Haldimand County Forest Strategy

Prepared for Haldimand County

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By

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EXECUTIVE SUMMARY

In March 2015 County Council adopted a staff report "To seek Council's approval for staff to further research tree management best practices across Haldimand County and report back with a proposed strategy." In the report Council recognized that there should be a County-wide strategy to deal with all tree-related issues on County-owned land.

This Forest Strategy and Management Plan will help set the direction for Haldimand County to understand more about its urban and rural forest, the environmental benefits it provides and the community's interests; to develop an infrastructure to help maintain and improve the trees and forest; and to develop methods to monitor, maintain and regenerate the forest owned and/or managed by Haldimand County. This includes publically-owned forest on urban streets, parks, cemeteries, and rural roads. In this context the forest refers to the trees, forests, greenspace and related abiotic, biotic and cultural components in areas extending from the urban core to the rural fringe. The strategy covers a five-year period from 2017 to 2021.

The urban forest is a key element of green infrastructure. Without healthy trees and forests, Haldimand County would not achieve its vision of environmental integrity, social wellbeing and economic vibrancy as laid out in its Strategic Direction and Official Plan.

The Forest Strategy includes a vision statement, guiding principles and goals. It provides information on current regulatory and operational situations in Haldimand County, forest benefits, management concerns and public consultation. The Forest Management Plan provides direction on establishing infrastructure management of the forest.

A Vision Statement reflects the desired outcomes of successful implementation of the Management plan. It was developed in consultation with the Forest Strategy and Management Working Committee and community to meet the needs of the County for County-owned trees and forests.

> **Haldimand County, being committed to preserving our natural beauty, values and is dedicated to protecting and managing its urban and rural forest, for the environmental, economic, community and health benefits these forests provide to its residents.**

> **Haldimand County will, in partnership with its residents, businesses and stakeholders work to promote and increase urban forest coverage that is a diverse, healthy and sustained asset for future generations.**

Guiding principles are intended to guide the development of the Management Plan and implementation of the plan. These statements represent best practices in the urban and rural forest in Haldimand County. Based on the guiding principles, Haldimand County will work towards a series of goals through the implementation of the management plans. Details of guiding principles and goals are found in Section 2.

Haldimand County is a rural county with a number of small towns and villages. There are numerous parks and cemeteries and over 1,500 km of roads. Background information and context about Haldimand

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County are found in Section 3.1. The Haldimand Official Plan (OP) has no explicit support or policy for managing the County-owned forest. There are numerous by-laws and provincial legislation that effect forests and trees in the County. The existing regulatory environment regarding the forest of the County is described Section 3.2. Management of County trees and forests is under the jurisdiction of several departments. There is no full time dedicated staff to tree/urban forest issues. There is currently a backlog of work orders. Information on existing tree related initiatives and tree management occurring in the County is described Section 3.3.

The benefits of the urban forest are widely recognized and documented. Trees in urban areas provide important economic, environmental, community and human health benefits. The community's trees will need to be managed in order to maintain this stream of benefits which are critical to the community's economic well-being and overall quality of life. **Unlike traditional municipal infrastructure such as transportation systems that depreciate, green infrastructure accrues in value and provides greater benefits to the community as time passes.**

Dealing with the urban forest is not without its challenges. There are a number of factors that can adversely affect the management and overall health of the County's trees and forests and these should be factored into the decision-making process when establishing forest policies. Most important among these are lack of policy protection to manage the forest, competition with built infrastructure, ensuring the right tree is planted in the right place, and the effects of pests, pathogens and climate change. Section 3.4 describes benefits of the urban forest and threats and challenges to it.

A Forest Strategy and Management Plan can be effective tools to ensure that municipal resources are efficiently directed, efforts are coordinated and cooperative and existing and potential partnerships are leveraged.

County trees are the citizens' trees and many residents will be compelled to comment on and otherwise advise how County-owned trees are managed. The development of the Forest Strategy and Management Plan included public comment opportunities on this strategy and the subsequent plan.

A public presentation was scheduled for citizens to hear about and comment on the development of the draft Forest Strategy and Management Plan outline. The presentation was also meant to develop community interest about the forest to see how the community can be involved in protecting and building the County's trees and forests. Although the presentations were not about the privately owned trees, ideas for engaging and educating the public are further outlined in the Management Plan. Section 4.0 explains the community involvement process for commenting on the Forest Strategy and Management Plan.

Adequate efforts were made to inform and receive input from the public throughout the vision, guiding principles and goals development. A survey was developed and was available on-line to obtain feedback regarding the draft vision, guiding principles and goals along with the content outline for the management plan. Overall public feedback was positive.

A sample inventory was done that included street, cemetery and park trees in Caledonia, Cayuga, Dunnville, Hagersville and Jarvis. Nearly 1,530 trees were surveyed to provide a reasonable indication of

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the urban forest population. The surveys indicated that silver maple is the most common species (20% - primarily on streets), followed by Norway spruce (11% - most in parks & cemeteries), Norway maple (11 %) and Ash (9%, mostly in parks). Silver maple also had the highest number of large trees, most with maintenance needs. Silver maple has the most conflict with public utilities and because there are many large trees there are more maintenance requirements. Maintenance needs are high particularly on street trees. The ash component will drop out within the next few years as ash are removed due to Emerald Ash Borer. Removal of ash in areas of high concentration will result in a number of potential planting areas. Although 56 species were identified, there is potential to plant other species. Preliminary information on the tree inventory sample is found in Section 5.0.

A set of criteria and indicators are included to provide a baseline indication of Haldimand County's forest. They should be used to measure, monitor and evaluate the implementation of the Management Plan at the end of each 5- year period.

A Management Plan will be developed as part of the next phase.
It is clear from the inventory that:
- there are a large number of hazard trees where maintenance is required,
- there is a low diversity of tree species,
- a large number of trees will be removed due to Emerald Ash Borer infestation.

The Inventory should be completed for all County-owned trees along roads and in cemeteries and parks.

The County must develop policy, regulation, and guidelines to:
- support efforts in improving tree health, and reducing tree hazards,
- protect trees during construction and development,
- support tree establishment in the correct locations,
- deal with the large number of dying ash,
- deal with the waste wood resulting from tree removals.

The County must work with citizens and other partners to improve tree cover in the County.

ACKNOWLEDGEMENTS

PREFACE

Haldimand County engaged Williams & Associates, Forestry Consulting Ltd. to develop a Forest Strategy with vision, guiding principles and goals which direct development of the Management Plan. The Plan will include recommendations for a real-time inventory, maintenance standards, address Emerald Ash Borer (EAB) mitigation, and opportunities for revenue and replanting. The project was guided by a Working Committee consisting of staff from county departments and other agencies involved in managing the County forest.

The project started by developing an understanding of the infrastructure involved in managing Haldimand forest assets. A sample urban tree inventory was conducted at selected locations in five urban centres to characterize trees in the urban forest. This was done to assess tree condition and maintenance needs, and as input when developing recommended management strategies and infrastructure to provide for a productive and safe forest. This improved understanding of the existing urban forest will help the county move forward in developing the infrastructure and practices to keep its urban forest healthy and better deal with forest health problems such as EAB. The understanding of the forest also assists with risk management.

The sample inventories and discussions with the Forest Strategy and Management Plan Working Committee provided the baseline information/assessment of current status to start the process of developing of a Forest Strategy, and Management Plan. Williams & Associates assessed current practices and policies through the Working Committee as the project proceeded. This process identified financial, staff and equipment needs, budgets and schedules appropriate for the Haldimand County and its resources.

1.0 STRATEGY

Haldimand County has the responsibility of managing trees on its own lands, ensuring public safety, and maintaining the urban and rural forest for the health of the forest and residents of the County. There are many values that forests and trees contribute in urban and rural environments, including: community health and aesthetics; shade, shelter and energy savings; environmental quality and wildlife habitat; and ameliorating climate change by improving carbon cycles and reducing fuel consumption. On County lands. A high priority in the County is maintaining the health and safety of trees in public-use areas such as roadsides, cemeteries and developed parks. Safety concerns with trees in County-owned woodlands that are along trails and near property lines adjoining developed private properties are also important. Haldimand County, like many Ontario municipalities, is dealing with Emerald Ash Borer (EAB) which is killing ash that have not been protected with pesticides. EAB-induced changes in urban forests and woodlands are forcing municipalities to revise their forest management plans.

This project is divided into two parts; 1) Forest Strategy and 2) Management Plan. The Strategy provides purpose, definition, rational, vision, guiding principles, and goals, current regulatory and operational situation and public consultation. The Management Plan, in a separate document, details action items for the strategies to support the forest, including developing policies and procedures, results of tree inventory, an Emerald Ash Borer plan, and identifies the necessary resources and suggested timelines to see the Management Plan implemented.

1.1 DEFINING THE URBAN FOREST

Urban forestry was first defined by Eric Jorgensen at University of Toronto in the early 1970's. He defined urban forestry as "… a specialized branch of forestry and has as its objectives the cultivation and management of trees for their present and potential contribution to the physiological, sociological and economic well-being of urban society. These contributions include the over-all ameliorating effect of trees on their environment, as well as their recreational and general amenity value."

In the first Canadian Urban Forest Conference (Deneke, 1993) expanded on the term: "Urban forestry is the sustained planning, planting, protection, maintenance, and care of trees, forests, greenspace and related resources in and around cities and communities for economic, environmental, social, and public health benefits for people. "

From these definitions, the urban forest can be defined as: trees, forests, greenspace and related abiotic, biotic and cultural components in areas extending from the urban core to the urban-rural fringe. *(Canadian Urban Forest Strategy 2013-2018)*

Urban forests broadly include urban parks, street trees, landscaped boulevards, public gardens, river and coastal promenades, greenways, river corridors, wetlands, nature preserves, natural areas, shelter belts of trees and working trees at industrial brownfield sites. The box shows the components of the urban forest both private and public. This Strategy and Management Plan applies only to County-owned streets, rural ROW trees, parkland, cemeteries and natural areas. The sample inventory for this project looked at trees

on selected streets, cemeteries and parkland in the five urban areas of Caledonia, Cayuga, Dunnville, Hagersville and Jarvis.

2.0 PURPOSE, VISION, GUIDING PRINCIPLES, GOALS

The vision, guiding principles and goals provide a guiding framework that takes into account the local context and specific management issues faced by the County. They have been developed with consideration for Haldimand County's biophysical and land use context, and in consultation with the Forest Working Committee. They also support the County's broader commitments to environmental sustainability by integrating with the County's Vision statement.

