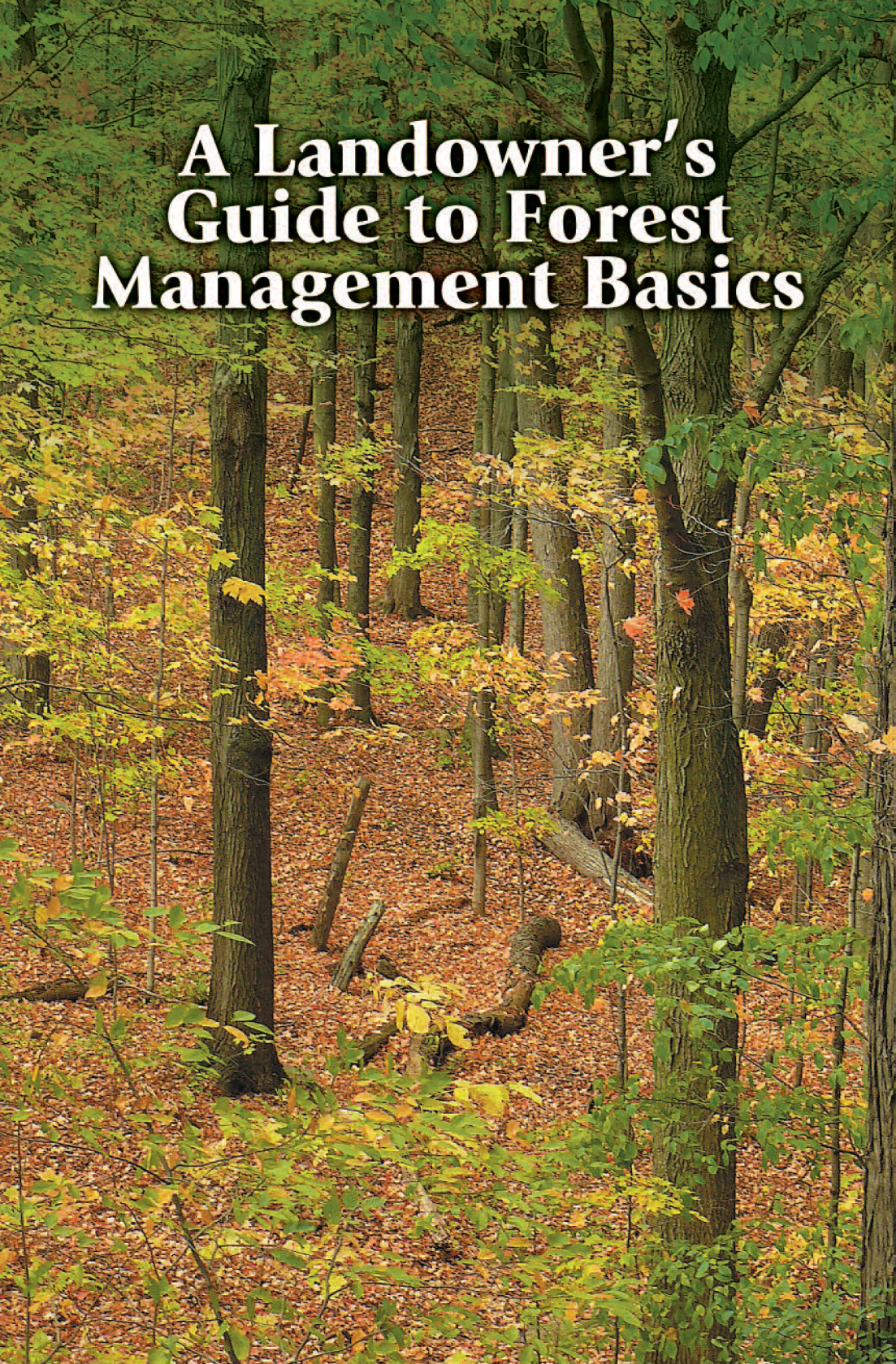
A Landowner's Guide to Forest Management Basics



The production of this publication was made possible through the generous support of:

The Stewardship Councils greatly acknowledge the assistance of many individuals and organizations in the preparation of this publication, most notably:

- Dave Pridham for text preparation
- Norm Wagenaar for editorial review
- Oak Ridges Moraine Foundation (Kim Gavine, Kate Potter, Lisa Turnbull and Judy Gilchrist)
- Photos by Katrina Vuckovic (front cover, Moraine in Focus Photo Contest) and Doug van Hemessen (closing photo)
- Images by Yang Huang

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Introduction

If you own land with trees and forests, you are the steward of a very valuable and important resource. Trees and forests are the natural vegetation of most of south-central Ontario and provide many economic and environmental benefits.

Two hundred years ago south-central Ontario's pioneers found a landscape of vast mixed hardwood and conifer forests. These were viewed at the time both as an unlimited resource to be exploited and a barrier to settlement. In fact, there was no market for most of the timber produced during land clearing. An example is the clearing of one of the greatest white pine forests in all of North America, in Norfolk County, which was mostly burned to make way for farming.

In the early 1900s the Provincial government recognized land clearing and logging had deforested large areas that proved to be unsuitable for farming in the long term. This resulted in severe erosion, flooding, and loss of habitat. The Province responded by establishing four provincial nurseries in southern Ontario to reforest as many of these areas as possible. The large pine and spruce plantations on municipal and conservation authority properties across Southern Ontario, as well as many private lands, testify to those efforts that lasted into the 1990s. These plantations, and second-growth natural regeneration, now comprise much of southern Ontario's woodlands. We have come to understand and appreciate large forested areas for the unique and essential habitat provided, as well as other benefits, such as recharging groundwater and minimizing flooding.

Today, forests and their managers face a new set of challenges. Insects and diseases from other continents have decimated several significant tree species – American chestnut, American elm, American beech, and butternut. The emerald ash borer threatens all ash species. Invasive plants and shrubs aggressively compete with native trees and plants. In addition, the impending effects of climate change are hard to predict but will certainly impact our forests.

This handbook is meant to provide woodlot managers with basic information to help meet these challenges and ensure tomorrow's forests continue to provide groundwater protection, habitat, and high-value forest products. Readers looking for in-depth information will find references to websites and reading materials among the explanations of essential forest topics. Appendix 1 provides a list of sources while Appendix 2 lists local and provincial contacts.

Woodland values

Well-managed woodlands provide many significant benefits, financial and otherwise.

- Rural landowners and mill operators can enjoy a reliable income from woodlands. A study of several Ontario woodlots, initiated by the Huron Stewardship Council and the George Morris Centre, found that well-managed upland hardwood timber usually makes more money than a cash crop grown on the same land[1]. The high costs of farming influence the results. Other factors are the value of high grade lumber and the very low cost of managing an established woodlot. A woodlot owner enjoys a significant advantage; he or she can wait until prices are high. Timber will, in most cases, add volume and value as the woodland manager waits for markets to improve.

- Maple syrup production provides a regular income for many maple woodland owners.

- Firewood can generate revenue, although its greatest benefit may be lowered heating costs for woodlot owners who cut poor quality trees and burn them as heating fuel.

- Alternative forest products, such as shitake mushrooms, can generate income. However, landowners should do their homework. For instance, contrary to popular belief, wild ginseng is not a high income product.

- Recreational activities such as hiking, cross-country skiing, bird watching and responsible off-road vehicle use provide eco-tourism opportunities and contribute to local economies.

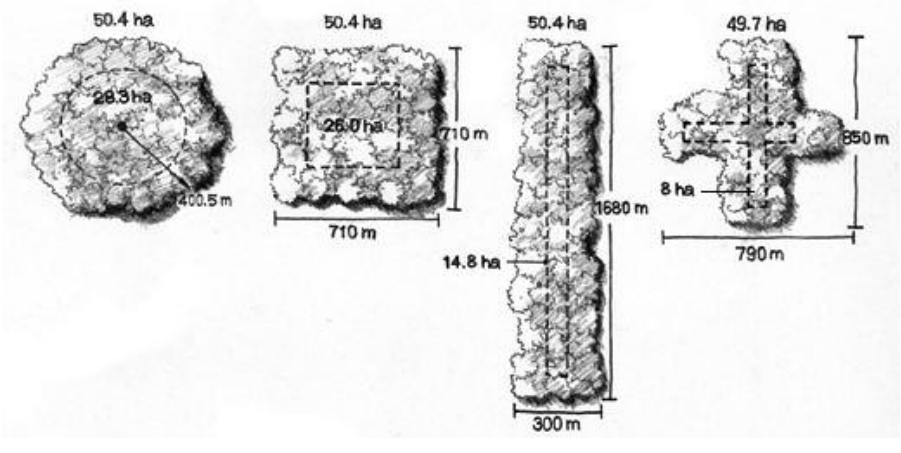
- Most woodlot owners cherish forests as places of solitude and quiet reflection within a developed southern Ontario landscape. Not so many generations ago, forests were an essential part of our human habitat – providing shelter and other life needs. This may explain why many people feel a deep sense of connection to woodlands.

1 *Case Studies, Sustainable Management of Private Woodlands: Huron Stewardship Council*. https://www.huronstewardship.ca/projects/trees-forestry/private-woodlands/

Woodlands and biodiversity

Forests dominated the Ontario landscape before European settlement. Today in southern and central Ontario the remaining forest cover is mostly small fragmented woodlands separated by farms, towns, rural homes, roads and highways. These woodland islands combine with open spaces to provide prime habitat for certain species including deer, wild turkeys, raccoons, squirrels, coyotes, and some songbirds. However, many other bird, animal and reptile species require large tracts of intact forest connected by corridors of natural vegetation.

