the impact on people is probably an even greater benefit.

Rural Water Quality Program

Municipalities and other partners cost-share with farmers to increase the adoption of water-quality enhancing practices. Initiated by the Regional Municipality of Waterloo, and delivered by the Grand River Conservation Authority, this program is experiencing great up-take in first Waterloo Region, then Wellington County, and then the rest of the Grand River watershed. Similar programs also exist in other parts of Ontario.

Reforested buffer strips are the primary tree-related practice for which cost sharing is available. Manure storage solutions, conservation tillage, and related practices are also supported. Much of the action in the Rural Water Quality Program is in the intensively farmed till plains which are the area of greatest concern in the watershed regarding non-point source pollutants.

The program pays 75% of the cost of approved tree planting projects. This is in recognition of the fact that we all share in the benefits of these improvements, and therefore it is reasonable that the landowner not be expected to pay the full cost. It is also based on the fact that it can be cheaper to scrub pollutants from the water system by keeping them on the land, than it is to up-grade a water treatment facility to do the same job where the river reaches a large city. This program is producing some of the most outstanding land retirement and buffer strip plantings ever done in this watershed. Significantly, the program is proving popular with the full spectrum of the farming community, including conservative Mennonites.

One of the prerequisites of this program is completion and peer review under the Ontario Environmental Farm Coalition’s Environmental Farm Plan. This program is delivered by the Ontario Soil and Crop Improvement Association, and provides a strong educational foundation for the Rural Water Quality Program.

This program, in one form or another, is available throughout the watershed, but at present the funding is short-term, a situation that Grand River Conservation Authority is attempting to remedy.

Although it is a very strong model with respect to water quality, funds for cost sharing are limited. The vigorous focus on water quality means that other opportunities on a farm may be missed, such as critical habitat plantings.

Trees for Guelph – Planting Trees to Offset Carbon Emissions

McNeil Consumer Healthcare located in Guelph, is striving toward "environmental neutrality". After a decade of supporting the greening of Guelph's industrial basin, McNeil is now leading the way in ensuring that the net impact of its operations is not environmentally negative. The "Greening" is a decade-long program of Trees for Guelph and its many partners, including Grand River Conservation Authority, to increase tree cover in the industrial, institutional, and public parts of the City of Guelph. High school students do most plantings as a hands-on environmental learning experience. McNeil's initiative takes this model a step further.

Under the system developed by McNeil, a factory, or any corporation can audit its environmental performance. Carbon emissions, among others, are measured and reduced as much as possible, and then the remaining emissions are offset by local tree planting.

This model, if adopted by other enterprises, could lead to wide-spread corporate action on conservation of resources, pollution abatement, and most importantly for the watershed forest, to the planting of trees. The potential is for every corporation in the watershed (and beyond) to have commitments and targets for their environmental performance, and to improve their standing with actions that could include tree planting.

Students from Rockway Mennonite Highschool and McNeil have a long-standing partnership

In McNeil's case, their calculations have lead them to renew their commitments to plant trees on their own grounds. However, like most corporations, their property isn't big enough to hold all the trees that they would like to plant under this initiative. Partnerships with community groups and agencies, therefore, are the key to fulfilling such tree planting commitments.

Whatever form Canada's greenhouse gas reduction commitments take, they will be added incentive for corporations and others to consider such a program. "Carbon credit" trading and accumulation has already inspired some tree planting programs recently (trees hold, or sequester, carbon in their wood and thus help reduce atmospheric carbon dioxide, a chief greenhouse gas). Additionally, accreditation programs such as ISO 14001 are a catalyst for this sort of corporate evaluation and commitment setting.

The Forest Gene Conservation Association's Seed Certification Program

The Forest Gene Conservation Association aims to conserve the genetic resource embodied within our native forests. Seed Certification is one of the main programs of the association. With major funding from the Ivey Foundation, the association is currently at a pilot project stage to adapt a model from Minnesota for use in Ontario.

When this process is in place, consumers and planting professionals in Ontario will once again be able to make informed choices and ensure that genetically appropriate stock is used in their projects. The Grand River Conservation Authority, along with other Conservation Authorities has already committed to supporting the seed certification process. In practice, this means buying only stock from an appropriate seed source, where feasible.