2.1 PURPOSE

The purpose of the Forest Strategy is to provide a comprehensive suite of strategies– supported by the public - that will enhance the trees and forests over time, and address the risk management and design issues that face the community. It provides a framework within which planning, design, budget and risk management decisions can be made.

This Forest Strategy will help set the direction for the County to understand more about its urban and rural forest, the environmental benefits it provides and the community's interests; to develop an infrastructure to help maintain and improve the trees and forest; and to develop methods to monitor, maintain and regenerate the forest.

Green infrastructure is defined as natural vegetation and vegetative technologies that collectively provide society with a broad array of products and services for healthy living. (Green Infrastructure Ontario).

Green infrastructure takes many forms including but not limited to the following: urban forests, natural areas, greenways, streams and riparian zones, meadows and agricultural lands; green roofs and green walls; parks, gardens and landscaped areas, community gardens, and other green open spaces; rain gardens, bioswales, and engineered wetlands.

Green infrastructure also includes soil- in volumes and qualities adequate to sustain living green infrastructure and absorb water, as well as technologies like porous paving, rain barrels, cisterns and structural soils.

Green infrastructure provides a multitude of economic, social, environmental and health benefits, most of which are not recognized in our current legislation and policies. These benefits are described later.

The infrastructure includes County policy, staff and resources, partnerships with agencies and companies, and links with the Haldimand community and the benefits it provides to the community and environment, the interests of the community. The urban forest is a key element of green infrastructure. Without healthy trees and forests, the County would not achieve its vision of environmental integrity, social wellbeing and economic vibrancy as laid out in its Strategic Direction and Official Plan.

2.2 POLICY SUPPORT FOR THIS STRATEGY

In March 2015 County Council adopted a staff report "To seek Council's approval for staff to further research tree management best practices across Haldimand County and report back with a proposed strategy." In the report, Council recognized that there should be a County-wide strategy to deal with all tree-related issues on County-owned land. The full report is found in Appendix A.

Background information and context are found in Section 3.1. The existing regulatory environment regarding the forest in the County is described Section 3.2. Information on existing tree related initiatives and tree management occurring in the County is described Section 3.3. Section 3.4 describes benefits of the urban forest and threats and challenges to it. Section 4.0 explains the community involvement process. Preliminary information on the tree inventory sample is found in Section 5.0. A set of criteria and indicators for Haldimand County is Section 6.0 and Appendix D. A summary of what this all means is Section 7.0. Next steps are found in Section 8.0.

2.3 VISION

The Vision Statement reflects the desired outcomes of successful implementation of the Forest Strategy and Management Plan. It was developed in consultation with the Forest Strategy and Management Plan Working Committee to meet the needs of the County for County-owned trees and forests.

Haldimand County, being committed to preserving our natural beauty, values and is dedicated to protecting and managing its urban and rural forest, for the environmental, economic, community and health benefits these forests provide to its residents.

Haldimand County will, in partnership with its residents, businesses and stakeholders work to promote and increase urban forest coverage that is a diverse, healthy and sustained asset for future generations.

2.4 GUIDING PRINCIPLES

Guiding Principles are intended to guide the development of the Forest Strategy, Management Plan and implementation of the plan. These statements represent best practices in the urban and rural forest in Haldimand County.

I. Increased understanding of the County's urban forest will support more effective management.

II. Trees are municipal infrastructure and managed within an integrated asset framework.

III. The County strives to have efficient and cost-effective management of its urban forest.

IV. County trees are maintained in a healthy and safe condition through good management practices.

V. The right tree is planted in the right place to establish and maintain an optimal level of age and species diversity, and to maximize benefits and minimize hazard, nuisance, hardscape damage, and maintenance costs.

VI. The community is engaged in the support of the conservation, management and stewardship of the local urban forestry program.

VII. County trees are monitored and assessed periodically.

VIII. An adaptive management approach is used to adjust management practices as needed using current information and research.

IX. Well-managed privately owned trees also contribute to the urban forest.

X. Work towards optimal levels of tree/canopy cover to maximize urban forest benefits.

XI. New technologies are used to integrate trees in existing and new developed settings.

XII. Heritage tree policies are considered important.

2.5 GOALS

Based on the Guiding Principles, Haldimand County will work towards the following goals through the implementation of this strategy and subsequent management plans.

1. To undertake an inventory of County-owned urban and roadside trees and forests to identify tree species, age, condition and recommendations for maintenance, removal and replacement.

2. To develop a policy framework, infrastructure and procedures for trees on County lands with respect to tree maintenance, removal and replanting practices so that the urban forest is recognized as green infrastructure and a municipal/community asset.

3. To improve the resilience of the urban forest to current and anticipated stressors, including climate change, pests and diseases by implementing policies and management practices that optimize tree species diversity, structure and age classes, with appropriate monitoring.

4. To utilize human resources efficiently and effectively to address the tree-related activities.

5. To prioritize protection and maintenance of mature, healthy trees and preservation of older large-canopied species to the greatest extent possible.

6. To transition towards proactive tree establishment and replacement whereby all potential plantable spots on the County lands are explored and apply "right tree, right place" principles, except where policy requires that new trees be planted on adjacent private property development.

7. To build awareness and engagement among County staff and the community, regarding the importance and value of the urban forest and the County's efforts to sustain this resource.

8. To expand stewardship initiatives, and develop more partnerships that support the urban forest with initiatives such as tree planting and maintenance.

9. To use new technologies in selected areas for integration of trees in hardscapes such as downtown centres and parking lots.

10. Based on the current plan, in year four, update the Forest Management Plan and associated Operating Plans to ensure that the Forest Management Plan and operating budgets are updated on a regular basis.

3.0 STRATEGY BACKGROUND

3.1 THE CONTEXT FOR HALDIMAND COUNTY'S FOREST

Haldimand County is located within the Golden Horseshoe, Ontario's most populous region, with a population of 45,200 and a rural landscape of 1,251 square km, which includes 83 km of shoreline along Lake Erie. Its climate is one of the mildest in Ontario. There are six urban areas including Caledonia, Cayuga, Dunnville, Hagersville, Jarvis and Townsend and a number of hamlets, but the County is mainly rural.

Haldimand County was first settled by European and British Loyalists in the late 1700's. Forest clearing and settlement building began as more settlers came. Probably every tree on cultivated land and settlement was cleared or every acre was logged. The County has been predominantly an agricultural community; however a growing industrial and tourism base are important features. Natural/forest cover is 14 percent of the County, consisting mainly of farm woodlots often in the rear of the property, and forests along watercourses and wetlands.

Haldimand County is dominated by the Haldimand Clay Plain physiographic region, with soils deposited during the deep water stages of the post-glacial lakes. Surface soils are mainly clays and silts, except in the Dunnville area where sands overlay the clay. There is exposed limestone pavement (alvar) and karst topography in some areas that also have deep, subterranean catacombs in the limestone bedrock.

The forest is part of the Deciduous Forest Region and the Carolinian Life Zone in Ecodistrict 7E5, an ecological zone that supports native plants and animals having affinities with more southerly areas. Trees typical of the Carolinian Zone include black walnut, shagbark hickory, American chestnut, black oak, tulip tree, sassafras and sycamore.

The County is bisected by the Grand River, a Canadian Heritage River that extends through Haldimand from the north to its mouth at Port Maitland on Lake Erie. Haldimand County also has

Figure 3.1. County map showing Conservation Authority boundaries, settlement areas, County lands and woodlots.

many protected areas. Several provincial parks line the edge of Lake Erie within the County, and include Selkirk Provincial Park, James N. Allan Provincial Park, and Rock Point Provincial Park. Three Conservation Authorities have jurisdiction within the county. Niagara Region, Grand River and Long Point Region Conservation Authorities cover the County from east to west respectively and each own a number of properties. See Figure 3.1.

An extensive trail system and many heritage properties offer opportunities for community connection and outdoor activities including hiking, bird watching, cycling and canoeing (Haldimand County Economic Development, 2010) (Haldimand County, 2011).

Haldimand County owns 203 ha of active and passive parks, 31 ha of cemeteries, 115 ha of managed forest, 346 ha of municipal infrastructure, forest, industrial and other land under various levels of management. See Table 3.1. As well, the County manages a large park (including tree management) on a Grand River CA property and numerous small cemeteries. There are just over 1,500 km of roads and streets in the County including 145 km of streets in the five urban areas. Depending on location and public use, the County has to deal with tree management issues on its property. However, because of the higher public use, most maintenance concern is on street trees. Most tree planting opportunities may be on some of the urban and rural lands not designated for development.

Table 3.1. Land class, numbers of properties and area of Haldimand owned land

Land Class	# of Parcels	Area (ha)
Park (Not including managed forest)	50	203
Cemetery	21	31
Other land in urban area Including public infrastructure, ROW, forests but not including roads	171	205
Land in rural area	89	141
Managed forest land	5	115
Total area owned by Haldimand	**336**	**695**

Based on Ontario Places to Grow estimates, the County is forecasted to increase by approximately 1.1 percent in population and housing between 2011 and 2041. Population is expected to increase by 17,300 growing from 46,700 persons in 2011 to 64,000 in 2041. This represents an average annual population growth rate of 1.1 percent similar to Ontario's overall growth. Haldimand County's housing base is forecast to increase from approximately 16,830 in 2011 to 24,140 in 2041.   All urban areas are expected to grow. Caledonia is projected to double its population from 10,800 in 2016 to approximately 21,200 by 2041 mainly due to its close proximity to Hamilton. *(*Watson & Associates Economists Ltd, 2014.)

The result of this expansion will be new trees planted along streets in new construction (although mostly on private property) and new public parks established. Having a plan to plant and manage these trees, as well as one to educate citizens, will benefit the community and save costs in the future. Involving community partners will result in greater acceptance and understanding of the value of trees. This green infrastructure will continue to increase in value for more than two generations.