Large woodlands contain high quality wildlife habitat known as **forest interior** – now rare in southern Ontario. As a rule, forest interior habitat is the area within woodlands more than 100 metres from any 'edge' – large gaps where the forest cover stops at fields, roads or hydro corridors. To illustrate impact, a square four hectare (10 acre) woodlot measuring 200 metres by 200 metres will contain only a fraction of one hectare of forest interior habitat. Some bird species require up to two hectares of home range and may not tolerate other nesting pairs of the same species within their range. Conversely, certain species require interior habitat large enough for several nesting pairs to interact socially. The population of these species may decline when interior habitat size falls below a certain threshold. The 'edge effect' in small, irregular shaped woodlands can minimize the forest interior available, as illustrated below.



Woodland size and shape affects forest interior area.

Reasons to be concerned about fragmented woodlands

- Less mobile species such as salamanders, tree frogs and small forest plants are weakened by the isolation of their population's gene pools in small, unconnected habitats.

- Small woodlands generally have fewer tree and woodland plant species. For example sugar (or "hard") maple is gradually dominating many small woodlots. Sugar maple is one of the few tree species that successfully regenerates under shade.

- Greater edge and trail access allows more nest predators into the forest. Many forest interior birds, which nest on the ground or in shrubs, have not adapted to deal with the large numbers of **raccoons, skunks**, and **cats** now active on woodland edges. The **cowbird**, a nest parasite, frequents woodlands into about 100 metres looking for active nests where it can lay its eggs, sometimes displacing the eggs of the nester. The adoptive parent then incubates the cowbird eggs and feeds the young.

Good reasons to protect forest interior

- Forest interior areas tend to contain more aquatic features such as small wetlands, springs, streams, and vernal pools. These provide critical life cycle habitat for species such as salamanders and tree frogs.

- Old growth features such as super-canopy trees provide specialized nesting habitat for some birds.

- Trail access to large areas of remote forest interior tends to be more limited.

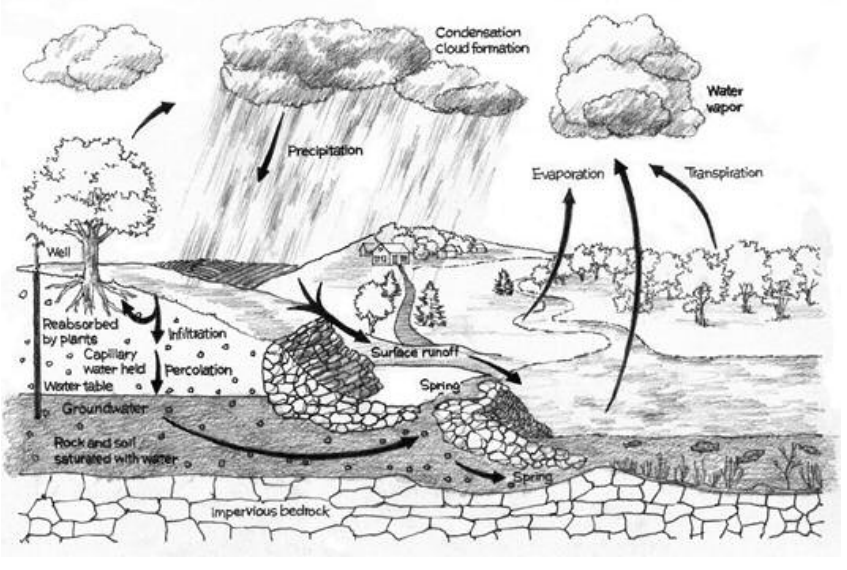
- Large woodlands contain more 'mast' trees – fruit and nut producers such as oaks, hickories, and cherries – which feed forest birds and animals.

- More woody debris accumulates on the forest floor, providing essential habitat and recycling nutrients.

The hydrologic cycle and aquatic features

The hydrologic cycle is a complex web of events that move water in the atmosphere, on the land, and below the ground. The cycle involves processes such as evaporation, transpiration and rainfall, as well as natural features such as streams, rivers, geology and the water table.

Woodlands affect the hydrology of watersheds by holding back melt water and storm water runoff. Tree cover creates and maintains a mat of leaf and twig litter which absorbs runoff, reduces erosion and increases rates of groundwater recharge. The older, most decomposed materials near the bottom of this layer become the organic matter in the soil, tending to be rich in nutrients, with improved soil structure. As trees grow, they develop root channels which improve infiltration of water into the soil.



Woodland Streams

With their ability to absorb groundwater and discharge a constant 'base flow' throughout the year, woodlands are most often the origin of small headwater tributaries. Overhead shade helps maintain cool water temperatures. These small streams can provide essential habitat for native brook trout which require cool temperatures and high oxygen levels.

Wetlands

Forested and small headwater wetlands are home to a complex and interdependent web of life forms. These include microbes, bacteria, mammals, birds, reptiles, amphibians, fish, insects and other invertebrates that use wetlands for reproduction, migration, rest, shelter, and food. But wetlands do even more:

- Wetlands take up great amounts of harmful impurities, bacteria and excess nutrients. In fact, wetlands are so good at this process that constructed wetlands have been treating stormwater runoff in Europe for several decades, and now in Ontario.

- Wetland plants stabilize shorelines, trap sediments and reduce erosion.

- Wetlands store water, reduce storm and spring flooding, and help replenish groundwater.

- Wetlands gradually release stored water into streams and rivers. This slow release of water can be crucial to maintaining stream flow during droughts.

Vernal pools

Vernal pools, also known as ephemeral pools or temporary forest ponds, lie in natural forest depressions with no inflow or outflow. Created by seasonal rains and snowmelt, and tending to dry up in most summers, these pools are sensitive ecosystems that provide unique habitat. Many amphibian species require vernal pool habitat where they lay their eggs very early in the spring. This allows the young enough time to mature before the dry season. Vernal pools also provide migratory stopovers and watering holes for a variety of wildlife in dryer areas. Their moist, rich organic soils provide conditions for a great diversity of woodland plants. Learn more about vernal pools at: www.ontariowoodlot.com/publications-and-links/featured-articles-news/wetlands-in-ontario.

Woodland types and forest dynamics

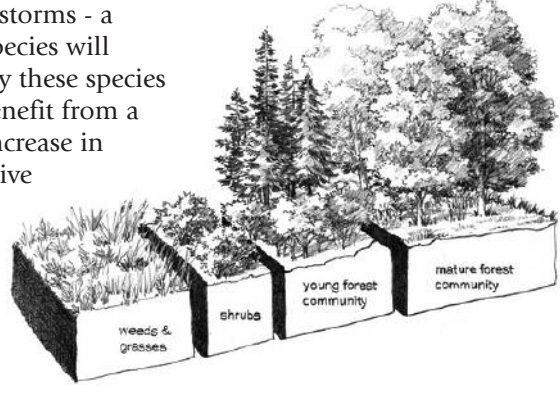
The forests of the Oak Ridges Moraine and south-central Ontario are part of the Great Lakes-St. Lawrence forest region located in between the conifer-dominated boreal forest to the north and the deciduous forest region to the south.

The Great Lakes-St. Lawrence region contains several 'forest types' - combinations of trees that normally grow together which are unique, and others that share features with forests to the north and south. Landowners who wish to increase their knowledge of forest types and tree identification skills can refer to Trees in Canada[2] by John Farrar as a comprehensive guide.

In very simple terms, the main forest types of our area are **upland woodland, lowland woodland**, and **early successional or 'pioneer' forests**. Another major southern Ontario woodland type is the plantation – with various species and many planting arrangements. They are generally established on eroded valley lands, riparian areas next to watercourses, and abandoned or marginal farmlands, including large blow sand areas commonly found on the Oak Ridges Moraine and other regions with widespread fine sandy areas.

Succession

A discussion of forest types benefits from an understanding of **'succession'** - the gradual and continuous process by which one forest or vegetation type replaces another as conditions change. All vegetation communities compete constantly for sunlight, moisture, soil nutrients and growing space. After significant disturbances - fires, windstorms - a community of pioneer species will 'colonize' the site. Usually these species are plant types able to benefit from a sudden and significant increase in sunlight; they tend to thrive in hotter, drier site conditions, in soils that may be degraded. Examples include raspberries, poplars, white birch, cherries



2 *Trees in Canada*; by John Laird Farrar, published by Fitzhenry & Whiteside Limited and the Canadian Forest Service, Natural Resources Canada, in cooperation with the Canada Communication Group – Publishing, Supply and Services Canada, 1995. ISBN 1-55041-199-3.

and other shrubs. As this vegetation community matures, it is often unable to reproduce under its own shade, providing opportunities for other, more shade tolerant species. **When considering management options, take into account the successional stage of your woodland.**

Pioneer forests

Pioneer forests are the **first stage in succession**, naturally regenerating in disturbed areas or abandoned farm fields. These forests are usually fast growing, relatively short-lived hardwoods requiring full sunlight for germination and growth. Within several decades, many pioneer species die off, having created cooler, moister, and more nutrient-rich conditions for the natural succession to longer-lived species that grow more successfully in shade.

- Primary pioneer species include trembling and large-toothed aspens, balsam poplar, soft (silver and red) maples, red and black cherries, and white birch. With the right soil conditions and a ready seed source, red oak, white ash, white pine, spruce and white cedar can also grow as pioneer species.

- Conifer pioneers can include white pine, white cedar, balsam fir, and white spruce. However, these species can tolerate slightly more shade and usually follow a few years after the pioneer hardwoods.

- Shrub species include hawthorn, beaked hazel, dogwood, elderberry, choke cherry and wild raspberries.

- Introduced species such as Scots pine, varieties of Norway maple, and the very invasive European buckthorn and certain honeysuckles thrive in these conditions and often grow as pioneers.

Upland forests

There are several variations of an upland forest, ranging from pure deciduous stands to mixes of deciduous and coniferous tree species. Factors include soil types, drainage patterns, stages of succession, and land-use history. Variations of upland forest types can be found growing side by side, often signalling a change in the site or stand history.