Summary of Models

These innovative and progressive programs point to some solutions for the future watershed forest. None are fully "rolled out" to the whole watershed with long-term funding. The originators of these programs are/were not necessarily focused on the Grand River watershed as the target area. However, it is the recommendation of this plan that they are adopted watershed-wide.

Targets

Environment Canada suggests that 30% forest cover is needed for a healthy, sustainable, watershed. Only the Milton and Six Nations of the Grand River areas of this watershed have 30% or more forest cover. In the most intensively farmed or urbanized parts of the watershed, this may be an unrealistic target in the near-term. In other areas it may be achievable.

A long-term vision is offered here, from which near-term targets are suggested below.

The long-term vision is to have an over-all percent forest cover of 30%, recognizing that some areas will be lower, and some areas will be higher. A swath of natural vegetation will buffer every watercourse. Every Grand River ecoregion (except already urbanized areas) will have at least one large "core" forest of at least 200 to 500 hectares in size and with significant old-growth components. These core areas would be part of a web linked by swaths of forest at least 100 meters wide. The canopy cover in the city will be at least 40%.

How long is long-term? If we increase forest cover at about the same rate as we have done in the past one hundred years, then it would take between one and two hundred years to achieve this vision.

What of a nearer-term target? In ten years the following is achievable with concerted effort:

1. 500 additional kilometres of watercourse buffered on both sides;
2. Every existing "core" forest area buffered, enlarged, and/or linked, as appropriate;
3. 20,000 additional hectares of cropland sheltered by windbreaks;
4. 2,000 hectares reforested;

To give an idea of logistics involved, this would be about two thousand projects resulting in about ten million trees.

Priorities for tree planting are suggested as follows:

1. Riparian buffers (all, but especially those)
    a) in the Nith and Conestogo River watersheds
    b) and/or that would serve as significant linkages between core forest areas
    c) in urban areas
    d) impacting on potential and existing coldwater streams or regional groundwater recharge or discharge areas
2. Fragile* agricultural land retirement (all, but especially those)
    a) in the Nith and Conestogo River watersheds
    b) and/or buffering, expanding, or linking core forest areas
    c) impacting coldwater streams

3. Urban plantings (all, but especially those)
    a) with greatest potential to increase *Leaf Area Density* (areas where large-crowned trees are able to thrive to maturity—most likely in greenspace plantings);
    b) with greatest potential to counteract urban heat island effect (any urban area currently low in tree canopy but high in highly-reflective and/or hard surfaces (especially near where people spend their school or work-days);
    c) with greatest potential to reduce energy consumption and greenhouse gas production (use of air conditioning is rapidly expanding and the cooling effect of trees strategically placed to reduce the need for air conditioning probably offers a great opportunity);
    d) in Kitchener-Waterloo and Cambridge, being the largest urban agglomeration in the watershed.
4. Biodiversity-focused plantings
    a) including, but not limited to, the linkages and buffers noted above
    b) that restore and/or expand core forest areas
    c) that restore non-core areas and that attempt to restore a "natural" community
    d) that accelerate the conversion of conifer plantations to a more natural forest
    e) that help implement recovery programs for species at risk (e.g. sweet chestnut, butternut, red mulberry)
5. Shelter plantings
    a) that help prevent erosion of soil and associated migration of nutrients and pesticides into watercourses, especially in Conestogo, Nith, and Whiteman's Creek watersheds
    b) that double as linkages
6. Marginal** agricultural land plantings, especially in
    a) headwater areas
    b) subwatersheds with less than 20% forest cover
7. Other plantings

*Fragile agricultural lands are those that are profitable to farm, but are actively eroding. Examples include cropped floodplains and steep slopes.

**Marginal agricultural lands are not profitable to farm, but are not necessarily eroding. Examples include excessively wet, stony, or small fields.

Note that in order to achieve the targets for the watershed, all areas will have to be addressed.

Action Items:

- **Protect existing trees and forests. Realize that protection mechanisms should not be so restrictive as to discourage tree planting or ownership of forests.**
- **Promote the concept of landscape health. Recognize that forests, wetlands, meadows, prairies, savannahs, and other natural communities are equally important to landscape health.** The need and opportunity for ecological improvement through tree planting should not blind us to the value of a diversity of natural communities.