3.2 Current Policy and Regulatory Status of Forestry in Haldimand County

3.2.1 County Policy

3.2.1.1 County Official Plan

The Haldimand County Official Plan (OP) was adopted in by Council in 2006 and approved by the Ministry of Municipal Affairs and Housing in 2009. The OP has specific policies for development and site alteration required to protect the Natural Environment as mandated by the Provincial government including Provincially Significant Wetlands, and Habitat for Endangered and Threatened Species, and adjacent lands. There are general policies for protecting other significant natural environmental features but no Significant Woodlands guidelines). Many municipalities in southern Ontario have policies addressing woodland protection.   Haldimand County has a Forest Conservation Bylaw for privately owned woodlands. **The Haldimand OP has no explicit support or policy for managing the County-owned forest.** The OP does not specifically use the words "urban forest" or "green infrastructure", but clearly asserts the importance of green spaces and natural areas to the community, and provides specific direction to development projects.

Sections that reference trees are mostly referring to private lands, however some could apply to County-owned land as well. Areas in the OP that refer to trees include:

- Site Plan Control requires buffering and landscaping that require "Landscaped vegetation in the form of trees and bushes or grassed areas preferably using indigenous plant material";

- Regarding Commercial development in Commercial areas;
    - Landscaping requires "New street trees shall be required to be planted on private property along the road frontages";
    - "A variety of plant material should be provided including perennials, shrubs, coniferous and deciduous trees, and groundcovers";
    - "Exotic or non-species, which are considered invasive, should not be used";

- In Dunnville, specifically along Broad Street, the streetscape plan requires tree planting for an attractive environment;

- In the section on Site – Specific Policies, the County undertook to establish Urban Design Guidelines that include among other things, tree preservation and conservation of natural environment areas. These guidelines are meant for new residential development in designated greenfield areas.

Through its OP Haldimand County encourages active transportation such as walking and cycling. "The development of streetscapes that are safe, convenient and attractive for pedestrians shall be encouraged through measures such as …, trees ….".

3.2.1.2 Haldimand County Streetscape Plan and Urban Design Guidelines

The Haldimand County Streetscape Plan and Urban Design Guidelines is a short-term plan and imple-mentation strategy that guides County-funded initiatives into streetscape improvements for the urban areas and rural hamlets in the County. Implementation started in 2010 and all five urban areas have

started implementation. The hamlet plan has also been approved for six hamlets with four of them receiving an initial phase of construction (Selkirk, Fisherville, York, and Byng) and two to take place in 2016 (Port Maitland and Rainham Centre).

This work is intended to be a catalyst to; stimulate private sector investments of property within the designated downtown area, improve the physical and visible qualities of the downtown area, protect and enhance attributes of the historical crossroads and downtown core, and promote economic development by increasing opportunities for shopping, tourism, employment, and living in the downtown area. Streetscaping elements will include lighting, street furniture, cross-walk materials, and landscaping measures. (Office for Urbanism, 2010).

Trees and landscaping are shown in every plan as an integral part of the beautification. These trees will be located on the public right-of-way. These plans define number, situation, size and cost of trees to be planted. Specifically and most important the original plans call for "determining the ideal healthy state of trees, the care required to maintain health (such as avoiding over-salting of streets, which kill tree roots), and any regular pruning, hedging, or planting required." (Office for Urbanism, 2010).

The Rural Streetscape Plan (RSP) is being developed for six identified hamlets: York; Byng; Port Maitland; Rainham Centre; Fisherville and Selkirk, and will identify recommended improvements to the public places and spaces. The intent is to improve the physical and visible qualities of the core areas of each hamlet, protect and enhance attributes of the historical crossroads, and increase opportunities for shopping, tourism, and employment. Streetscaping elements can include lighting, street furniture, decorative cross-walks, and landscaping measures.

The Urban Design Guidelines provide aesthetic direction for both private sector and the County, for ongoing development of these areas. Guidelines are provided for placement, species, size and situation for trees.

3.2.1.3 Haldimand County Design Criteria

Haldimand County Design Criteria for Street Tree Planting (Section 0) was revised in 2015. It guides tree planting on new developments on private lands but may apply on public lands. It lays out locations and spacing, time of planting, types of trees, quality and source, installation and use of trees as screens (Haldimand County, 2015).

3.2.2 BY-LAWS AND RELATED LEGISLATION

3.2.2.1 Property Standards By-law 730/06

The Property Standards By-Law can ensure that yards, lots and vacant places "shall be kept clean and free from…dead, decayed or damaged trees or other unmaintained natural growth' and 'trees or parts thereof that have expired shall be removed or maintained in a condition which is not hazardous to person expected to be on or about the property."

3.2.2.2 Policy #2014-02 Public Conduct on Haldimand County Property

This policy provide for consequences for acts of vandalism as well as inappropriate behaviors and violence to County property. Damage to trees and other natural heritage is not specifically mentioned in the vandalism section, but includes arson, graffiti and theft.

3.2.2.3 Cemetery By-law 1501-15

This by-law protects trees in cemeteries owned by the County. There are 84 cemeteries in the County. However, the County is responsible for maintaining the cemetery landscaping and trees on the 19 County-owner cemeteries and on 20 inactive cemeteries accounting for about 42 hectares. The active cemeteries - nine the County owns and 10 the county maintains, but does not own, cover 31 hectares. Trees and shrubs can be planted only with the permission of the County. The County is responsible for trees and shrubs "in any lots which have become detrimental to adjacent lots, drains, roads or walkways by means of their roots or branches, which negatively affect the general appearance of the cemetery, that are diseased or pose a safety hazard and may be removed by the Corporation."

3.2.2.4 Public Parks and Facilities By-law 1535-15

Under this by-law the injury or damage to property is prohibited.
"No person shall in any Public Park:
a. injure any Natural Attribute or tree;
b. injure any Parkland;
c. climb any building, structure or equipment unless it was intended or designed for recreational climbing;
d. cut any vegetation along the banks of the Grand River or other riverbank unless authorized by the County and the Grand River Conservation Authority."

3.2.2.5 Forest Conservation By-law 15-00

Existing trees in woodlands in Haldimand County are protected by the Regional Municipality of Haldimand-Norfolk Forest Conservation By-law 15-00. The OP states "development within and/or adjacent to woodlands as defined by the Forest Conservation By-law may be reviewed by the County Forester. Prior to removal of trees within woodlands defined in the Forest Conservation By-law, a permit may be required." This by-law pre-dates municipal restructuring however, remains in effect for regulating the cutting or destruction of trees in woodlands in Haldimand County. The County has a By-Law officer that enforces this bylaw and a contract with Norfolk County for Forestry Conservation and Management Services to support the By-law and provide other services as noted below. The cost of these services in 2014 was approximately $26,110. This contract management activity is administered by the Building Controls & By-law Enforcement Division.

Haldimand Contract with Norfolk County for Forestry Conservation and Management Services
Haldimand County contracts with Norfolk County for forest management of the County-owned forest land. This includes forest health monitoring, boundary delineation and monitoring of encroachment, GIS forest stand mapping, prescription development, tree marking, tender development and harvest contract supervision. There are 115 ha of managed County forest on five properties. They include from largest to smallest, Haldimand woodlot 17 & 19, Marshall Woodlot, Canborough Transfer Site, Haldimand US Steel woodlot and Dunnville soccer field woodlot. Norfolk also provides forest extension services for

private landowners. They also provide site inspection for development application review and professional arborist consultation as noted elsewhere. See Appendix B for contract details.

3.2.3 OTHER REGULATORY ENVIRONMENT

3.2.3.1 Conservation Authority Policies

Portions of the County fall within the jurisdiction of three Conservation Authorities (CA) (Figure 1); the Long Point Region Conservation Authority (LPRCA), the Grand River Conservation Authority (GRCA), and the Niagara Peninsula Conservation Authority (NPCA). Under the *Conservation Authorities Act, 1990,* each CA regulates designated hazard lands within and adjacent to watercourses, wetlands and shorelines; and regulates alterations to wetlands in order to protect the natural environment from damaging activities. Some County lands are found in these regulated areas.

3.2.3.2 Province of Ontario Policies

The involvement of the provincial government in urban forestry matters is limited, leaving the bulk of the responsibilities to municipal governments. However, there are a number of provincial statutes, policies and plans that directly and indirectly affect municipal urban forest management and regulation, as presented in Table 3. 2.

Table 3.2. Province of Ontario Statutes and Policies affecting the urban forest

Statute or Policy	Relevance
Planning Act, 1990	Establishes the framework for municipal planning in the province. It provides municipalities with the power to develop official plans and regulate development, including requiring landscaping with trees and shrubs on the site and parkland dedication.
Provincial Policy Statement(PPS), 2014	This companion to the *Planning Act* provides guidance for land use planning, protection for significant woodlands, and encourages jurisdictions to integrate green infrastructure, including the urban forest.
Growth Plan for the Greater Golden Horseshoe (Places to Grow) 2013.	This plan encourages planning authorities to; - identify natural heritage features and areas that complement, link, or enhance natural systems, - develop a system of publicly accessible parkland, open space and trails, including shoreline areas, - establish an urban open space system within built-up areas, which may include … public parks. When there is a conflict between this and the PPS with regard to natural environment then the direction that applies the most protection to the natural environment prevails.
Municipal Act, 2001	Allows any municipalities to regulate the injury or destruction of trees on public and private lands. It allows the municipality to enter land along its highway to inspect trees and remove trees if they pose a hazard to persons using the highway.
Ontario Heritage Act, 1990	Allows for the designation of heritage properties and/or cultural heritage landscapes in the Province, including trees on such lands that may have heritage value.
Forestry Act, 1990	Provides a legal definition for "woodlands" based on stem densities, and "good forestry practices" for tree by-laws, as well as certain provisions pertaining to boundary/shared trees.
Endangered Species Act 2007	Applies to species listed as Endangered or Threatened in the Act. There are about 50 terrestrial species in Haldimand including trees such as American chestnut, butternut, flowering dogwood.

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3.2.3.3 Federal Policies

The involvement of the Canadian federal government in urban forest management remains limited and indirect. However, some support related to pest management is provided through by Canadian Food Inspection Agency (CFIA) and Canadian Forest Service, which monitor and control the spread of invasive insect pests, the most important of which include Asian Long-horned Beetle and Emerald Ash Borer.

3.2.4 SUPPORTING THE FOREST: EDUCATION, OUTREACH AND STEWARDSHIP

3.2.4.1 Haldimand County

The County website has little in the way of information about trees or forests. There is a tab for the Forest Conservation Service (contracted to Norfolk County) to advise private landowners interested in a forest harvest to make contact with the Forest Conservation Service. As well, there is a FAQ under Residential Services to advise citizens about urban trees on private and County property. There is a contact telephone number to generate a work order to request a tree inspection for potentially hazard or problem trees.