Upland oak-pine forests are generally found on drier sites, with red oak being the major hardwood species. This forest can grow on shallow or drought-prone soils, such as the coarse sand and gravel found on the higher slopes of the Oak Ridges Moraine. Oaks do not tolerate shade well, and usually follow shortly after the **pioneer** species. Oak-pine

forests may even be a variation of a pioneer woodland. Associated species include:

- White pine - generally the most common conifer species, with red pine also frequently present on sandier, acidic sites.

- Poplar, soft (silver or red) maple, black and white oak, bitternut hickory, white birch, black cherry, and white spruce.

- As the oak forest matures, it is generally unable to regenerate itself under its own shade. Without another disturbance, upland oak-pine forests gradually mature, decline and regenerate to species more tolerant of shade such as hard maple, beech, and hemlock.

Upland hardwood forests are comprised primarily of deciduous trees with higher tolerance to shade, growing most successfully in slightly moist, deep soils typical of mid-range slopes and well-drained flat lands. Hard (sugar) maple, American beech, ironwood (hop hornbeam), and white ash are primary deciduous species, with hemlock and balsam fir occasionally being primary coniferous species. All are moderately to very tolerant of shady conditions. These species can successfully regenerate in small openings, such as occur when one or two mature trees die or blow over. This forest type is the final step of the succession process, and is often referred to as the **climax forest** – able to sustain itself for centuries until a major disturbance occurs, when the process may start over again. Associated species include:

- Black cherry, white ash, basswood, bitternut hickory, silver or red maple, red and white oak, white pine, white spruce, and butternut. These species are less tolerant of shade and establish themselves along edges or in larger, sunnier openings following a disturbance within the forest. The presence of these species is historical evidence of a large opening on that site – an old field or fire.

- Yellow birch, white cedar, silver or red maple, black ash and poplar are most common in moister areas of these forests.

Lowland forests

Lowland forests can vary widely in species composition. Distinct types often grow side by side or in various mixtures. A change in elevation of one metre can affect soil moisture enough to completely change species composition.

White cedar swamps are dense woodlands of low areas, higher

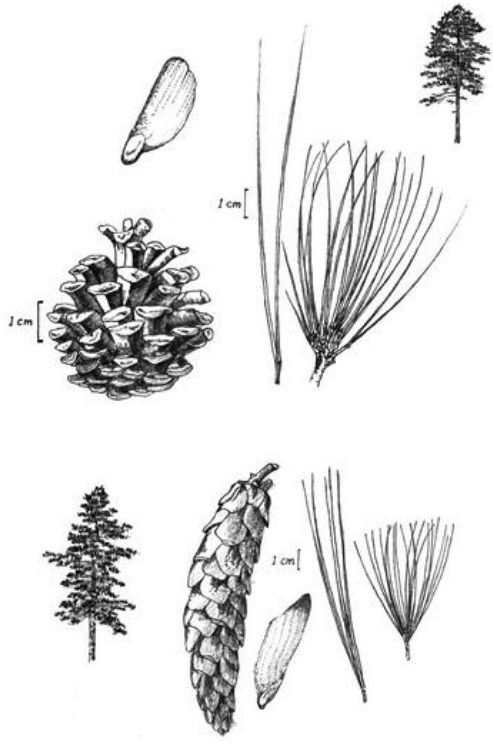
moisture soils, and valley lands next to streams and small rivers. Species commonly associated with white cedar include white spruce, white pine, balsam fir, hemlock, yellow and white birch, black ash, white elm, aspens and poplar. Tamarack is often associated with white cedar, tending to be more common on sites with higher water levels. Wetland shrubs such as red osier dogwood, alder, and willow are usually present. Black spruce is a lowland conifer species common in the boreal forest, but rare in southern Ontario.

Coniferous forests growing on better drained lowlands include hemlock, white pine and white cedar mixtures. Associated species include white spruce, white and yellow birch, soft maple, hemlock, and balsam fir. When a seed source is available, white cedar can quickly colonize abandoned fields on these sites, and could then be considered a 'pioneer forest'.

Lowland deciduous forests grow on similar sites and become established after a disturbance or on abandoned farmland.

Major species include soft maple, white and yellow birch, red cherry, black cherry, white ash, and trembling or largetooth aspen. These require full sun to germinate and flourish, and grow fast. Associated conifer species include white pine, white cedar and white spruce. Silver maple often grows in almost pure stands in flat, moist lowland sites that may hold standing water well into spring.

Common hardwood species on sites with higher moisture levels include black ash, balsam poplar, white elm, silver or red maple, and willows. White cedar and tamarack are the most common conifer species.



White pine is our only native soft pine with five needles in a cluster. (bottom) Red pine has two long needles 10 to 14 cm long. (top) Jack pine has two needles two to four cm long while the introduced and invasive Scots pine has two needles that are each twisted and four to eight cm long.

Plantations

Some of the finest examples of reforestation in North America can be found on the Oak Ridges Moraine and other such areas in southern Ontario. The Ganaraska, Northumberland, York and Durham forest plantations were established on thousands of acres, abandoned when they became unsuitable for farming, then acquired by municipalities or conservation authorities. Deforestation of these lands in the 1800s resulted in severe erosion, fast snowmelt, dust storms and events such as a catastrophic flood in the Port Hope area.

Reforestation began in the 1920s and 30s with seedlings from provincial tree nurseries in Orono in the former Durham County, Midhurst in Simcoe County, St. Williams in Norfolk County, and Kemptville in the Ottawa valley. These nurseries also provided seedlings for planting on privately-owned lands, including the provincially funded Woodlot Improvement Agreement responsible for the reforestation of thousands of acres through to the mid 1990s.

Reforestation in south-central Ontario relies on conifer species, particularly red pine, which can survive hot, dry conditions and the sandy, often acidic soils found on the Oak Ridges Moraine. Other species include white pine, white spruce, European larch, and some hardwoods such as red oak. Planters space the conifers in close rows to quickly establish crown closure and stabilize the soil with the intention that forest managers will thin the trees in approximately 30 years, and periodically afterwards. This provides softwood lumber and creates opportunities for natural regeneration of hardwoods under the protective canopy.

Creating a new forest

A landowner wishing to create a new forest, or improve an existing one, has many options. Considerations include: local climate and soil conditions, existing tree species, the amount of energy and money they wish to spend on the project, and personal objectives for their property. Planning is essential.

There's also the 'big picture' to consider, particularly for landowners whose objectives include improving landscape features and habitat. Reforestation can connect fragments of existing forest and round out the corners of an irregular woodlot to increase interior forest area. Streams and spring areas can benefit from increased natural cover. Consider how reforestation on your property might connect with woodlands on neighbouring properties. Find out if your neighbours are planning a planting project; perhaps there's an opportunity to improve a woodland across multiple properties.

Natural regeneration in old fields and other open areas

Allowing the forest to regenerate on its own is a viable option. Although this can be a longer process than planting a new forest, many would consider this natural process a preferable option. There are a few factors to consider:

- Are seed trees present? Are they upwind or downwind? Are they a suitable species for that site?
- Is natural regeneration already present?
- Will a small amount of strategic planting help achieve your objectives?
- Is the site being taken over by invasive species such as buckthorn or Scots pine? If so, control is likely necessary.
- **Maintaining natural grassland habitat has benefits.** Songbirds such as bobolinks, some sparrows, and meadowlarks reproduce only in meadow habitats.

Planting a new forest

Landowners have reforested thousands of acres across southern Ontario by planting trees each spring in field corners, along stream banks and fence rows, and in abandoned farm fields. Here are some tips for success with your planting projects:

- You will invest time, money, considerable effort, and a piece of your property. **Planning and research are essential**.
- **Know what species will do best on your site.** Consider soil depth and type, available moisture, competing vegetation, and rockiness.
- **Slope** is an important factor. Tree survival is often less successful on the top half of steep slopes due to excessive drainage and poorer soils.
- **Ploughing and cultivating** before planting can make planting easier, but provides an **excellent growing opportunity for weed seeds** present in the soil. Minimal disturbance may be best. Plant the seedlings in the sod and follow up with spot spraying of herbicides, grass cutting, or apply a thick layer of mulch after the soil warms up.

- **The most successful species for reforestation on the widest range of sites** tend to be white spruce, Norway spruce, white pine, white cedar and European larch. Acidic, well drained sandy soils, to a depth of two to three feet, are usually perfect for red pine.

- **Avoid planting alternate rows of different species.** One species is usually more suitable to each site and will outgrow the other species on either side. It is best to plant species in separate blocks of five to six rows for each species, or in patches.

- **Avoid large scale planting of hardwoods, other than for specialized purposes.** Hardwoods require intensive follow up for eight to ten years to control grass and weed competition. Rodent control is important.

- **It is not necessary to always plant in rows.** A variety of site appropriate species can be planted as scattered clumps of various sizes and spacing. Over time the empty spaces between the clumps will fill with natural regeneration, including seeds brought in by birds and mammals attracted by the planted trees. Consider including shrubs that are a favourite of wildlife, for example, nannyberry, dogwoods, and serviceberry.

- Understand the very significant need for **proper storage** of seedlings before planting and **tree handling** during planting. Seedlings must be kept cool and moist before they go into the ground. Many factors increase mortality by two to three percent or more, and also decrease growth – these factors will add up.

- **Follow up is essential.** If you have little or no time for follow up, plant a moderate number of conifer species, such as spruce.

- **Be aware of your time and physical limitations.**

The Landowner Resource Centre, in partnership with the Ontario Ministry of Natural Resources, publishes more than 50 Extension Notes on topics including tree planting, forests, agro-forestry, pests, water and wetlands, property management and wildlife. These Extension Notes are available online at: www.lrconline.com

Provincial and local agencies offer a number of tree planting programs, some with funding to reduce the landowner's expenses. To find out what is available in your area, contact your local Stewardship Council. Their contact information is listed in Appendix 2.