- **Increase awareness of the services and benefits that forests provide for all watershed residents through education material and programs.**
- **Promote the benefits of natural regeneration and direct-seeding to increase forest cover. Realize that tree planting is not the only way (or even the best way in all cases) to increase forest cover.**
- **Expand, enhance, support and maintain the Community Forest Initiative watershed-wide.**
- **Expand, enhance, support and maintain the Rural Water Quality Program watershed-wide.**
- **Expand, enhance, support and maintain the Trees for Guelph model watershed-wide.**
- **Promote the adoption of the Forest Gene Conservation Association's Seed Certification protocol watershed-wide.**
- Adopt the ten-year targets set out above.

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

4.3 Tourism and Recreation

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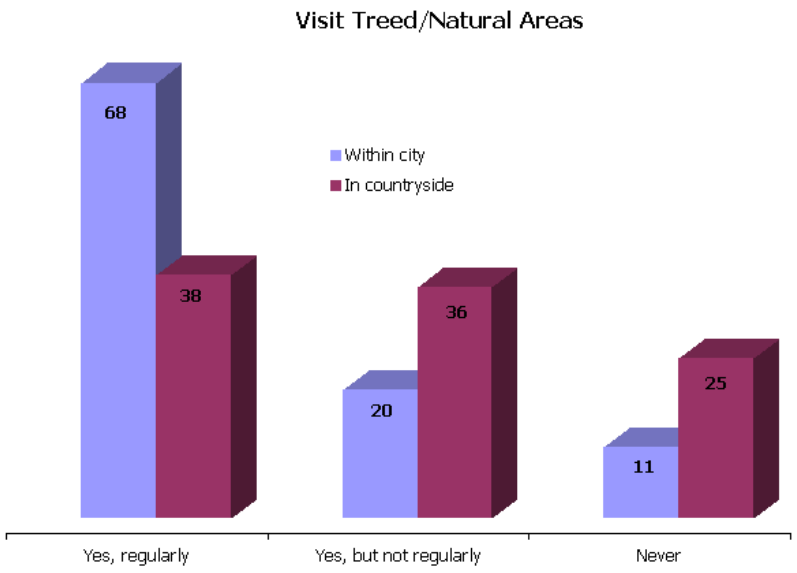
Over half a million people are in treed natural areas of the Grand River watershed at least once a month (seven in ten respondents to the Environics survey). This use is concentrated in urban parks, conservation areas, and rail trails. Other people get "off the beaten track", and in so doing, the track becomes beaten. There is a basic conflict between nature's ability to bear our traffic and our desire and need to enjoy nature.



Trees and forests are important to recreation and tourism within the Grand River watershed, but exactly how important is hard to quantify. There are more than a million visits each year to the dozen conservation areas operated by Grand River Conservation Authority. The Elmira Maple Syrup Festival attracted about 80,000 people in 2000, and was subsequently recognized by the Guinness Book of World Records as the largest single-day maple syrup festival in the world. The appeal of these attractions flows at least partially from trees.

The most common activity that people report doing in these areas is walking or hiking. There is also growing demand for biking, snowmobiling, and horseback riding trails. Hunting, fishing,

canoeing, kayaking, birding, photography, and nature appreciation are among the many other activities that people choose to do in forested environments. Hunting, fishing, birding, and nature appreciation are particularly important because they are forms of recreation that, if channelled in such a way, can form the backbone of a citizen's habitat monitoring program.

Aside from the potential for conflict between trail users, and the degradation that occurs if trails are too heavily used, there is also the issue of remoteness. Some interior forest areas should receive little or no human traffic, if we want the sensitive species living there to remain part of the watershed ecosystem. Some parts of some of the large publicly owned forests, mostly in the hands of Grand River Conservation Authority, should be off-limits to humans.

A comprehensive survey is needed to put numbers to recreation and tourism as it relates to the Grand River watershed and the watershed forest.

Municipal and Conservation Authority parks officials will require additional resources to ensure that the popularity of their parks does not lead to their degradation. In some cases, this may require sustainability surveys in the parks to gauge usage and impact, and to recommend improvements to ensure that the park is able to withstand the traffic without impairment.