The *Community Partnership Program* (CPP) is a County program that helps the County partner with community groups to develop and enhance community assets on property owned by Haldimand County. The CPP ensures a single entry-point into the County for proposals from groups and/or individuals, as well as a fair and consistent approach to reviewing, assessing and approving community proposals. *(Policy 2011-01)*. Only proposals for projects taking place on County-owned property are considered. The CPP considers and approves all work conducted on County property regardless if funding is provided.

The first funding component of the program is for Capital Projects on County property. Currently, there is an annual budget of $150,000 for these capital projects. The funding formula is 35% from the County and 65% from the community organization.

The second funding component of the program is the Community Beautification Fund. Tree planting is one component that includes community signage and streetscape and park improvements. Currently, $60,000 is available annually for disbursement among eligible community groups to support community beautification projects on County-owned property. The funding is provided in recognition of the importance of beautification to the vitality of any community, as well as the sense of pride and quality of life it fosters for residents and visitors to the County. Showcasing the communities supports business attraction and retention, and leads to potential new tourism and economic development opportunities. Groups may apply for beautification funding of up to 50% of the total cost of the proposed project to a maximum of $4,000 per year/per organization. Through the Community Beautification program, the County has provided grant funding related to tree planting to four organizations (six grants over ten years for a total funding value of $21,966) for; replacement of trees planted during streetscaping, planting of trees in soccer park for shade, native tree plantings and tree distribution for roadside beautification.

The *Haldimand Rural Water Quality Program* (HRWQP) is an initiative of Haldimand County and its partners to improve water quality in the County. This voluntary program provides technical assistance and funding to private landowners for tree planting/natural restoration - stream buffers, fragile land retirement, and field windbreaks among other projects to protect and improve water quality. The program

is delivered by the three local Conservation Authorities, the GRCA, the LPRCA and the NPCA. The HRWQP also provides funding for Living Snow Fences as defined by Haldimand Roads Operations. The benefits of improved water quality include a safe secure water supply, a healthy aquatic ecosystem, increased recreational opportunities, sustainable agricultural operations and a vibrant economy. Everyone benefits when water quality is improved and protected.

3.2.4.2 Other Incentives

The Conservation Authorities also work with landowners to access the Forests Ontario, 50 Million Tree Program funding as well as their own tree planting programs. The LPRCA also has tree planting programs funded through Ontario Power Generation and their own Erosion Control Incentive Program, and Trees for Roads Program. The Niagara Peninsula Conservation Authority provides support and funding for habitat restoration including buffer strips, shelterbelts and windbreaks, floodplain & fragile land retirement, reforestation of sensitive lands & connecting fragmented woodlands.

3.3 CURRENT STANDARDS AND PRACTICE IN HALDIMAND COUNTY

3.3.1 PROGRAM MANAGEMENT

Management of County trees and forests is under the jurisdiction of several departments. There is no full time dedicated staff to tree/urban forest issues. Haldimand County contracts with Norfolk County for "consulting" arborist services and forestry support for the by-law officer.

- Trees in parks and cemeteries are the responsibility of the Facilities and Park Operations within the Community Services Department.
- Street trees, including those trees under the Streetscaping improvements, and trees on rural right-of-ways, are managed by Roads Operations in the Public Works Department.
- Trees in new developments are established through the development process in the Planning and Economic Development Department.
- The Community Development & Partnership Division provides Beautification grants to community groups whose project may include tree planting.
- Building Controls and By-Law Enforcement Division implement regulations affecting privately owned trees through the Property Standards and Forest Conservation By-Laws, as well as some protection of public trees under various by-laws.
- Community groups also fund and plant trees on County property.

The Property Standards By-Law can ensure that yards, lots and vacant places 'shall be kept clean and free from…dead, decayed or damaged trees or other unmaintained natural growth' and 'trees or parts thereof that have expired shall be removed or maintained in a condition which is not hazardous to person expected to be on or about the property'. The Forest Conservation Bylaw limits harvesting in, and clearing of, woodlands larger than one hectare in size.

3.3.2 TREE INVENTORY

Currently there is no tree inventory for the publically owned urban forest in the County. The Norfolk County Arborist responds to maintenance requests and adds trees to a database as trees are assessed. The

Norfolk Arborist compiled an independent tally of trees and an inventory of trees in Central, Kinsmen, Gardiner and other Parks in Dunnville in October 2015. As part of this project, Williams &Associates completed a sample inventory on selected streets, cemeteries and parks in Caledonia, Cayuga, Dunnville, Hagersville and Jarvis.

3.3.3 TREE ESTABLISHMENT

The County does not have a professional arborist/landscape architect that plans tree planting/forest replacement. Planting regularly occurs in new sections of cemeteries, in park developments, or in areas being re-developed. Some trees are replanted as trees are removed for safety reasons. However there are no policies or guidelines regarding tree replacement. Local garden centers (e.g., Mohawk Garden Centre) are contracted to supply and plant trees. Streetscapes plans, designed to invigorate and make people-friendly downtown areas, include tree planting on streets in the County-owned urban areas.

Haldimand County has developed design criteria for street-tree planting in new developments where trees are required to be planted on private property. The guidelines specify locations and distances from road allowances, timing of planting, species, quality, source and installation as well as trees for screening. Currently Norfolk forestry staff comment on development plans. Landscape architects were involved in the implementation of development/streetscape plans.

3.3.4 TREE MAINTENANCE

3.3.4.1 Service Delivery and Inspection - Requests

Roads Operations mandate is to maintain approximately 1,500 kilometers of public right of way (roads), 120 kilometers of sidewalk and eight Municipal Parking Lots consisting of approximately 20,000 square metres in asphalt surface area. This includes responsibility for tree maintenance issues within the County owned right-of-way.

Tree maintenance is conducted on a complaint and/or risk basis. When staff or a member of the public identifies a tree problem and sends a request to the County, Customer Service generates a work order. The work order is delivered to the appropriate department work location. One of four Road Maintenance staff, situated at the Cayuga, Dunnville, Oneida or Walpole Yards, is assigned to review it. The contract arborist assesses the tree as requested and determines maintenance or removal requirements. Road Operations has two chippers, 17 chainsaws and four polesaws.

If tree removal can be conducted without out risk to property or utility lines, the Roads staff will fell and remove the tree. If the work has risk or requires specialized equipment or arboricultural expertise or requires stumping, the work is contracted to a local tree service. The Roads Operations Division has seen an increase in tree management activity. In 2014, 253 work orders were created. This is an increase from 2013 which saw 230 work orders, which was a substantial increase from the 68 reported work orders in 2012. There is currently a backlog of work orders.

Facilities and Parks Operations (FAPO) contracts the Norfolk arborist to assess any trees in question by staff or the public. The recommendations of the arborist are implemented and the majority of tree maintenance or removal issues are contracted out. The FAPO Division has also experienced increased tree maintenance and removal costs in various parks and cemeteries.

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As a result of Emerald Ash Borer infestation there is a one-time capital budget of $250,000 for ash tree removal and storm water management in Dunnville Lions Park and another $100,000 for replanting for 2016-17. As shown in Table 3.3 this project was under budget.

Table 3.3. Chart of costs related to the urban forest and tree removal 2013 to 2016

Project	Costs				
	2013	**2014**	**2015**	**2016 YTD (Oct 2016)**	**2016 Budget**
	$	$	$	$	$
Roads Operations - removals:					
Internal resources (staff & equipment) 1	252,729	133,390	213,866	215,330	not segregated
Tree Service contract 2	91,284	91,874	123,059	97,912	105,710
Facilities and Parks Operations:					
Administration Facilities	1,131	-	1,913	458	not segregated
Cemeteries	2,936	6,400	21,750	3,150	not segregated
Parks	4,142	9,441	9,575	10,563	not segregated
Arborist contract (Norfolk)	25,825	26,109	27,083	-	27,240
Tree management strategy (contract)					30,000
Capital Program:					
Cemeteries		17,100			
Parks				52,745	400,000
Roads	16,678			78,725	234,200
Total	**394,725**	**284,313**	**397,246**	**458,882**	**797,150**

[1] There were 68 Roads Operations work orders in 2012; 230 in 2013, 253 in 2014 and 220 in 2015.
[2] The Roads tree service contract manages approximately 124 trees per year.

As a by-product of tree maintenance operations such as pruning and removal, Roads and Parks produce both wood chips and stem and limb wood. Smaller branches are processed through an on-site brush chipper, producing wood chips. Stem and limb wood are cut into manageable pieces by staff equipped with chainsaws. For work being conducted in Parks and natural areas, all chipped material is left on site. Large pieces are cut to manageable size and left for public use. For street trees, wood and/or chips are left for the home owner if they want it. Large pieces may be left at roadside for removal on a 'first-come first-serve' basis. Otherwise material is moved to the Roads yards for free pickup. Schools and service groups get priority for mulch material. Eventually material is moved to the Canborough Waste Management Facility. This Facility is newly opened so procedures are not defined. The plan is to have a contract tub

grinder once a year to produces mulch. The tub grinder pulverizes wood into small pieces. Depending on the terms of the contract this will be removed from the site or left for the public to pick up.

3.3.4.2 Pruning

Pruning is conducted on trees through customer service/work orders and generally contracted to a local tree service following direction of the Norfolk Contract Arborist. Trees planted in downtown areas as part of the Streetscape plans, are maintained by Roads Operations. Otherwise there is no corrective/structural pruning program for young trees.

3.3.4.3 Utility Line Maintenance

Tree maintenance along utility lines was previously done by Haldimand Hydro following a five-year maintenance cycle. This consists of removing branches in conflict with the electrical wires. Communication wires are not affected by this work. In June 2015, Haldimand Hydro was purchased by Hydro One who will be expected to continue the maintenance schedule beginning in 2016. Hydro One contracts tree work on utility line maintenance to Davey Tree Service. Work scheduled for the larger urban areas in 2016 has been completed.

3.3.5 RISK MANAGEMENT

The County does not have a formal process to assess and catalogue risk associated with publicly-owned trees. The County does not have a tree risk management policy, nor is there a post-storm inspection protocol or inspection process. Tree risk issues are usually identified through customer service requests or observations by staff or contactors doing other tasks. With no assessment protocol, the County is potentially vulnerable when damage or safety issues arise.