Plantation thinning

Plantations in the 30-40 year range should be evaluated for thinning. The size of the plantation may determine whether there is enough product to interest a buyer, who will look for at least three to four hectares. The first two thinning operations provide limited revenue, but are essential for continued forest health and revenue.

- The first thinning is usually scheduled when the average tree will provide a marketable product – usually 30 years or more in age for red pine, as an example.

- The first thinning is a row removal; this is necessary to create space to fell the trees and provide access for future harvests. One row is removed and, depending on a number of factors, either two or three rows are kept between the harvested rows.

- The second thinning is a selection of about 40 percent of the trees growing in the remaining rows, eight to 10 years after the first row thinning and generally leaving the highest quality trees for future growth.

- Natural regeneration usually starts to become established after the second thinning, when more sunlight reaches the ground.

Forest management planning

Whether your objective as a woodlot owner includes generating revenue, creating habitat, recreation or heating your home, you will benefit from a plan. Forest management planning is a process requiring an accurate forest inventory, with consideration to the landowner's short and long-term goals. A properly researched plan can meet multiple objectives and may even reduce your property tax bill.

First things first

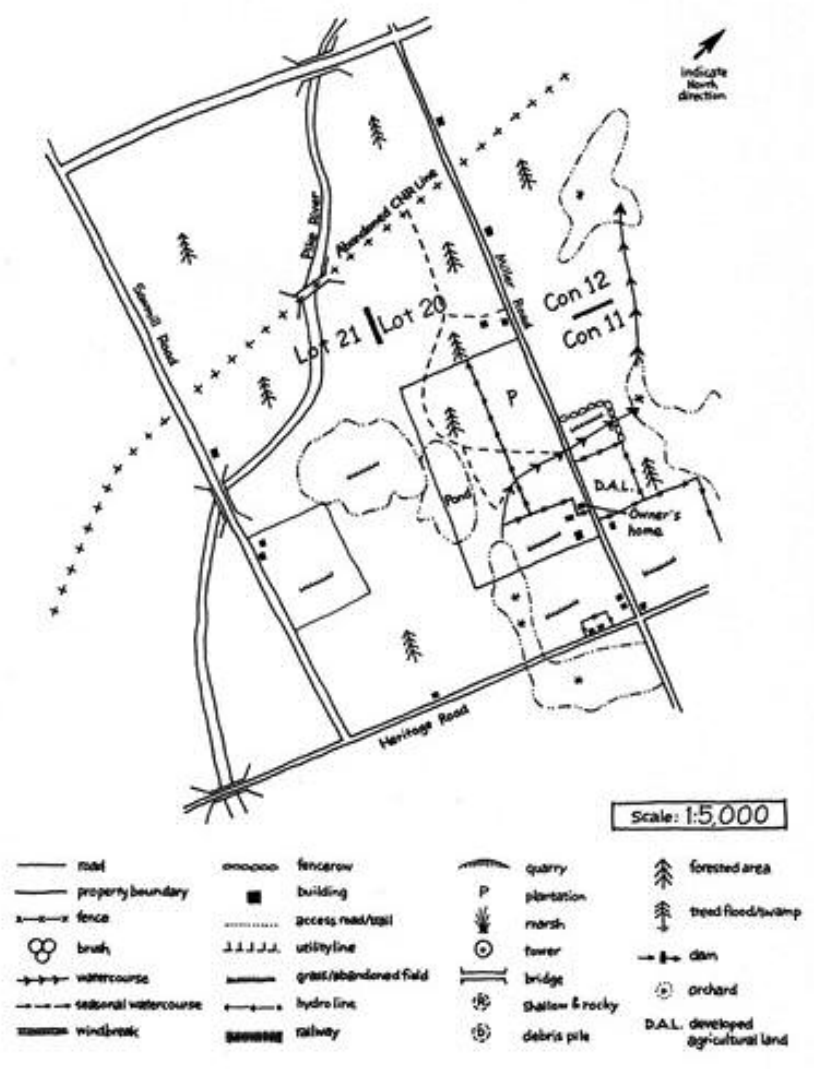
Get to know your property. Walk the trails and become familiar with the forest between the trails. You can view aerial photographs and make a natural heritage area map using the Make A Map: www.ontario.ca/page/make-natural-heritage-area-map. It will help you locate harder to find features such as small ponds, wetlands, or rock outcrops. Know how to use a compass or GPS (global positioning system). Exploring the remote areas in your forested property and discovering new features can be a great source of enjoyment.

Get to know and maintain property boundaries. Determine and mark approximate boundary location with ribbons if a fence is not in place. After agreement with your neighbour, you can construct a more permanent line by blazing poor quality boundary trees and painting the blazes. Maintain boundary markers as needed. Keep in mind that establishing a property line without an actual survey or remnants of an old fence can lead to conflict. However, a mutually agreed boundary may be a considerable distance from where it actually should be. You may wish to hire a professional surveyor.

Divide your property into separate compartments – those areas of your property with unique and definable features such as soils, tree species, and topography. A typical property could include a maple compartment, a plantation compartment, a cedar lowland compartment, a cattail marsh compartment, or a meadow compartment. Inventory each compartment separately. Physical compartment boundaries aren't necessary, but be aware when you travel from one to another. Create a property map that illustrates:

- Property boundaries.
- Compartment boundaries and descriptions.
- Aquatic features such as wetlands, springs, streams, ponds, and small lakes.

- Access and recreational trails, agricultural fields, and municipal roads.
- Features you feel are significant – hawk nests, small wildflower patches, major landforms, and fence lines.

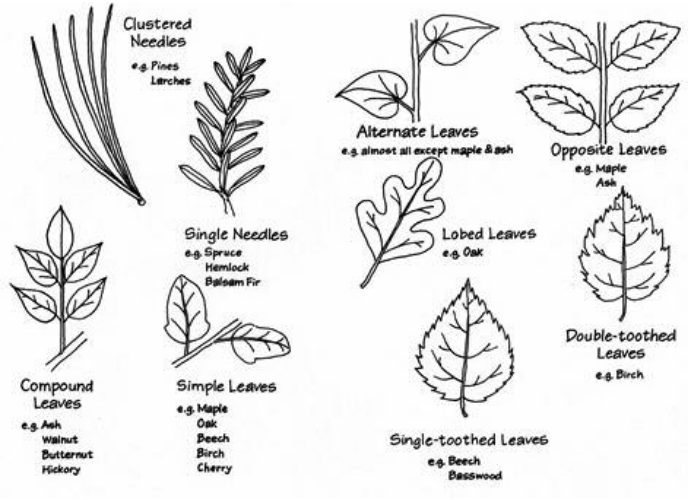


A property map illustrating compartments

Inventorying your compartments

Before making any woodlot management decisions you need to know what you have, for example tree species, age class and size. A woodland inventory is the first step in developing a plan. Then you can develop realistic objectives and schedule activities that contribute to your objectives.

Species identification is the basic skill needed, requiring training and regular practice. See the bibliography in Appendix 1 to learn about publications that can help you. Other learning opportunities include workshops offered by woodlot associations, naturalist clubs, stewardship councils and conservation authorities. Their contact information is listed in Appendix 2.



A landowner can do a basic inventory. A good description for conducting a woodlot inventory can be found in *The Woodlot Management Handbook*, pages 73-94[4]. The Ontario government handout: *A Guide to Stewardship Planning for Natural Areas*, provides basic outlines for inventories and developing a management plan. This guide is available at most Service Ontario centres, your local stewardship coordinator, or conservation authority.

Local field day events, referred to above, may provide an introduction to forest inventories and calculating tree density. Even with this information it's very possible for an inexperienced person to make a serious error. This can result in significant financial loss when quality timber is present, and compromise other personal objectives such as enhancing old growth characteristics, wildlife habitat and protecting sensitive areas.

4 *The Woodlot Management Handbook*, by Stewart Hilts and Peter Mitchell, published by Firefly Books Ltd., 1999. ISBN 1-55209-236-4

A comprehensive inventory requires knowledge of forestry science, an elementary understanding of 'what is happening' in your woodland, and includes an assessment of:

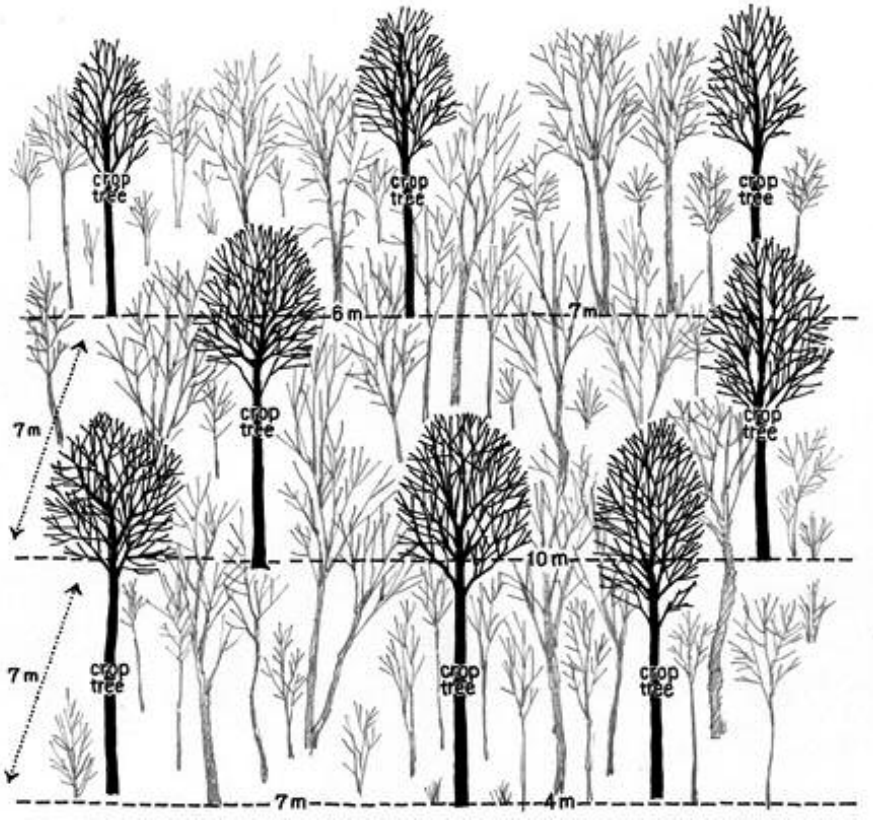
- Tree species and other significant plant communities.
- Tree density, quality and health.
- Site features – soil types, slope, sensitive areas and aquatic features.
- Natural regeneration.
- Wildlife habitats such as cavity trees, stick nests, mast trees, and wintering areas.
- Physical features – ridges, rocky outcrops, valley lands, access trails or roads, fences.