There has been monumental progress in the past decade in converting abandoned rail lines into trailways, and this is a situation where high traffic is sustainable. It would be visionary to work toward an interconnected system of trailways that links cities to each other and to natural areas throughout the watershed. This would be a tremendous boon to recreation in the watershed, and could potentially provide a platform for one or more trail-based events that would boost tourism revenues. Consider the possibilities of a trailway "Ironman" marathon or a Grand River eco-race.

The Guelph-Wellington-Dufferin Health Unit recently produced a trail guide, *Trails Discovery*, to promote trail use for its health benefits. All of the trails were in treed areas. Some cities have brochures outlining the trails in their community. Grand River Conservation Authority has produced *Canoeing the Grand*. However, there is no complete guide to the trails of the Grand River watershed. A guide entitled *Hiking in the Grand River Area* would be useful in support of forest-related recreation, and could even raise awareness of forest issues and opportunities significantly.

The Grand River Conservation Authority has many trails not mapped or made public, and those that are appropriate for public use should appear on maps available to the public.

The potential exists for a *Fall Colour Festival* event in the watershed, based on the many scenic drives and communities in the Grand River watershed, and its tremendous diversity of landscapes and forests. There is no reason that, given the right combination of ingredients, such an event could not be on the scale of the *Elmira Maple Syrup Festival*.

Action Items:

- **Undertake a comprehensive study regarding revenue generated from recreation and tourism in the Grand River watershed as it related to the watershed forest.**
- **Develop or adopt sustainability indicators for high use areas to monitor environmental impact from recreation and ensure the integrity of the environment for the long term.**
- **Produce a detailed and complete guide to the trails of the Grand River watershed in support of forest related recreational activities and raise awareness of forest issues and opportunities.**

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

4.4 Wildlife Monitoring & Management Programs

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Management of wildlife resources in the watershed has been advanced in the last 10 years by a number of projects and programs. Some of the success stories are summarized below.

Christmas Bird Count

The Christmas Bird Count is an effective way to analyze and monitor long term changes in the distribution, abundance and population trends of birds that over-winter in the watershed. Since 1900, birdwatchers have been going out in 'parties' to conduct counts in the established 15-mile diameter (24 km.) circles in various parts of North America.

Local naturalist clubs organize the activity and send the data to the National Audubon Society in the U.S. The 1993-94 Christmas Bird Count in Ontario included 2,715 participants and a total of 172 species observed. The record high was 183 species in 1991, when a total of 1,047,299 birds were counted. The birdwatchers spent 6,414 'party hours' (the highest ever was 6,519) (L. Burr and D. Rupert, Feb., 1995). This data collection activity will benefit wildlife and wildlife management.

Breeding Bird Survey

The Breeding Bird Survey was initiated in the United States and Canada in 1966. It is a standardized roadside survey, which is implemented by volunteers each June. The volunteers are assigned a 40 kilometre route and 50 stops are made at 0.8 kilometre intervals.

All birds seen or heard during each 3 minute stop are recorded. Participation is increasing in these surveys. Between 1993 and 1994 Ontario participation increased by 37%. Over the 92 routes a total of 184 species was recorded with an average count of 64 species per route (C. Downes, 1995). The Breeding Bird Survey is examining ways in which habitat data can be obtained as part of the survey.

Ontario Herpetofaunal Summary

The abundance, distribution and ecology of Ontario's amphibians and reptiles have been documented since 1984 in the Ontario Herpetofaunal Summary.

By 1986, the volunteers who participated in the project had submitted 13,402 records of 51 species and subspecies. The volunteers numbered 586 in 1986, and 1003 in the period 1984 to 1986.

In the 1986 report, records were summarized on the basis of the Breeding Bird Atlas squares. These are the 10 km by 10 km squares based upon the Universal Transverse Mercator (UTM) grid system. From the summary map produced it is apparent that the southern half of the watershed and Luther Marsh in the upper half, have received a lot of attention. But, a great deal of work is required in the rest of the upper half of the watershed. This was originally intended to be a seven-year project, which would hopefully be adopted by other teams after 1990.