3.3.6 TREE PROTECTION

Tree protection in the County is conducted through several policies and regulations. Protection for trees in parks and cemeteries is provided through the Cemetery By-law (1501-15), the Public Parks and Facilities By-law (1534-15), and overall coverage under the Public Conduct on Haldimand County Property Policy (2014-02). There is no by-law protecting privately owned trees. A Forest Conservation Bylaw protects trees in private woodlands greater than one hectare. Property Standards can require maintenance or removal of trees on private land that threaten public or other property.

When new infrastructure projects are planned, the County involves the contract arborist to identify trees that show signs of risk and to establish protection measures to ensure trees on site are not damaged by construction.

3.3.7 COUNTY FORESTS

County owned forests are managed under contract to forestry staff from Norfolk County. The County receives money from harvest operations and prosecutions which is deposited into a special Forest Recovery account. The current balance is about $30,000 which is targeted for reforestation.

3.4. BENEFITS, THREATS AND CHALLENGES

3.4.1 THE BENEFITS OF THE URBAN FOREST
Adapted from; Urban Forest Strategic Plan for the City of Peterborough, 2011

Benefits of the urban forest are widely recognized and documented. Trees in urban areas provide important economic, environmental, community and human health benefits. The community's trees will need to be managed in order to maintain this stream of benefits which are critical to the community's economic well-being and overall quality of life. Unlike most other urban infrastructure, the value of the urban forest generally increases over time.

The urban forest is an essential part of a livable and economically-sound community. A healthy community is one that has a strong and vibrant green infrastructure. Environmental benefits of trees include the reduction in air pollution, greenhouse gases and storm water runoff. Economically, trees moderate temperature and the need for summer cooling and winter heating. Trees increase property values, and, as part of the green infrastructure, provide important ecological and social functions that result in cost savings to local government and stimulation of the local economy. **Unlike traditional municipal infrastructure such as transportation systems that depreciate, green infrastructure accrues in value and provides greater benefits to the community as time passes.**

The Environmental Benefits

For the Air: Trees have the ability to collect and remove pollutants from the air (such as carbon, nitrogen oxides, and sulphur dioxide). By consuming carbon dioxide, trees reduce greenhouse gases and release oxygen as a by-product. Trees filter dust, pollens and smoke.

> The benefits from just 100 mature trees provide the following benefits:
> - Remove 52 tons of CO_2 from the atmosphere per year
> - Remove 430 lbs. of particulate pollutants per year
> - Catch 538,000 gallons of rainfall per year. (McPherson *et al.* 2002).

For Storm Water: The urban forest takes up water from the ground and delays the movement of rain water, thus diminishing the peak capacity requirement of storm water systems such as storm sewers. Roots provide bank stabilization along open watercourses and remove toxins from ground water. The leaves of trees impede and soften the impact of heavy rain on ground conditions, thereby reducing erosion. Trees reduce the incidence of flooding by intercepting rainfall and enhancing percolation of storm water into the soil.

For Wind Reduction: Wind impacts at ground level can be mitigated with the strategic placement of trees as wind breaks.

The Social Benefits

For Mental and Physical Health: Studies indicate that one of the social benefits of trees is an improved sense of well-being. Trees reduce the stress of everyday life by creating greenery and softness among the hustle and hard surfaces of the City and provide the public with a sense of calmness. Studies have demonstrated that patients recover more quickly after surgery if their windows look out over treed landscapes. (Trees Ontario, undated)

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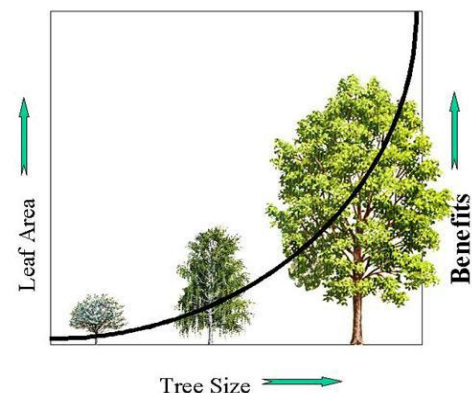
For Public Safety: Trees along transportation corridors narrow a driver's field of vision, reducing traffic speeds and increasing pedestrian safety by providing a natural, physical barrier. Studies have found that urban highways lined with trees decrease driver stress, resulting in fewer incidents of road rage (City of Vancouver Urban Forest Management Plan, 2007).

For Social Interaction: Public spaces with trees are inviting to visitors. Trees encourage social interaction and increase a sense of community. Trees foster sociable neighbourhood environments (Sullivan and Kuo, 1996).

> **Example of the ecological benefits of trees increasing exponentially as leaf area increases** (source: Faculty of Forestry, University of Toronto 2006

The Cultural Benefits

For Heritage: People associate many different events and memories with specific trees and stands of trees. Trees offer a link to past histories, providing connection to times and events of a bygone era. This connectivity gives society a sense of belonging not only to the here and now but also a sense of purpose for continuing to enjoy and appreciate these living memories.

For Sense of Place: The character of a neighbourhood is determined by private and public trees. People feel an immediate connection to the landscape fostered by ongoing association with trees.

The Economic Benefits

For Development: The presence of trees within a community provides an invitation to visitors, developers and investors thus enhancing the prosperity of a city. Mature trees on public and private property increase the value of these properties. "A mature tree can often have an appraised value of between $1,000 and $10,000 (Council of Tree and Landscape Appraisers, www.arborday.org/trees/benefits.cfm).

For Municipal Infrastructure: Tree cover reduces storm water run-off through interception and absorption. In 50 years, one tree can generate $30,000 in oxygen, recycle $35,000 of water and eliminate pollutants that would otherwise cost $60,000 to remove from the air.

For Energy Conservation: The reduction in energy costs as a result of tree shade is well documented. Trees reduce heating and cooling costs (Sustainable Forests in Urban Ontario, 1995).

The Engineering Benefits

Trees provide acoustical control. A screen of dense coniferous trees 30 meters wide can absorb 6-8 decibels. In terms of traffic control, trees provide pedestrian and vehicular-safety barriers and screen headlight glare (Faulkner, 2004).

Trees improve pavement performance. Research has documented that tree canopy over a road extends pavement life (McPherson et al. 1999).

Trees reduce peaks and base stormwater flows, reducing the costs and capacity of infrastructure

Other references
> **22 Benefits of Urban Street Tree 2008. Dan Burden, Walkable Communities** *(http://ufmptoolkit.com/pdf/Benefits-of-Urban-Street-Trees.pdf)*
>
> The **Ontario Urban Forest Council** *http://www.oufc.org/urban-trees/benefits-of-trees/*

"The net cooling effect of a young, healthy tree is equivalent to ten room-size air conditioners operating 20 hours a day." —*U.S. Department of Agriculture*
"If you plant a tree today on the west side of your home, in 5 years your energy bills should be 3% less. In 15 years the savings will be nearly 12%." —*Dr. E. Greg McPherson, Center for Urban Forest Research*
"A mature tree can often have an appraised value of between $1,000 and $10,000." —*Council of Tree and Landscape Appraisers*
"In one study, 83% of realtors believe that mature trees have a 'strong or moderate impact' on the salability of homes listed for under $150,000; on homes over $250,000, this perception increases to 98%."—*Arbor National Mortgage & American Forests*
"Landscaping, especially with trees, can increase property values as much as 20 percent." —*Management Information Services/ICMA*
"One acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen. This is enough to meet the annual needs of 18 people." —*U.S. Department of Agriculture*
"Trees properly placed around buildings can reduce air conditioning needs by 30 percent and can save 20–50 percent in energy used for heating." —*USDA Forest Service*

3.4.2 THREATS AND CHALLENGES

There are a number of factors that can adversely affect the management and overall health of the Haldimand County's urban forest and these should be factored into the decision-making process when establishing urban forest policies.

There are numerous threats and challenges to the sustainability of the County's urban forest, including:
1. Lack of policy protection to plan and manage the existing forest and forest renewal;
2. Lack of knowledge about the status and value of the urban forest;
3. Competition with built infrastructure;
4. Ensuring the right tree is planted in the right place;
5. An aging urban forest without a strategy in place to increase tree cover;
6. Invasive plant species, pest and pathogens;
7. Tree-related risk from structural and health problems;
8. Climate change (and associated extreme weather events);
9. Limited resource allocation;
10. Lack of biodiversity;
11. Attitude that trees are more trouble than they are worth; and
12. Engaging community.

These threats and challenges are described in greater detail, below.

1. **Lack of policy protection to plan and manage existing forest and renewal**
   Presently there are no specific policies for protection, management and renewal for urban trees in the County. There is no policy regarding EAB, tree replacement or maintenance. Having trees outside of

the County infrastructure system will continue to treat trees as second class. Green infrastructure is as important to the vitality of the County as grey infrastructure.

Municipal design guidelines regulate tree location species and other requirements on private property. They do not, however, regulate minimum requirements for green space and make no allowance for natural processes. This leads to trees being planted in poor growing conditions such as compacted soil, in spaces with too little room for root growth, in soil of insufficient nutrient quality, and left without enough permeable surface to allow water to percolate to tree roots. Moreover, the County does not have much power to protect existing trees. To protect the urban forest, the Official Plan must identify the significance and benefits that trees provide to the community.

Creating a sustainable urban forest requires planning for the biological needs of mature trees, and that trees are given equal consideration during development. New planning strategies that focus on intensification and road renewal are just two examples of the potential of losing tree canopy unless the requirements of trees are recognized and planned for.

2. **Lack of knowledge about the status and value of the urban forest**

    The County does not have a comprehensive inventory of the trees it manages. The sample inventory undertaken for this project is a first step towards understanding the existing urban forest. While most residents appreciate treed streets, relatively few understand their value for cooling ambient air, reducing air pollution and reducing stormwater runoff and flooding from intense rainfall. Even less is known about the trees on private property[1]. In the absence of a complete survey of the urban forest and clearly defined objectives for its management, resource requirements are difficult to determine. Protecting existing trees and finding suitable, long-term locations for new trees will require careful planning and support from various County departments, landowners, and the community at large.