You may wish to consider hiring a forestry professional for a comprehensive inventory. Information on hiring a professional is available on page 31 of this handbook.

Habitat and forest heritage features

Some woodlot owners make it a priority to identify and improve different types of forest habitats. Take time to become familiar with your property in all seasons. Individual features have a way of showing themselves over several years. Enjoy this process of finding something new when you explore your property. Watch for:

- Large woody debris decaying on the ground which provides habitat for amphibians, a perch where ruffed grouse will sit to drum their wings, and a medium for beneficial fungi. These pieces of old rotting wood recycle nutrients and also trap pockets of moisture during droughts.
- Hawk and owl stick nests that are often used several years, from early March to late June. Harvesting firewood or maintaining trails during the nesting season can stress bird life, leading to nest abandonment.
- Isolated banks of sandy soil often used as den sites for foxes and other burrowing mammals, or perhaps cliff swallows.



A generalized illustration of crop tree spacing

- Old rock piles and stone fences which offer habitat for small mammals and reptiles.
- Forest interior; the part of the forest more than 100 metres from any edge or major trail.
- Isolated conifer thickets which offer valuable shelter for many species during extreme winter weather.
- Significant patches of wildflowers such as wild ladyslipper orchids.
- Sensitive areas – seeps, small streams, woodland pools, ravines, and steep slopes. Modify your harvest and plan trails accordingly in these areas.

Some woodlot features are so important the Ministry of Natural Resources has developed specific guidelines used in the Ontario Tree Marker Certification course. When present, these features include:

- **Cavity trees** - About 50 bird and mammal species depend on cavity trees, including primary users which make their own cavities. Try to keep six living cavity trees per hectare, preferably over 25 cm in diameter at chest height, with at least one larger than 40 cm. Cavities constructed by the pileated woodpecker, which typically pecks a large, rectangular hole, are a priority to retain. Small cavities such as songbird cavities in the upper crown may require binoculars to locate, especially when leaves are out.

- **Mast (fruit and nut) producing trees** - Where available, keep eight healthy, full crowned trees per hectare, at least 25 cm in diameter at breast height, and preferably over 40 cm. Oak and American beech stand out in late fall and early winter because they keep their leaves long after others have fallen. Bear claw marks on the bark of beech trees indicate good mast producing trees.

- **Standing dead trees** - Keep four to eight per hectare, the larger the better.

- **Super-canopy trees** are those trees, usually white pine, with crowns that rise well above the rest of the forest canopy. They provide unique nesting habitat for a number of species, including eagles and ospreys in locations next to lakes. Keep at least one per four hectares, if present.

- **'Veteran' trees** are large diameter trees with healthy dominant or co-dominant crowns. Keep 10 per hectare. These trees often produce genetically superior seed.

Generally speaking, try to retain **solitary hardwood trees** in conifer compartments and **solitary conifer trees** in hardwood compartments.

Are you cutting primarily dead trees and downed trees for firewood? Consider keeping these woody materials in your woodlot and cutting live trees to create more sunlight for mast-producing trees and accomplish another habitat goal - retaining deadwood to increase the amount of 'large woody debris'.

In the southern Ontario landscape, with our forest management history and fragmented woodlands, it is usually impossible to have all the desired features present in a small woodlot. Your management strategy could include some alternative approaches:

- Neighbouring property owners may have complementary forest types and sites, such as a maple upland next to a cedar lowland. Two or more landowners may agree to coordinate management activities for an overall landscape improvement.

- Plant trees to create forested travel corridors between these two habitats. Use stream and river valleys where possible. Enhance natural cover already present.

- Plan a series of management activities to produce desired results in the future. For example, you can speed up the growth of white pine to 'super-canopy' status by harvesting neighbouring trees to reduce crown competition.

Assessing trees and timber

Assessing trees and timber can be the most challenging aspect of the inventory for landowners. It requires the greatest knowledge of forest science, practices and forest harvest operations.

Determining tree density is a necessary and relatively complex process for determining appropriate management activities. It is meaningless to merely calculate the numbers of trees per hectare without the number relating to stem diameters, because fewer large trees than small trees grow in a given area.

The most common density measurement used by forestry practitioners involves the calculation of **basal area**. Basal area is the *measurement of the cross-sectional area of a tree stem measured at 1.3 metres above ground level, also know as 'diameter breast height' or DBH. This measurement is usually expressed in square metres per hectare.* Another way of illustrating basal area is to imagine cutting a hectare of trees at DBH and then measuring the surface area of each stump. The total surface area of all the stumps would be the basal area of that hectare. This process is described in the extension note, *Promoting a Healthy Forest Through Tree Marking*[5].

A basic forest management practice is to identify 'crop trees'. Crop trees are those small to medium diameter trees with high quality stems, which would benefit from more space for improved growth and health. The intent is to harvest these trees at a future time when their economic return is the greatest. Forest managers also refer to 'crop trees' as **Acceptable Growing Stock** (AGS). Trees with undesirable characteristics

5 *Promoting a Healthy Forest Through Tree Marking* is one of the series of Extension Notes prepared by the Ontario Ministry of Natural Resources and other partners. Individual notes can be purchased from the Landowner Resource Centre. Phone 613-692-3571 or 1-800-267-3504, extensions 12 or 1132. Notes are available in PDF form at: http://lrconline.com/Extension_Notes_English/pdf/tree_marking.pdf

are referred to as **Unacceptable Growing Stock** (UGS) and are candidates for early harvest, either during a commercial harvest or when a landowner is cutting an annual supply of firewood.

Desirable crop tree, or AGS, characteristics

- Full, healthy, dominant or co-dominant crowns with good leaf colour and minimal storm damage are primary indicators of health. One-third of the tree should be a healthy crown. **Always, always be looking up!**

- Straight, tall and defect-free stems, with less than 10 degrees lean from vertical.

- Forks which are 'U-shaped' are less prone to splitting, as opposed to 'V-shaped' forks.

- Trees free of diseases and pests, generally with no visible fungi or deforming cankers.

- Vigorous, tight bark that doesn't flake off easily.

- Hardwood trees should have no branches or dead branch stubs on the lower portion of their stems.

- Conifers should have small diameter branches growing horizontally from the stem and showing a tendency to 'self prune', or fall off on their own.

Undesirable tree, or UGS, characteristics

- Look for diseased trees showing fungi or deformed by cankers. Some diseases, detailed later in this handbook, can be quite contagious. These trees are the highest priority during a commercial harvest, be used for personal firewood, or cut and left on the ground as large woody debris.

- Poor crown condition: very small and flat showing excessive dead

branches, weather damage or general decline.

- Poor crown position, overtopped by neighbouring trees.
- Poor stem form with defects such as seams, large dead branch stubs, splitting, or major forks.
- Excessive lean, more than 10 degrees from vertical.
- Abnormal 'butt swell' in the bottom one to two metres of the stem.
- Poor bark which flakes off easily.
- Exposed roots.

Natural regeneration

A primary objective of forest harvest planning is to create appropriate conditions for natural regeneration to replace the trees removed:

- **Upland hardwood woodlands** regenerate readily to hard maple with the small crown openings created by a single tree selection harvest. Species such as black cherry, oaks, hickories, and conifers require more sunlight, and therefore larger crown openings – see below. These conditions can be created during a well planned harvest designed to address a landowner's long-term objectives.
- Regeneration in **pine plantations** will establish itself in the gaps created by initial row thinning and flourish after the later selective harvest in the remaining rows.
- **Lowland woodlands**, typically white cedar and fast-growing hardwoods, usually regenerate satisfactorily on their own, but have specific sunlight and other regeneration requirements. These sites are usually sensitive to damage, with careful planning being a necessity.

Size of forest openings required for various species

Creating openings in the forest crown provides benefits to regeneration. The landowner may choose to plant seedlings in the openings, to promote greater species variety. The range of sizes indicated below reflect how longer periods of shade are provided by taller trees, i.e. the taller the trees around a forest opening, the shorter the period of overhead sunlight. Smaller crown gaps may be preferable in smaller woodlots, where a large opening may be a little drastic, but will require maintenance every few years to maintain sunlight on certain species such as black cherry or hickory:

- Species requiring the **most sunlight** need circular openings with a diameter equal to one-and-a-half to two times the height of the surrounding forest. These species include aspens and poplars, white birch, red pine, jack pine and Scots pine, hickory, black cherry, silver maple, black ash.

- Species with a **mid range of tolerance to shade** require circular openings with a diameter of three-quarters to almost two times the height of the surrounding forest. These species include American basswood, oak, white ash, yellow birch, white pine, white spruce.

- Species with the **highest tolerance to shade** require circular openings of one half to one times the height of the surrounding forest, or the crown gap created by the harvest of 1 or 2 trees together. These species include American beech, sugar (or hard) maple, ironwood, hemlock and balsam fir.