Wetland Evaluation

The majority of wetlands in the Watershed have been evaluated in a Provincial program that was initiated in 1984. Wetlands across Ontario have been compared through evaluations carried out in accordance with the Ministry of Natural Resources and Environment Canada Wetland Evaluation

Manual and wetlands have been given priorities for protection through classification and designation. Many wetlands in the Grand River Watershed have been given a 'provincially significant' designation. Grand River Conservation Authority has further inventoried and mapped wetlands with more comprehensive coverage of the watershed.

Carolinian Canada

The Carolinian Zone of Canada covers less than 0.25% of its land but has a large percentage of the number of the nationally rare species. In 1985 a program called Carolinian Canada was initiated to select a number of critical unprotected sites in the Carolinian Zone and facilitate protection of those sites through a variety of innovative means. Member agencies and organizations of Ontario's Natural Heritage League formed partnerships in projects to secure the 38 Carolinian Canada Sites. The Cambridge District office of the Ministry of Natural Resources and the Grand River Conservation Authority share the lead agency role in addressing the needs of 5 sites in the Watershed. They are: Beverly Swamp, Grand River Forests and Spottiswood Lakes, Sudden Bog, Oriskany Sandstone, and Six Nations of the Grand River.

The Conservation Authority has promoted private stewardship, acquired land and passed regulations in the first 4 sites and has assisted staff at Six Nations in their work. The projects have been well received by landowners.

Luther Marsh Management Area

The 5,679-hectare Luther Marsh Management complex is now operating under its second management plan. The complex has been under management by a steering committee of stakeholders for 35 years of its 44-year history. Waterfowl sanctuaries are protected from March 15 to November 14 and the marsh is closed to boating until July 31 each year. A number of research papers have been written on the resources and management aspects involved and a number of students have received training there.

Wetlands Research Areas

1. Puslinch Lake – Irish Creek
2. Guelph Lake
3. Grass Lake – Cranberry Bog

Research in these areas has been facilitated by an informal agreement between the Wetlands Research Institute at the University of Waterloo and the Grand River Conservation Authority. Land which the Authority owns adjacent to these wetlands has been set aside for 20 years or as long as possible for research. A number of theses and research papers have been published on the basis of work carried out in these research areas.

Prescribed burns

Prescribed burns have been carried out by fire staff of the Ministry of Natural Resources or consultants at Luther Marsh, the Drynan Tract of the Regional Municipality of Waterloo, the Taylor farm, the F. W. R. Dickson Wilderness Area (GRCA), the Brantford Rail Trail Prairie, the Blue Lake Road Prairie, and the Brantford Golf Course Prairie. These prescribed burns influence the

composition of the vegetation to maintain or enhance biodiversity.

Dunnville Wetlands property

The Nature Conservancy of Canada acquired over 900 acres of land between Dunnville and Lake Erie on the east side of the Grand River and turned it over to the Conservation Authority for management. A steering committee has been set up to guide resource inventories, research, management planning and habitat restoration. Most of the property is provincially significant marsh of the lower Grand River complex.

North American Waterfowl Management Plan Eastern Habitat Joint Venture

An agreement between the Ministry of Natural Resources, Ducks Unlimited, Wildlife Habitat Canada, and Environment Canada - Canadian Wildlife Service has facilitated work in the Watershed. Under the Eastern Habitat Joint Venture owners of provincially significant wetlands have been contacted and private stewardship has been promoted. Landowners in the Horseshoe Moraine, Waterloo Hills, Norfolk Sand Plain, Flamborough Plain and Haldimand Clay Plain regions have been contacted and many have entered into voluntary handshake agreements to maintain the natural heritage resources of their lands.

Action Items:

- **Recruit citizens groups (recreational clubs, naturalist groups, etc.) to form the backbone of a citizen's habitat monitoring program to perform data collection and monitoring under existing wildlife management and monitoring programs.**
- **Incorporate wildlife management objectives into landscape and property level management planning strategies.**
- **Use the habitat guidelines developed in "A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern" to guide habitat restoration efforts watershed wide**, prepared by Environment Canada's Canadian Wildlife Service and Great Lakes 2000 Cleanup Fund, the Ontario Ministry of Natural Resources and the Ontario Ministry of the Environment
- **Work with existing programs and agencies to restore degraded habitats** (e.g., field days sponsored by the Nature Conservancy of Canada and the Society for Ecological Restoration, Ontario Chapter) and naturalize schoolyards (e.g. the Evergreen Foundation's "Learning Grounds" program)
- Dialogue with garden clubs, naturalist groups and retail garden centres and nurseries: present both the problem and viable alternatives (for more background information, see the listed contacts at the end of this section).