3. **Competition with built infrastructure**

    Growing conditions for trees in urban areas typically include a more exposed environment, degraded and compacted soils, altered moisture regimes, little to no natural regeneration, and substantially reduced soil biological activity. In addition, trees in urban and urbanizing areas must compete for space with infrastructure, both above and below ground. Below ground, rooting habitat in built-up areas is typically characterized by inadequate soil volumes, quality and drainage. Roots must share space with underground utilities, and soils can become too compacted to support the fine roots that provide water, oxygen and nutrients to the tree. Above ground level, trunks, branches and foliage compete for growing space with buildings, utilities and transportation infrastructure. Trees must also contend with infrastructure maintenance activities such as de-icing salt application, pruning, and removal for the expansion and repair of infrastructure services such as sidewalks to under-serviced areas. As a result, conditions both above and below ground are challenging to tree growth, health and longevity.

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[1] Neighbourwoods© surveys in Dundas and Elora/Fergus and found 71 and 85 percent respectively, of all urban trees are privately owned.

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Managing infrastructure renewal requires integration of urban forest goals and targets at the onset of planning and construction; including better cooperation with both the private and public sector in designing these projects. County departments must improve inter-departmental procedures and practices to improve urban forest performance in both the short and long term.

4. **Ensuring the right tree is planted in the right place**

   Planting the right tree in the right place helps ensure that young trees can thrive and provide maximum benefits. Currently in Haldimand County there are no plans or guidelines for replacement or enhanced tree planting. It is important to ensure that trees are planted and protected in areas where they can reach their genetic potential. The average street tree in an intensively developed urban area lives 10 to 25 years (Urban, 1989) and most urban tree survival problems are due to insufficient soil volumes.

   Often tree plantings are based on available stock, with little consideration for soil conditions. Nurseries may have a limited supply of desirable species and may be unavailable unless orders are made a number of years in advance. Development and construction practices often create poor growing conditions that include limited rooting space that restricts the potential for young trees in new subdivisions. Native soil is often displaced or removed only to be put back in a thin layer over compacted subsoil. Tree roots are starved for oxygen and nutrients. The selection of species for these poor sites is much narrower because fewer species are able to tolerate these harsh conditions.

5. **An aging urban forest without a strategy in place to increase tree cover**

   Most urban forest ecosystems have been dramatically altered from their original state and are no longer "natural". They cannot be left "as is" and must be managed to ensure their sustainable long-term existence, use and protection. Recognizing that large stature trees at maturity provide the greatest benefits to the community, action must be taken to ensure that; 1) existing large stature trees and their soil habitat are managed and protected and 2) that new tree planting efforts focus on the planting of large stature trees and the establishment of the required soil volumes to grow trees to their mature size. With upgrades and expansions to infrastructure, the preservation of existing trees and the integration of new trees into developed landscapes become more challenging. The requirements of older, mature trees can be tempered through a system of risk assessment so that resource requirements are assessed realistically across the broad spectrum of the urban forest.

6. **Invasive plant, animal and pathogens species**

   An invasive species is any plant, animal or pathogen that has been introduced to an environment where it is typically not indigenous, and where it becomes a nuisance through rapid spread or population growth, often to the detriment of indigenous species. Today, the greatest current threat to eastern North America's urban forests is the Emerald Ash Borer (EAB), which has the potential to eliminate the entire ash tree population. Ash comprises an estimated 9 percent of the tree canopy in the County. EAB was first identified officially in the County in 2014 (although it is presumed to be present from 2007) and has been responsible for killing large numbers of trees. Ash removals are ongoing throughout the County. It is projected that almost all ash will be lost to the EAB over the next few years. Because of this high level of threat, a separate focus has been placed on managing the

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ash trees as they are being killed by EAB. Extra resources are needed to ensure trees are removed in a timely manner. Unfortunately it is too late to treat any ash to keep a few on the landscape.

Another insect of concern is gypsy moth which appears in cycles and defoliates many species but particularly oak trees. Fortunately there are a number of introduced pathogens that have kept defoliation levels low in recent years.

There are numerous invasive plants in southern Ontario trees and shrubs. A few such as buckthorn, Norway maple, garlic mustard are prevalent in the urban forest. In urban woodlands and forests, they can threaten local ecosystems by outcompeting and displacing indigenous plant communities. Numerous tree species are threatened by exotic fungi and parasites. Butternut is being killed by butternut canker; beech, by beech bark disease. Eradication of most invasive plant species is impractical or impossible, and even targeted control may be difficult. As such, management of invasive plant species typically requires dedicated resources over multiple years to be effective.

The challenge of identifying and controlling invasive pests has become more urgent for urban forest managers as increasing movement of people and commercial goods continue to bring new invasive species to North American forests. Once introduced, invasive pests can be difficult to detect, limiting management options and increasing the difficulty of effective control. Although natural areas are frequently affected by intense invasive species pressure, urban forests are under significant threat as well. Important urban trees are increasingly at risk; elm has been essentially wiped out by Dutch elm disease and EAB sees no boundaries. Trees in urban areas can be more susceptible to the effects of pests and pathogens than trees in natural settings due to stressful urban environments. Problems brought on by invasive pests are often compounded by insufficient management practices that promote tree health and vigour. This can result in limited street tree species diversity, and overreliance on pest-prone species, improper sanitation and disposal of infected wood materials, and continued production and use of poor-quality nursery stock.

7. **Tree-related risk from structural and health problems**
   Many urban trees possess some inherent degree of risk, although relative to other sources of risk that exist in urban areas, it is relatively small. Nevertheless, as trees mature and grow in size, they may develop structural or health problems that predispose them towards higher likelihoods of breakage or whole-tree failure. Risk is related to the presence of potential 'targets' of tree failure (i.e., people and/or property), and is therefore greater in more densely populated urban environments.

   As municipalities are responsible for managing trees they own according to a reasonable standard of care, potential personal injury or property damage and subsequent legal action is magnified if due diligence in identifying and mitigating tree risks is not being met. Unfortunately, tree risk mitigation is often unduly focused on reactive tree removal rather than pre-emptive management, such as structural tree pruning or young tree maintenance. Striking a balance between proactive mitigation of risk to a reasonable degree and maintaining mature and ageing trees in the urban landscape is an ongoing challenge for urban forest managers.

There is also a lack of public understanding of the considerable care urban trees require to be able to survive and mature in the stressful urban environment. Urban trees on private and public land need to be watered, pruned and monitored for disease, pests, and stress arising from heat and air pollution. Many urban trees are planted by contractors who must water and maintain the trees for two years after they are planted. However, in an urban environment, trees require a longer period of care and many trees die five to seven years after planting. Split or broken limbs are hazardous and pose a threat to public safety and property. Roots penetrate water mains, and crack and lift sidewalks. Foliage and other tree debris clog eaves troughs which can be mitigated or avoided through proper planning, policies and maintenance. The County has no pruning regimen due to insufficient funding. The decrease in overall tree maintenance results in increased operating costs because there are more hazardous tree work orders generated that must be dealt with on an emergency basis.

8. **Climate change (and associated extreme weather events)**

   Climate change also poses a significant threat to the County's urban forest. While there is general consensus that climate is changing, there is a great deal of uncertainty around the nature and extent of these changes. The general predicted trends for southern Ontario are warmer, longer summers with little or no increase in precipitation resulting in more droughts, and warmer, shorter winters with more snowfall generally a milder climate. Extreme weather events such as windstorms, intense rainfall, snow storms and very high temperatures are expected to occur more frequently. Specific challenges and are presented in the next section.

9. **Limited Resource Allocation**

   Responsible urban forest management, planning and maintenance can be costly but is normally more economical than dealing with contingencies. Currently, there is only a contract arborist (part-time) to provide arboricultural advice. The removal of high-risk trees on roads is conducted by contracted tree services and roads personnel. Current funding and infrastructure are not able to meet arboriculture requirements to maintain County trees on a planned, regular basis. Activities are undertaken in a reactive mode. Municipal trees should be inspected and where required receive arboricultural intervention on a pre-planned rotation cycle. Both roads and parks departments have a recognized lack of resources related to staffing and equipment required to meet existing service levels.

   Urban forestry programs must compete with other municipal initiatives to secure adequate resources, and staff and financial resource constraints can limit the ability to deliver core forest management services such as routine tree maintenance, risk mitigation, and urban forest monitoring. Providing sustained support for urban forest initiatives will be important to keeping Haldimand a vibrant and livable community, with due diligence over its urban forest assets.

10. **Lack of biodiversity**

    While there are many tree species in the County (over 55 inventoried on County land), relatively few make up the majority of the urban forest. Silver maple (22% of sample inventory), Norway maple (11%), Norway spruce (11 %) and ash (9%) are   a significant portion of the urban forest. This species diversity leaves the urban forest more susceptible to invasive insect and other problems, like the expected loss of all ash trees. There are challenges to increasing the diversity of trees. These can be overcome by effective planning and purchasing or by municipalities growing their own trees.

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Variability in the species age and structure in an urban forest helps to limit potential damage from disease or infestation. Managing the urban forest to ensure a wide variety of species, and a good mix of old, medium-aged and young trees, and offers enhanced protection from the stresses that impact trees. In landscaped areas where lawns surrounding trees are mown, natural tree regeneration is not possible and young trees must be planted. This makes the selection of planting stock a key factor in the diversity of the urban forest.

Biodiversity at the genetic level is an important consideration for all new plantings. The horticultural industry often uses cultivars (identical copies, or clones of a parent tree). Cloned individuals can all succumb to a single pest that affects the parent tree. Trees grown from seed that was naturally cross-pollinated have greater potential to adapt to changing conditions and resist new problems.

Monitoring and control of invasive species is an important factor in protecting biodiversity. Increasing biodiversity is an effective means of mitigating the impact of invasive species and insects on the urban forest. As witnessed with the EAB, ash trees represent 9% of the trees growing in Haldimand and 22 percent of park trees (from the current inventory sample), and it is a costly undertaking to replant these trees. In all likelihood, it will also be many years before these newly planted trees provide the same level of benefit.

11. **Attitude that trees are more trouble than they are worth**

The desires, attitudes, and perceptions of stakeholders and decision makers can have a large impact on an urban forest plan. There are many concerns among citizens such as general annoyance with the nearby tree because of yard maintenance and potential property damage. This is offset by those who understand the value and benefits of trees, who are willing to deal with problems, and who are looking for ways to contribute to having more trees in the community. Cooperation is required from multiple groups to develop, fund, and implement the plan. Municipal plans typically require wide public input and support.