Aerial view of a canopy gap. Small canopy gaps encourage tolerant species of trees, medium gaps encourage mid-tolerant species and large openings encourage intolerant species.

Assessing natural regeneration

When assessing your woodlot's compartments pay attention to natural regeneration. How you manage the seedlings and small saplings of today will have great impact on species composition in the future. The relative abundance of natural regeneration and its characteristics can tell you much about the density of the larger trees – too many or too few - and whether thinning is needed. Ask yourself:

- Is abundant regeneration present; what species is it? Do these species require lots of sun, or are they more tolerant of shade? Are these the species you want in your woodlot in the future?

- Does some direct overhead sunlight reach the forest floor for at least four to six hours per day? Requirements will depend on the species. For example, black cherry requires much more sunlight than sugar maple.

- What about health and vigor? Do individual seedlings or saplings have a strong leader with good growth and smooth, healthy appearing bark? This is an indication that enough sunlight is present.

- Does natural regeneration tend to exist as a carpet of small seedlings generally less than 30 to 40 cm in height, under a closed canopy, with few saplings or polewood? Or is regeneration present in a wide range of sizes?

- Are the larger seedlings or saplings already spreading their crowns at eight to 12 feet of height, or less? This indicates these saplings are receiving insufficient sunlight. Whether this is a concern or not depends on your stand structure. For instance, an abundance of small and intermediate crop trees in the immediate vicinity may indicate a greater priority on managing them than creating larger crown openings for natural regeneration.

- Underplanting, in forest openings, is an option for landowners who wish to maintain a variety of species in their woodlots.

Determining management options

Your management activities must be linked to what you find during your inventory. Consider your **broad, longer term objectives** and put them into words for each of your forest compartments. Suppose an

objective is to **increase the mast-producing red oak and black cherry in your woodlot**.

Next, define some **actions** that will help you achieve your objectives:

- Locate and identify healthy oak and cherry already present. If their crowns are getting pinched off, do a little thinning around these trees.
- Create crown openings in their vicinity to encourage natural regeneration or plant seedlings.
- Protect the seedlings with tree guards for the first six to eight years.
- Monitor and maintain suitable overhead sunlight for these juvenile trees on an ongoing basis.

Other objectives could include producing maple syrup, personal use firewood, an improvement cut to encourage faster growing crop trees, or a commercial, selective harvest. If your **objective** is managing for wildlife your **activities** could include putting up nesting boxes, creating brush piles, and encouraging the growth of mast trees.

> Black cherry is a hardwood tree of potentially high value that can grow to well over 20 inches in diameter and up to 100 feet tall. Its distinctive black, scaly bark resembles 'burned corn flakes'.

Thinning your woodlot when harvesting firewood

Proper thinning encourages your highest quality trees to grow faster, relieves stress from crowding, improves overall woodlot health, and provides opportunities for natural regeneration. It also provides a ready source of firewood. Here are some tips for harvesting firewood:

- Pick your crop trees, or Acceptable Growing Stock (AGS), and identify with a ribbon or small paint mark.
- Identify the poorest quality trees, or (Unacceptable Growing Stock) UGS.
- Looking up at the crown of your crop trees, identify the two or three UGS trees with crowns that are crowding against the crown of the

crop trees. Often the crop tree will have a flat crown on one or more sides; this shows which sides most urgently need room to grow.

- Harvest the UGS trees, or poorest AGS trees, to provide crown release for the crop trees. When you provide more room for the crowns, the same thing is happening under your feet in the rooting zone.

- In woodlots with a history of good management there are often too many crop trees; the woodlot owner needs to make careful decisions.

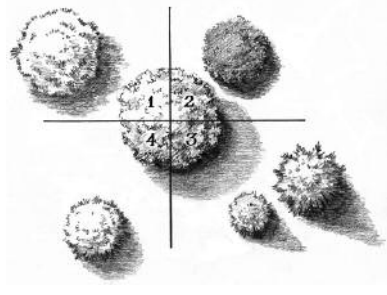
- Standing dead trees aren't competing with live trees. They do provide wildlife habitat - unless there's a safety concern, keep them.

- Before you decide to remove a tree, consider that it may have aesthetic or wildlife habitat value. For example some trees may have small cavities for nesting or feeding.

- Manage the highest quality tree on each site - don't always favour any one species that may be more valuable in today's market.

Which trees to remove

- Identify your most promising stems.



- Look into the crop tree crown and visualize four separate quarters.

- Evaluate these four quarters for competition from neighbouring trees and their crowns.

- A crop tree with a flat side due to competition, or less than a one metre space between its crown and the neighbouring tree, is having its growth reduced by the tree in that quarter.

- Try to provide at least two to three metres of growing space on at least two three sides of each crop tree.

A word of caution! When the average diameter at breast height in a compartment reaches 25 cm, the trees have grown to a size when valuable sawlog products may be present. At this stage, it is probably a

good idea to have a professional look at your woodlot. Even UGS trees often contain high grade log materials that can provide revenue worth more than firewood.

Crop tree management is explained in *Managing Young Hardwood Stands for Sawlog Production*, one of the Extension Note[6] series developed by the Ontario Ministry of Natural Resources. Other materials listed in Appendix 1 also provide information on managing crop trees.

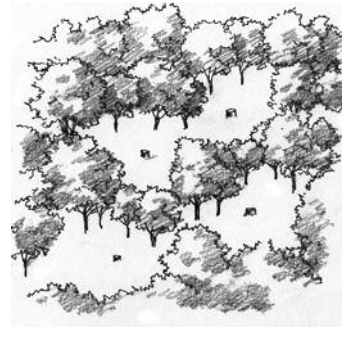
Forest harvest systems

A planned forest harvest can provide an income and accomplish several management objectives. When harvesting is an option, several systems can be considered to be 'good forestry practice'. The best option depends on the forest type, management history, landowner objectives, and other factors determined by the inventory. The 'single tree selection' and 'group tree selection' are the forest harvest systems most commonly used in southern Ontario woodlots. **Beware of any buyer who advocates a "diameter limit" harvest.** This is basically a harvest of all good trees over a certain diameter, usually retaining all large diameter trees of poor quality, with no management of smaller diameter crop trees.

Single tree selection

This system allows for the periodic harvest of mature and defective stems, primarily in upland hardwood forests - maple, beech, ash, and oak. The purpose is to encourage and maintain a distribution of trees of varying ages, providing a crop of mature timber every 12 to 18 years.

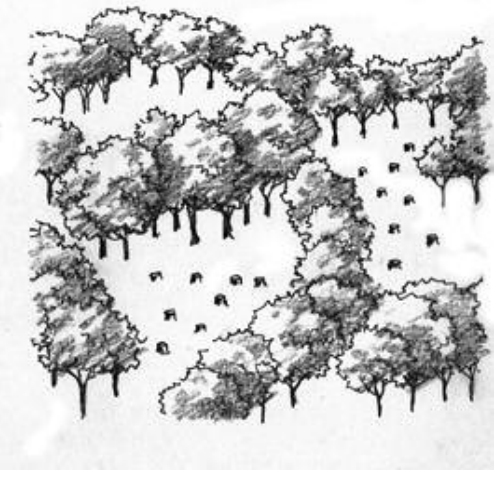
- This system works best where an 'all-aged' or 'uneven-aged' structure is present, with an adequate to good representation of 'pole wood', small, medium and large diameter trees.



6 *Managing Young Hardwood Stands for Sawlog Production* is one of the series of Extension Notes prepared by the Ontario Ministry of Natural Resources and other partners. Individual notes can be purchased from the Landowner Resource Centre. Phone 613-692-3571 or 1-800-267-3504, extensions 12 or 1132. Notes are available in PDF form at: http://lrconline.com/Extension_Notes_English/pdf/swlg.pdf

- Generally, mature crop (or AGS) trees and defective trees of all sizes are selected for harvest, with about one-third of the stems being harvested in each cycle.
- After one to two harvest cycles, 12 to 18 years apart, the average stem quality is usually much improved, depending on management history and site productivity.
- Crop trees for future harvests receive regular crown release.
- Small crown openings are created to promote natural regeneration.
- Habitat and other forest values are considered during marking and harvest operations.

Group tree selection



This harvest system is a variation of - and usually used in conjunction with - single tree selection. Small groups of mature AGS, unhealthy or other UGS trees are removed to create larger openings for regeneration of species that require significant sunlight – oak, white pine, black cherry, hickory, white ash or basswood. Under the right circumstances, this can also be a management technique for white cedar.

The objective is to create scattered crown openings with a diameter of three-quarters to one-and-a-half times the height of the crown. These openings are typically 30 metres across.

This system is best used where timber is either over mature or of poor quality, and a primary objective is to create opportunities for natural regeneration of timber with future value.

Planning for a harvest and selling timber

Income from a high quality hardwood woodlot or pine plantation can be in the tens of thousands of dollars, with additional benefits such as increasing the value of trees managed for future harvests and other values such as appearance, wildlife habitat and recreation. Unfortunately, too many landowners rely on a buyer to tell them the product's value, mark boundary lines, determine trail location, select the trees for harvest, and even provide the sales contract. **Think about this for a minute** and consider the following points:

- Will your interests be fully protected if the buyer is also your forest manager?
- Should you trust one buyer to tell you what your product is worth and what volume he has harvested?
- Would you run any other business that way?

Most landowners who own their property for a lifetime will sell timber only two to three times – it is impossible to become an expert. *A Landowner's Guide to Selling Standing Timber*[7] provides important information. Here are some tips from that handbook:

- Determine whether your woodlot is actually ready for a harvest.
- If you are not sure what products are in your woodlot, or the difference between a veneer log, a lumber log or fuelwood, or their values, get advice from an unbiased third party.
- Whether you are harvesting for revenue or other objectives, you will benefit from planning.
- Mark the trees you intend to have harvested. You can only compare bids from buyers if you advertise a specific number of marked trees.
- Get more than one bid, preferably three or more.
- Ask for and contact references. If possible, have a look at woodlots previously harvested by any logger you are considering.