Bold text indicates item is listed in Part 5: Watershed Forest Plan Action Items summary.

More information can be obtained from:
Carolinian Canada (London), Big Picture project:
Tel. 519 873-4631,
Website: www.carolinian.org
E-mail: info@carolinian.org

Evergreen Foundation (Toronto):
Tel. 1 888 426-3138,
Website: www.evergreen.ca
E-mail: info@evergreen.ca

Federation of Ontario Naturalists (Toronto): local clubs can provide plant lists for your area and help distinguish native from exotic.
Tel. 1 800 440-2366,
Website: www.ontarionature.org
E-mail: info@ontarionature.org

Invasive Plants of Canada (Ottawa):
Tel. 613 722-6291,
Website: infoweb.magi.com/~ehaber/ipcan
E-mail: ehaber@magi.com

Nature Conservancy of Canada, Ontario Office (Guelph):
Tel. 519-826-0068,
Website: www.natureconservancy.ca
E-mail: sandyt@natureconservancy.ca

Society for Ecological Restoration, Ontario Chapter:
Tel. 519-888-4567 ext.5616,
Website: www.serontario.org
E-mail: info@serontario.org

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4.5 Community Roles in the Implementation of the Watershed Forest Plan

Landowners

1. Promote the Environmental Farm Plan ($1500). Federal funds for environmental planning and actions. (woodlot management, reforestation, buffers, habitat restoration);

2. Make landowners aware of the Best Management Practices, Farm Forestry and Habitat Management, booklet by Agriculture Canada (windbreaks, fencerows, reforestation, buffers, Silvopasture, habitat and woodlot management).

Service Clubs

1. Many service clubs are most willing to present speakers on interesting community projects. Members could be made aware of the Watershed Forest Plan. They enjoy taking part in hands on family oriented activities (i.e., clean up littered areas -plant tress -weed out exotic species -raise funds).

2. The Rotary Clubs and Optimist Clubs have environmental committees with a budget for environmental grants. Forestry funding initiatives could be supported.

Educators

1. Incorporate forestry education in general to all parts of the curriculum.
2. Develop forestry curriculum connection at specific grade levels - Gr. 1, 4, 7, and 12.
3. Promote outdoor education and field trips throughout the watershed.
4. Create a Watershed Fair where students learn and share information.
5. Adopt a forest.
6. Utilize established forestry projects -
    - Ecoscope Project- resources to assist school in forestry projects;
    - Global Rivers Project- water quality and forestry monitoring;
    - Learning Grounds Project- Naturalization of school grounds;
    - Trails Youth Incentives- personal development of youth through conservation;
    - Boy Scouts, Girl Guides, 4H Clubs, YMCA/YWCA- all have environmental programs.

Corporations -

1. Friends of the Environment (Canada Trust) have eleven branches within the watershed. They are most willing to help in funding any environmental project. The Kitchener FEF has a large budget of over $100,000 each year. Its mandate is to use 80% of the funds. Now, Kitchener, Cambridge, Waterloo, and New Hamburg are combining Chapters making them an even richer source of funding.

G.R.C.A

1. Monitor forest ecosystem.
2. Voice strong messages to the government promoting environmental education and environmental funding.
3. Be a forest action resource for the individual, schools and general public groups.
4. Guide community groups in initiating, planning, and implementing large restoration projects.
5. Develop a Watershed Forest Community network by promoting good communications among all groups of the watershed from Dundalk to Dunnville (i.e., through the use of website, publications, meetings, radio, television and presentations).