12. **Engaging community**

Engaging the community during the development of forest management strategies and plans improves knowledge of the forest and its management and helps to ensure public support for policies and activities. Community engagement takes time and resources from those directly involved in planning and operations, as well as other departments. Through years of experience, urban forest managers have found that public education is the true key to reaching the goals of an urban forestry program in a community.

Having a functional tree inventory and urban forest management plan improves public relations and education. The inventory data, maps, and/or summary reports can be made available on a website or in print so the public can access them. In this way, the public can gain a better understanding of the work of urban forestry and become more willing to support its program, and potentially reduce the number of calls to staff. Including policies and goals in a management plan helps citizens understand why actions are taken. The County will gain more public support for its policies and activities as the value of trees to economic development, environmental health, and quality of life issues in the community are realized.

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3.4.3 CLIMATE CHANGE THREATS

In the case of Haldimand's urban forests, the most important potential impacts of climate change include drought stress, storm damage, insects and disease, and invasive species. These environmental stressors will make urban forests more vulnerable to damage, pests, and invasive species. Climatic conditions may even become entirely unsuitable for certain species of trees adapted to current climatic conditions as range shifts proceed (McKenney *et al*., 2007).

Potential and specific impacts to Haldimand's urban forests that are anticipated based on these predictions include:
- more frequent and / or more long-lived insect and disease outbreaks;
- increased tree drought stress may affect tree health and forest growth, as well as other related functions;
- some local tree species may be less suited to local conditions, potentially reducing their resilience to other stressors;
- reduced ability to store and sequester carbon;
- the geographic range of plants and wildlife is predicted to move north as the temperature increases;
- changes in water and air temperature that may make conditions more favorable for diseases and invasive species, which may stress native species;
- some species may disappear from their current habitats; and
- in the short term, tree growth of some species may increase due to longer growing season.

A number of the stressors that have been linked with climate change have the potential to pose a threat to the long term sustainability of the trees and forests throughout the County. While there is general consensus that climate is changing, there is a great deal of uncertainty around the nature and extent of these changes. The general predicted trends for southern Ontario are warmer, longer summers with little or no increase in precipitation resulting in more droughts, and warmer, shorter winters with more snowfall – generally a milder climate. Extreme weather events such as windstorms, intense rainfall, snow storms and very high temperatures are also expected to occur more frequently.

In the case of Haldimand's urban forests, the most important potential impacts include drought stress, storm damage, and conditions that favour a proliferation of tree insects, diseases and invasive plant species. Some of these pests already occur in the area and others are likely to become problems in Haldimand in the future.

3.4.3.1 **Climate Change Impacts on the Urban Forest**

Climate change is already beginning to exacerbate the stressors that threaten urban trees and adds urgency to the need to address the challenges that County staff currently face in managing the forest. Climate change creates challenges for some trees and forests, and results in changes that favour other species or forests. The following climate change impacts were adapted from and are described below.

Climate change adaptation options for Toronto's urban forest. 2007. The Clean Air Partnership
http://www.cleanairpartnership.org

Hotter Summers

The hotter summers associated with climate change, are expected to have major impacts on trees in urban areas. Trees are already under stress from extreme heat (Ubbens 2006) and the expected rise in summer temperatures will worsen this situation. Newly planted trees are particularly vulnerable to heat and drought conditions, and require regular watering to survive, especially in the first three to five years after planting.

More Variable Winter Temperatures

Milder winters and increased variability of winter temperatures under climate change (Franklin 2007) can negatively impact trees. Warm weather too early in the year can trick trees into triggering bud or bloom formation. When the warm spell is followed by a cold snap, the new growth often dies. Milder winters also allow insect pests that are normally killed during cold spells to overwinter. As a result, pests with a more southerly range will be able to move north, and foreign pests introduced via shipping have a greater likelihood of surviving (Greifenhagen and Noland 2003).

More Variable Precipitation

As climate change progresses, precipitation patterns are expected to become more variable (Koshida *et al*. 1999; Meteorological Service of Canada 2005), making it more problematic to rely on rainfall to provide trees with water at regular intervals.

Increase in Ground-Level Ozone

Concentrations of ground-level ozone are expected to increase with the onset of hotter summers. High concentrations of ozone can damage tree leaves and slow down growth, and in combination with drought conditions can leaves trees and other plants more vulnerable to pathogenic fungi and pests.

Threats to Biodiversity

Growing seasons are lengthening as the climate gradually gets warmer. This leads to a northward migration of flora as plants move to locations with conditions more favourable for their survival. Because climate change is occurring faster than vegetation can migrate (MacIver 2005), the change in climate is more likely to lead to stressed plants, vegetation dieback and a loss of native biodiversity. There is more likelihood to see more southern species move into the region. Although these species may be better adapted to the warmer average temperatures, they may not fare well in Haldimand's winter climate, which is subject to periods of cold extremes not common to more southerly regions.

Tree Damage from Increased Frequency of Extreme Weather

The expected increase in ice storms and high winds will take its toll on trees, taking down branches or entire trees altogether. Ice and wind storms, common in southern Ontario have potential to take down hundreds of limbs and a number of trees. Extreme weather in combination with a host of other urban stressors has the potential to seriously devastate Haldimand County's urban forest.

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A sound climate change mitigation and adaptation strategy requires two fundamental components:

1) a proactive program that influences day to day operations and activities improving the resilience of the urban forest; and

2) a reactive program that can respond to extreme events such as ice storms, drought, wind, and insect and disease outbreaks.

A significant focus of the Urban Forest Strategy and Management Plan is to improve the current level of tree care and tree management within the urban forest. As the standards and best management practices within the County improve it is expected that these changes will improve the overall health and resilience of the urban forest which will provide a significant buffer to future climate change impacts.

3.4.4 Responding to the Challenges – The Need for a Forest Strategy and Management Plan

The existence of a Forest Management Plan in a community indicates a high level of commitment to protecting trees, and it indicates a higher level of awareness about natural resource issues in general. The benefits of trees can be maximized when both professional management resources and an informed public coexist. A Forest Strategy and Management Plan are effective tools to ensure that municipal resources are efficiently directed, efforts are coordinated and cooperative, and existing and potential partnerships are leveraged so that the County's trees and forests are established, managed and protected in order for the forest to remain resilient to various stresses and sustained for generations to come.

The primary purpose of this Forest Strategy is to provide purpose, vision, guiding principles, and goals to improve the current regulatory and operational situation and to consult with the community. The Plan is to identify the most effective ways to achieve urban forest sustainability and improve the urban forest management program while considering the physical and social context.

4.0 COMMUNITY ENGAGEMENT PROCESS

This strategy is about supporting, protecting and rejuvenating trees and forests on County-owned property. County trees are the citizens' trees and many residents will be compelled to comment on, and otherwise advise how County-owned trees are managed. This development of the Forest Strategy and Management Plan includes public comment opportunities on this strategy and the subsequent plan.

One presentation is scheduled for staff and one for citizens to hear about and comment through a facilitative workbook process on the draft strategy and management plan content. The presentations are also to meant to develop community interest about the trees and forests to see how they can be involved in protecting and building the forest. Although the public meetings are not about the privately owned trees, ideas for engaging and educating the public are further outlined in the Management Plan.

During the development of the draft strategy and management plan, it is expected that key documents will be made available for public review online, at County offices, or at local libraries. Adequate efforts have

been made to inform and get input from the public throughout the plan development process. However, issues may be raised from citizen input that will need to be addressed in the plan in some way.

A survey will be developed available on-line to obtain feedback regarding the draft strategy and content outline for the management plan.

4.1 PRESENTATION TO VIEW AND RESPOND TO DRAFT FOREST STRATEGY AND MANAGEMENT PLAN CONTENT

The objective of this is to:
- present the Forest Strategy with vision, guiding principle, strategic goals and current status of the Haldimand forest;
- allow public input through a facilitated workbook session; and
- understand interest and potential volunteer activities.

The presentations will be held in early June with presentation in the afternoon for staff, and in the evening for the public (targeted stakeholders will be notified directly). It will be held at the County Office, Cayuga. Williams & Associates, Working Committee members and/or County staff will be present.

Presentation Agenda
  Displays
- Vision statement
- Guiding principles
- Goals
- Draft inventory results (State of Resource)

  Presentation by Williams & Associates on the above
  Facilitated Workbook session for feedback
  Comment form
  Respond to questions

Post Public Information Centre
- Immediate Debrief
- Summarize comments and survey
- Respond to questions, if not able to at the presentation
- Finalize Forest Strategy
- Finalize Management Plan content

4.2 SUMMARY OF COMMUNITY ENGAGEMENT

Public engagement was held to obtain opinion on the draft Vision, Guiding Principles and Goals. In person presentation were made June 9 for Haldimand staff and the public in two separate sessions. Participants were asked to provide feedback on the draft Vision, Guiding Principles and Goals. On-line feedback was open to the public for a 2 week period immediately following. General questions asked for age, gender and residence by ward (online only).

Participants were asked to respond to the two parts of the Vision statement, the 12 Guiding Principles and the 10 Goals with "I agree; I can live with it; I have no opinion; I don't like it; and I fundamentally

disagree. In some cases there was no response. Thirteen staff completed the survey; nine members of the public attended the second session and completed the survey. There were 34 responses online. Age of participants was skewed to 50 plus among the public and 40 to 59 among staff. Staff males outnumbered females about 2:1 ratio; the public was 50:50 male: female.

The entire report with scores and all comments is found in Appendix E.

Response to Vision
Almost all respondents 'agree' or 'can live with it' for with both Vision statements. One person had no opinion and one didn't like it.
Comments included

"… already have many complaints from residents that see a green tree & don't understand that it is not healthy or is a liability to property."

"Would like to eventually see canopy % targets for communities to engage in and aim for."

Response to Guiding Principles
Combining all the responses to the 12 Guiding Principles, 83% agreed, 11% can live with it, 4% had no opinion and 2% did not like or fundamentally disagreed.

Response to Goals
Combining all the responses to the 10 Goals, 91% agreed, 6% can live with it, 2% had no opinion and less than 2% did not like or fundamentally disagreed.

5.0 SAMPLE INVENTORY - SUMMARY

5.1 INTRODUCTION

The foundation of an effective urban forest management program is a functional tree inventory that supports a tree inspection cycle and proper tree maintenance and hazard abatement. Effective tree monitoring enables park managers, urban foresters and planners to evaluate the forest resource and develop short and long-term initiatives which can in turn provide substantial cost savings and mitigate safety issues.