7 *A Landowner's Guide to Selling Standing Timber.* To purchase a copy, go to the Ontario Woodlot Association website at www.ontariowoodlot.com or call (613) 713-1525

- Have a contract that protects your interest. Many buyers have their own contract, but these often offer you little protection. A sample contract is provided in the *A Landowner's Guide to Selling Standing Timber*.

- Show interest in the harvest and express any concerns immediately. Good operators want to hear what you are thinking and will address your concerns.

- Consider hiring a forestry professional. The relatively small sum you pay to have an expert working on your behalf could be repaid many times by helping to ensure a fair price for your timber and that your woodlot is left in good condition after the harvest.

Where to find help

The Professional Foresters Act legislates that a person practicing most forest management activities must be a member of the Ontario Professional Foresters Association. Visit their website at www.opfa.ca to find a listing of local consultants.

For other lists of service providers, visit the website of either the Ontario Woodlot Association at www.ontariowoodlot.com or Forests Ontario at www.forestsontario.ca and look for the appropriate link. Each of the two associations offer membership opportunities and provide certain services. The Ontario Forestry Association works primarily at a provincial level, offering a listing of marked woodlots in their marked woodlots in their newsletter. The Ontario Woodlot Association has local Woodlot chapters and has a web-based Forest Services Directory.

Tips on hiring a forest manager

- Select a forest manager as you would any other service.

- Call two or three who provide services in your area.

- Some practitioners are more experienced with management planning, tree marking and selling timber, while others are more expert in woodland plants or enhancing wildlife habitat. Know what service you require. Find a person with expertise suited to your objectives?

- How many years field experience does the forest manager have? Is their experience in your general geographic area, or elsewhere?

- Does he or she carry professional liability insurance?
- Get quotes; prices can vary considerably.

Forest conservation by-laws

Forest conservation bylaws now regulate commercial forest operations in many southern Ontario municipalities. These bylaws are intended to achieve municipal official plan objectives of sustaining a healthy natural environment, while regulating forest harvests according to good forestry practices. They also provide a certain measure of protection to the landowner. Here's what a landowner should know:

- Good forestry practices must be demonstrated, according to local by-law requirements.
- For any type of commercial harvest, the municipality usually requires that a 'notice of intent' be filed, usually for a specific period of time before any harvest activity. In some cases the buyer is responsible for signing the document, while in others it is the landowner, or it could be both.
- A notice of intent may not be required for harvests of strictly personal use materials, such as firewood or cedar posts.
- If you are not sure, contact your local municipal office.

The Managed Forest Tax Incentive Program – MFTIP

Rural landowners whose forested land is not assessed as agricultural land can enjoy a tax reduction for having a management plan. The forested area must be four hectares or greater, not counting about half a hectare that must be deducted for a residence.

MFTIP is a voluntary program. To be eligible, landowners must prepare a managed forest plan; have it approved by a certified managed forest plan approver and commit to good forest stewardship. For more information about this program visit: Ontario.ca/MFTIP

Forest health

Several thousand species of insects and diseases attack woody plants in Ontario. During the growing season, all trees and shrubs experience a certain level of infestation and, in some cases, minor damage. The few attacks that threaten tree health usually occur infrequently in localized outbreaks of short duration. Monitoring forest health and knowing a little about specific insect and tree disease and fungi pests is an important part of your inventory or annual inspection. Two excellent sources of information that detail identification and controls are the Canadian Forest Service's website on insects and diseases at https://tidcf.nrcan.gc.ca/en/home and the handbook *Common Pests of Trees in Ontario* by B. H. McGauley and C. S. Kirby[8].

The introduction of non-native insect pests and tree diseases to North America is an unfortunate trend. Our native trees have no natural resistance to these diseases, and introduced insect pests face few natural enemies. Some insects and diseases can devastate certain tree species, causing significant economic hardship and ecosystem damage. The Government of Canada maintains a website at www.exoticpests.gc.ca that provides up-to-date information on introduced forest pests. The Canadian Food Inspection Agency also plays an important role in protecting Canada's plant resource base from the introduction of alien insects and diseases.[9]

Tree insects

Tree insects can be categorized into five main groups: those that **eat leaves, borers** that tunnel into stems and branches, **sucking** insects and mites, **gall-makers** (insects that cause plants to produce abnormal growths) and **root-feeders**.

Most insects are native to our woodlands, with populations cycling from low to high over several years. After building for two to three years, high populations tend to collapse with the rise in natural controls that follows. **Control measures by the landowner** are rarely necessary, especially with native insect pests, although some situations should be watched closely. Here are a few common examples – native and introduced:

8 *Common Pests of Trees in Ontario*, B. H. McGauley and C. S. Kirby. ISBN 0-7743-9439-0. This comprehensive handbook is available for download
Location: https://www.svca.on.ca/downloads/Common_Pests_of_Ontario_s_Trees.pdf

9 Canadian Food Inspection Agency, Government of Canada. For more plant pest information, go to: www.inspection.gc.ca

- **White pine weevil:** This native insect is a serious pest of young white pine, jack pine and Norway spruce, disfiguring small trees and significantly reducing commercial values. The most effective control involves the **pruning and destruction** of infested leaders as soon as wilting of the shoot tip is detected. This wilting indicates an active larvae under the bark. This usually coincides with the ripening of wild raspberries around mid-July. The loss of the leading shoot will cause some disfiguration but pruning for tree form can be undertaken in the following years.

- **Sawfly family:** These pests, mostly native, are a family of serious defoliators of conifer trees and plantations, appearing as colonies of caterpillars that can kill trees. Plantations should be inspected periodically in early to mid summer. These insects are hard to find initially but as they grow in size they quickly start to devour large quantities of needles. Control measures include direct spray of an insecticide to the colonies, and even wearing a rubber glove and crushing them by hand.

- **Forest tent caterpillar and Eastern tent caterpillar:** These two native caterpillars are major leaf defoliators with population cycles every eight to 15 years. Natural controls reduce the population two to three years after it starts to build. **The forest tent caterpillar** infests large forest trees such as maple, oak and poplar, and feeds only in the crown – **it doesn't build a tent**. **The eastern tent caterpillar** builds a tent and generally feeds on smaller trees and shrubs in colonies. **Do not burn off the tents** as it often causes more tree damage.

- **Gypsy moth:** This non-native (introduced) caterpillar-type pest can now be considered to be naturalized. It goes through cycles of outbreaks and natural control much like the tent caterpillar. It overwinters as spongy tan-coloured egg masses attached to trunks and branches of trees or forest debris.

- **Other** non-native **insects of note:** A number of non-native (introduced) insect species threaten the integrity and diversity of Ontario's woodlands. Consult your local stewardship council, conservation authority or the internet to learn more about the **emerald ash borer,** the **Asian longhorned beetle,** the **brown spruce longhorned beetle**, and the **sirex woodwasp**.

Tree diseases

Tree diseases can be devastating. Some native tree species have been reduced to remnant populations by non-native diseases. Landowners are encouraged to retain healthy trees of species such as American beech, elm and butternut – they may have a genetic resistance to these introduced diseases. Programs are being developed for seed collection and re-establishment of resistant seedlings to other Ontario woodlots.

Here are a few common examples – native and introduced:

- **Chestnut blight:** This blight was introduced into North America in the early 1900s from Europe. The American chestnut, a significant widespread tree in eastern North America at the time of settlement, has become a rarity over the last century.

- **White pine blister rust:** This disease was introduced from Europe in the early 1900s. It is one of the most important forest diseases in North America and has significantly decreased reforestation of white pine, despite the species' considerable commercial value.

- **Dutch elm disease:** Another disease introduced from Europe in the mid-1900s that has decimated another significant tree species, the white, or American elm.

- **Beech bark disease:** This disease results from the combined action of the beech scale insect, introduced to North America in the 1800s, and a pathogenic fungus, *Nectria coccinea*. Beech, once common and a very important wildlife tree is now threatened throughout its range.

- **Butternut canker:** This exotic species was first reported in Canada, in Ontario, in 1991. Butternut is now on the endangered species list.

- **Eutypella canker:** This is a native disease that forms large cankers on the stems of hardwood trees such as hard maple. Although it is not usually fatal to large trees, it is contagious and reduces the volume of merchantable material. Trees showing these symptoms should be removed during any commercial or firewood harvest.

- **Nectria canker:** This native canker disease of hardwood tree stems is similar to the *Eutypella*, and infected trees should be removed during any harvest. After it has been growing for a few years a distinctive target-shaped scar appears in its centre.

- **Root rots:** Several native root rots are generally present in the soil. Although not usually the primary cause of tree mortality, these fungi are quick to attack the roots of trees weakened by serious insect attack, overcrowding, or drought.

Other factors

A number of other factors can impact woodland health:

- **Fire:** Although many consider fire only to be a primary threat in areas of continuous forests, some local situations can cause concern. For instance, residences built within forested areas such as the old Scots pine and other conifer plantations can be susceptible. Often conifer plantations are located beside grassy roadsides or may be surrounded by old pasture fields. These areas become very combustible when the grass is dead in early spring. A practical method of reducing this hazard is to maintain a fire break with a cultivated strip at least three to four metres wide between any grassy area and the forest. Consider purchasing a backpack container that holds water and sprays with an attached trombone-type hand pump. Keep it filled and handy.

- **Red pine decline:** Red pine has been commonly planted on private land over the last 60 to 80 years, often on less than ideal sites and not appropriately thinned. Stressed red pine becomes susceptible to root diseases, insect pests, drought, and nutrient deficiencies, often resulting in large scale mortality in a very short period of time.