Other Agencies and Associations

(through the use of resources, grants, educational materials)

1. Environment Canada, Environmental Conservation Branch (416) 739-5829
2. Ontario Ministry of Agriculture (416) 444-8419
3. Ontario Ministry of Environment and Energy 1-800-565-4923
4. Ontario Ministry of Natural Resources (416) 341-1177
5. Conservation Council of Ontario (416) 969-9637
6. Ducks Unlimited (705) 721-4444
7. Earth Day Canada (416) 599-1991
8. The Evergreen Foundation (416) 596-1495
9. Federation of Ontario Naturalist (416) 444-8419
10. Heritage Resource Centre (519) 885-1211, ext.2702
11. National community Tree Foundation (705) 645-7393
12. Ontario Environment Network (519) 837-2565
13. Ontario Federation of Anglers and Hunters (705) 748-6324
14. Ontario Forestry Association, Project Tree Cover (416) 493-4611
15. Ontario Public Interest Research Group (416) 598-1576
16. Ontario Tallgrass Prairie Association (519) 354-7340
17. Harmony Foundation (grants) (613) 230-7353
18. Council of Outdoor Education (416) 495-4264
19. The Canadian Network for Environmental Education and Communication (905) 863-3306
20. Ontario Society for Environmental Education (OSEE) (519) 579-3097
21. Habitat 2000-(grants for school habitat restoration) 1-800-575-9453

General Public

(through action projects)

- clean up littered areas
- plant trees
- weed out exotic species
- raise funds
- participate in local bird counts - build bird boxes
- adopt a forest
- plan a Watershed Forestry Day
- form a watershed global releaf group

- monitor woodlots
- participate in local dendrology trails
- participate Tree Searches Contests
- write to politicians expressing views
- attend presentations on Carolinian forests
- encourage family outings on trails
- report unlawful activities
- adopt a tree
- plant and learn from demonstration gardens
- plant urban gardens
- develop media displays
- develop computer networks
- read and share publications and information
- utilize local self-guided trails
- volunteer in schools

Planning a Large Project

Looking at the "Big Picture"

A. Practical guidelines are necessary in order to implement a restoration management strategy on a big scale involving many people and stakeholders. An excellent plan for site restoration can be found in, Restoring Nature's Place, Daigle and Havinga, 1996. They suggest the following steps.

1. Define the local site context.
2. Conduct a site inventory and analysis.
3. Articulate goals and objectives
4. Prepare a site plan.
5. Identify a plant community model.
6. Develop a restoration and management strategy
7. Develop a plant list and plant source.
8. Develop a project monitoring program.
9. Prepare an action plan.

B. A Citizens Forester's Guide, The Simple Act of Planting a Tree, (Lipis 1990), is an informative, comprehensive, practical guide for creating a forestry vision and putting it into community action.

APPENDIX A: MAPS

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Political Map of the Grand River Watershed

A general map of the watershed showing its relation to major urban centres and highways in southern Ontario.

Watershed Forest Cover

This map is used to clearly display the forested areas of the watershed without the interference and clutter of overlaying data. Forest cover data is from Ontario Base Maps.

% Forest Cover by Lower Tier Municipality

Percentages of forest cover for each of the lower tier municipalities were derived using areas for forest cover calculated from digital base mapping and applied against the area of forest cover for the watershed.

% Forest Cover by Ecoregion

Percentages of forest cover for each ecoregion were derived using the same methodology as applied in the lower tier municipality coverage.

Interior Forest

This map displays the watershed's forested areas with 100m, 200m and 300m interior setbacks. Interior forest is a critically low habitat type in the Grand River watershed. A 300m setback from the forest edge is required for wildlife and plant species, which need interior forest habitat for their survival.

Rare & Endangered Species Occurrences

Data from the Ministry of Natural Resources, Natural Heritage Information Centre element occurrence database was used to produce this map displaying the general distribution of species at risk in the watershed.

Groundwater Recharge and Forest Cover

This map shows areas of importance for groundwater recharge in the watershed against the forest cover in these areas.

Groundwater Contamination Vulnerability and Forest Cover

This maps shows groundwater areas vulnerable to contamination from surface pollutants due to the shallow depth to water table or the uppermost aquifer against forest cover in these areas.

Sawmills & Logger Operations

This map shows the locations of all surveyed sawmill and logger operations in 2000, within 200 kilometres of the Grand River watershed.

Non-Point Source Pollution and Forest Cover

Areas of major non-point source pollution in relation to forest cover.

Satellite Classification of Forest Cover

A satellite image of the Grand River watershed classified to display forest cover by composition.

Satellite Image of the Watershed

A satellite image of the Grand River watershed classified to appear as a colour aerial image.

APPENDIX B:

WORKING GROUPS

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