- **Grazing:** Cattle grazing in wooded areas can impact forest health. Livestock browse on young trees, compact the soil with their hooves, and can cause root damage.

- **Overabundant wildlife:** Changes in land use, combined with winter climate patterns have changed wildlife populations. Greater numbers of deer over-browse saplings and high turkey populations may be over-consuming mast crops, reducing oak and cherry regeneration.

- **Climate change:** Global climate changes are expected to impact our woodlands with warmer temperatures and changing rainfall in the coming decades. This could result in large shifts in vegetation distribution. For instance, some forests may become grassland vegetation communities which will survive with less rainfall. Forest zones are expected to shift north as the climate warms. More immediately, our woodlands may show symptoms of poor health with no apparent reason. The best we can do is

manage for forest health by regularly thinning to reduce excessive competition, removing diseased trees, maintaining a diversity of species, and restricting livestock from woodlands.

- **Invasive plants:** Invasive plants are now well established in our southern Ontario forest ecosystems and natural areas. An invasive species is one that has been moved from its native habitat, usually another continent, to a new area, often for gardening or other domestic uses. Occasionally a plant escapes and reproduces so aggressively in its new environment, without the natural controls of its native environment, that it displaces native species. Purple loosestrife, which invades wetland areas, is a well-known example.

Invasive plants

Some particularly persistent plant species now well established in Ontario woodlands include **buckthorn, dog-strangling vine, garlic mustard**, and **Norway maple** with its many cultivars. These plants can displace native plants such as trilliums and ferns, while smothering the natural regeneration of forest trees. Some of these plants may also have allelopathic qualities, i.e. they discourage other plants from growing nearby. For example garlic mustard is thought to produce chemicals that interfere with the interaction of roots and soil fungi that facilitate the absorption of nutrients and water by native trees and plants.

Controlling invasive plants is a daunting task. A critical first step is for landowners to identify invasive plants and take early action before a plant becomes established. Adjacent roadsides and access trails are often the site of the first infestation. Regular reconnaissance is necessary, with hand control possible when small, isolated hotspots are discovered. Herbicide application is often necessary and can become the only option to control certain species. To elaborate on control methods is beyond the scope of this guide, and much information is available online.

Beware of buying plants for your garden that are advertised to 'grow with little care anywhere'.

Access and recreational trails

Proper trail location is important, especially when your forest property has steep slopes, fragile soils, aquatic features, or perhaps even sensitive habitats. Trail work can be a conservation project that provides both access and environmental protection. Stone or timber steps can both provide

easier climbing on steep slopes and prevent erosion. Small wooden plank culverts or stony passage ways, strategically placed to cross your trail in depressions, can effectively maintain natural drainage patterns. Constructing narrow hiking trails that skirt steep slopes, boggy areas and wild flower patches may discourage or minimize damage from trespassing all-terrain vehicle users. Trail construction and maintenance are specialized projects requiring thought and care. Improper trail construction, such as using a bulldozer without proper supervision, can result in considerable loss of timber values and damage sensitive areas. The Appalachian Mountain Club provides an excellent guide to trail work.[10]

In conclusion

Informed and concerned private landowners have a crucial role to play as our woodlands and other natural environments face challenges including climate change, invasive species, pollution, and fragmentation due to human activities. Understanding how your woodland functions, and managing it accordingly, can be a lifetime learning experience offering many rewards. Well-managed woodlands provide great wildlife and recreational benefits, may generate unexpected income, and will be a part of your own personal legacy. Taking the time to become informed and build a personal network with other forest owners and organizations can help with the education process, and introduce you to like-minded landowners and local support.

10 *The Complete Guide to Trail Building and Maintenance, 3rd edition*. Carl Demorrow and David Salisbury. ISBN 1-878239-54-6. Published by the Appalachian Mountain Club.

Appendix 1 – List of Sources of Information

Tree Identification

Trees in Canada; by John Laird Farrar, published by Fitzhenry & Whiteside Limited and the Canadian Forest Service, Natural Resources Canada, in cooperation with the Canada Communication Group – Publishing, Supply and Services Canada, 1995. ISBN 1-55041-199-3.

A Pocket Guide to Ontario Trees & Some Woodland Plants by Stew Hilts, University of Guelph, 1997, ISBN 0-88955-456-0. To obtain a copy, contact the Ontario Forestry Association
Tel. 416-493-4565 or Ontario Nature
Tel. 416-444-8419 or 1-800-440-2366.

Extension Notes

The Landowner Resource Centre, in partnership with the Ontario Ministry of Natural Resources, publishes more than 50 Extension Notes on topics including tree planting, forests, agro-forestry, pests, water and wetlands, property management and wildlife. These Extension Notes are available online at: http://www.lrconline.com

Woodlot Management

Crop Tree Management in Eastern Hardwoods, by A. Perkey and B. Wilkins, published by U.S. Dept. of Agriculture, Forest Service, #NA-TP-19-93
To view a copy, go to the Forest Service Federal website at:
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1412415&ext=pdf

The Woodlot Management Handbook, by Stewart Hilts and Peter Mitchell, published by Firefly Books Ltd., 1999. ISBN 1-55209-236-4

Building a Case for Sustainable Management of Private Woodlands: Ontario Woodlot Association.
https://www.huronstewardship.ca/projects/trees-forestry/private-woodlands/

A True Picture: Taking Inventory of Your Woodlot, Published by Eastern Ontario Model Forest, 1997, ISBN 1-896392-48-2. https://www.eomf.on.ca/media/k2/attachments/A_True_Picture.pdf

Woodlot Harvesting

A Landowner's Guide to Careful Logging
To obtain a copy, visit - https://www.ontariowoodlot.com/publications-and-links/owa-publications/landowner-guides/a-landowner-s-guide-to-careful-logging

Forest Insect & Disease Pests

Common Pests of Trees in Ontario, B. H. McGauley and C.S. Kirby. ISBN 0-7743-9439-0. This comprehensive handbook is available for download.
Location:
https://www.svca.on.ca/downloads/Common_Pests_of_Ontario_s_Trees.pdf

Canadian Food Inspection Agency, Government of Canada. For more plant pest information, go to: www.inspection.gc.ca

Forest Recreation & Wildlife

The Complete Guide to Trail Building and Maintenance, 3rd edition. Carl Demorrow and David Salisbury. ISBN 1-878239-54-6. Published by the Appalachian Mountain Club.

Appendix 2 – List of Local and Provincial Contacts

Government

Canadian Forestry Service Great Lakes Forestry Centre
1219 Queen Street East
Sault Ste Marie, ON P6A 2E5
Tel. (705) 949-9461
Fax (705) 759-5700
Website: https://www.nrcan.gc.ca/science-and-data/research-centres-and-labs/forestry-research-centres/great-lakes-forestry-centre/13459

Managed Forest Tax Incentive Program (MFTIP)
300 Water Street, P.O. Box 7000
Peterborough, ON K9J 8M5
Tel: 1-800-667-1940
Email: MFTIP@ontario.ca
Website: Ontario.ca/MFTIP

Ministry of Natural Resources and Forestry
300 Water Street, P.O. Box 7000
Peterborough, ON K9J 8M5
Tel. (705) 755-2001
Fax (705) 755-3125
Website: Ontario.ca/mnrf

Conservation Land Tax Incentive Program Ministry of Natural Resources and Forestry
300 Water Street,
Peterborough, ON K9J 8M5
Tel. 1-800-263-3237
Website: Ontario.ca/cltip

Non-Government Organizations

Forest Gene Conservation Association
275 County Rd. 44
Kemptville, ON K0G 1J0
Tel. (705) 755-3284
Fax (705) 755-3292
Email: barb.boysen@ontario.ca
Website: www.fgca.net
Contact: Barb Boysen

Oak Ridges Moraine Foundation
112A Dupont St.
Toronto, ON, M5R 1V2
Tel. (905) 833-5733
Website: www.moraineforlife.org

Forests Ontario
144 Front Street, Suite 700
Toronto, ON M5J 2L7
Tel: 1-877-646-1193
Email: info@forestsontario.ca
Website: www.forestsontario.ca

Ontario Professional Foresters Association
5 Wesleyan St, #201
Georgetown, ON L7G 2E2
Tel: 1-905-877-3679
Email: opfa@opfa.ca
Website: www.opfa.ca

Ontario Nature
214 King Street West, Suite 612
Toronto ON, M5H 3S6
Tel. (416) 444-8419 or 1-800-440-2366
Fax (416) 444-9866
Email: info@ontarionature.org
Website: www.ontarionature.org

Ontario Woodlot Association
10 Campus Dr., Unit 4
Kemptville, ON K0G 1J0
Tel. (613) 713-1525 or 1-888-791-1103
Fax (613) 258-0207
Email: info@ontariowoodlot.com
Website: www.ontariowoodlot.com

Forest Invasives Canada
Developed by the Invasive Species Centre
Website: forestinvasives.ca

Durham Sustain Ability
126 Water St. Unit 3 (2nd Floor)
Port Perry, ON, L9L 1B9
Tel: 905.985.3279
Email: info@sustain-ability.ca
Website: http://sustain-ability.ca

Peterborough County Stewardship
Peterborough, ON
Email:
peterboroughcountystewardship@gmail.com
www.peterboroughcountystewardship.org

Land Stewardship Publications

Centre for Land and Water Stewardship
Richards Building, University of Guelph
Guelph, ON N1G 2W1
Tel. (519) 824-4120 ext.8329
Email: rcorry@uoguelph.ca

Landowner Resource Centre
3889 Rideau Valley Dr. P.O. Box 599 Manotick ON K4M 1A5
Tel. (613) 692-3571 or 1-800-267-3504
Fax (613) 692-0831
Email: info@lrconline.com
Website: www.lrconline.com

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