There are many considerations when planning an inventory. The type of inventory used is important and depends on information needed and size of community or area to be surveyed. Windshield surveys are a good first step to collect general information on tree characteristics or specific information such as the number of ash trees when faced with EAB infestation. Statistically sound surveys using sampling are cost-efficient particularly for large areas but provide information on an area rather than on specific trees. Partial surveys where defined areas are surveyed provide good information on important areas are helpful but only apply to the areas sampled. A full inventory provides the most complete information on the trees, but should be easily updated to reflect current conditions. The cost and usefulness of an inventory is affected by the type and amount of information collected on each tree.

Inventory data can provide a raft of valuable information. Location, species, size and condition and maintenance needed are important initial attributes. Other important information includes more specific attributes such as vigour, wire conflicts, insect problem, plantable spots and more.

Information collected is summarized or analyzed to help in strategic planning. Inventory data can be used to identify species diversity and distribution, percentage of canopy cover, size/class distribution, etc.

5.2 SAMPLE INVENTORY PROCEDURE

Sample inventory locations were provided by the County, consisting of cemeteries, parks and on County-owned streets in Caledonia, Cayuga, Dunnville, Hagersville and Jarvis (Table 5.1). Data specified in the Terms of Reference and additional recommended information was collected from all trees in the specified areas. The variables assessed are shown and described in Table 5.2. Initial surveys began January 6, 2016 and were conducted variably until February 4, 2016. Final survey review was completed in late May and early June to assess tree health and vigour.

Table 5.1. Location of sample inventory in the five urban areas.

Town	Siting	Location
Cayuga	Street	Winnett St. from Hill St. to Brant St.
Cayuga	Street	Echo St. from Ottawa St. to Johnson St.
Cayuga	Park	Cayuga Kinsmen Park, 61 Ouse St. (lower Kinsmen)
Cayuga	Cemetery	Riverside Cemetery, 65 Cayuga St. South
Caledonia	Street	Caithness St. East from Edinburgh Square to Aberdeen St.
Caledonia	Street	Sutherland St. East from Edinburgh Square to Banff St.
Caledonia	Street	Wigton St. from Argyle St. to Haddington St.
Caledonia	Park	Caledonia Kinsmen Park, 49 Caithness St.
Caledonia	Cemetery	Caledonia Cemetery,150 Wigton St.
Dunnville	Street	Broad St. from George St. to Ramsey Dr.
Dunnville	Street	Alder St. from Niagara St. to George St.
Dunnville	Street	Pine St. from Main St. to Concession St.
Dunnville	Park	Dunnville Kinsmen Park, 985 John St.
Dunnville	Cemetery	Riverside Cemetery, Main St. West
Hagersville	Street	Howard St.
Hagersville	Park	Hagersville Park, 38 Sherring St. North
Hagersville	Cemetery	Ballsville Cemetery, 4488 Hwy #6
Hagersville	Cemetery	Hagersville Cemetery, 8904 Indian Line
Jarvis	Street	Talbot St. East and West
Jarvis	Street	Mary St.
Jarvis	Park	Jarvis Park, 1 James St.

The tree inventory attributes were developed based on the Norfolk and other municipal inventories and are shown in Table 5.2. Further explanation of attributes such as structure, vigour, risk, maintenance priority are found in Appendix C. Data was collected using Motion tablet computers with ArcPad™ software. Data was mapped and analyzed using ArcGIS 10.3.1™ and MS Excel™.

Table 5.2. Haldimand tree inventory variables collected with description.

Attributes	Data Type	Description/units
FID	Numeric	Computer generated number
SHAPE	Numeric	Represents point location of tree
ID	Numeric	Tree number (assigned individual value given to each tree).
Street Name	Text	Street name of tree location.
Municipal Number	Numeric	Street Address # or 911 #
Township	Text	Not used
Town	Text	Urban area.
Siting	Text	Boulevard, residential (between sidewalk & building), park, woodland or cemetery.
Ownership	Text	County, Private Landowner, shared/unclear.
Access	Text	Notes on access/location and aerial imagery.
Specie	Text	Menu of 242 species common and scientific name.
DBH	Numeric	Cm – measured-Diameter at Breast Height (1.3m).
Height	Numeric	Meters – Ocular Estimate of total height.
Crown Diameter	Numeric	Meters – Ocular Estimate.
Structure	Text	Poor, Fair, Good:
Vigour	Text	Dead, Poor, Fair, Good:
Risk	Text	Low, Medium, High (estimate of potential risk to people or property associated with the tree
Risk Problem	Text	Noted risk elements with the tree, such as hanging branch, deadwood, poor structure etc.
Maintenance Required	Text	Options for removing or limiting risk problems – includes pruning, crown reduction, deadwood removal, etc.
Maintenance Priority	Text	Low, Medium, High
Wire Conflict	Text	Hydro, Phone/Cable - No conflict, Potential conflict, Conflict
Insects	Text	EAB, Gypsy moth, other.
Date Survey	Date	Survey date.
Date Review	Date	Date of 2nd visit.
Surveyors	Text	Name of Surveyor
Comments	Text	Notes of useful information about said tree.

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5.3 SAMPLE INVENTORY RESULTS

This is a general overview of preliminary results. A more comprehensive analysis and reporting will be included in the final Management Plan. Table 5.3 summarizes the number of surveyed tree by specific location. Fifty-six species were identified.

The sample inventory assessed 1523 trees in the specific locations (Table 5.1) over a length of 10.9 km of streets (7.5 percent of the total length of 145 km) of all streets in the five urban areas. The inventory included approximately 16 and 13 percent of streets in Dunnville and Jarvis respectively, 8 percent of Cayuga streets, and 2 and 3 percent of streets in Hagersville and Caledonia respectively. The number of street trees ranged from 280 in Dunnville to 13 in Hagersville (Table 5.3).

The inventory also included 17 ha in cemeteries and 25 ha of parks. The cemeteries assessed, included the largest and most developed County-owned cemeteries with the exception of Dunnville Woodlawn Cemetery. Trees at five parks (25 ha) were assessed. All had sports fields except at Cayuga Kinsmen Park. Caledonia Kinsmen Park is owned by the Grand River Conservation Authority but maintained by Haldimand.

Table 5.3. Number of trees surveyed by site and urban area.

Urban Area	Cemetery	Park	Street	Total
Caledonia	168	105	95	368
Cayuga	155	30	85	270
Dunnville	96	77	297	470
Hagersville	111	135	13	259
Jarvis	-	108	48	156
Grand Total	530	455	538	1523

Silver maple was the most common species in the inventory, accounting for 20 percent of all trees surveyed. However it was more common among street trees where it was 26 percent of trees surveyed. Figure 5.1 shows the distribution of most common trees on the three main sites; streets, parks and cemeteries. Figure 5.2 shows the number of trees by diameter class of the four most common species and black walnut. Silver maple, in addition to being most common, had the highest number of large trees. Many ash were smaller trees - less than 20 cm, while Norway maple and Norway spruce had many medium-sized trees in the 21 to 50 cm size range.
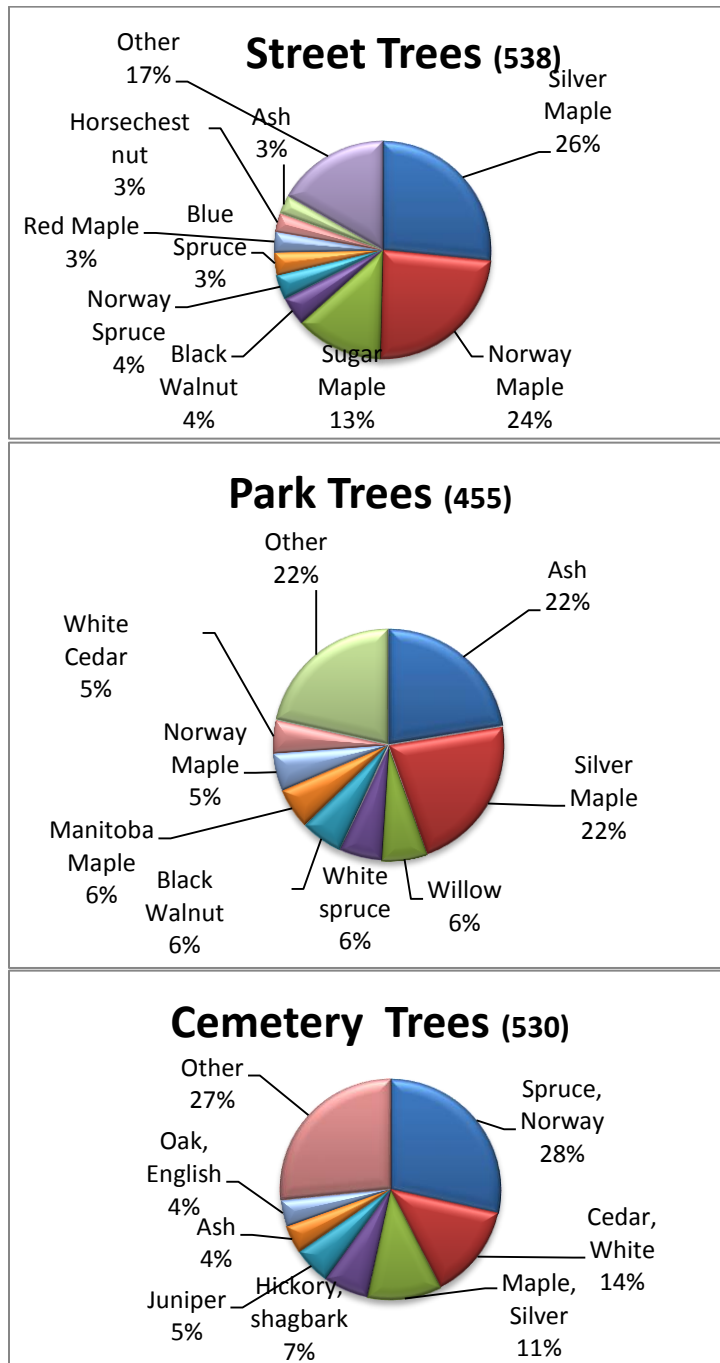
Figure 5.1. Main tree species on streets, in parks and cemeteries in five County urban areas.
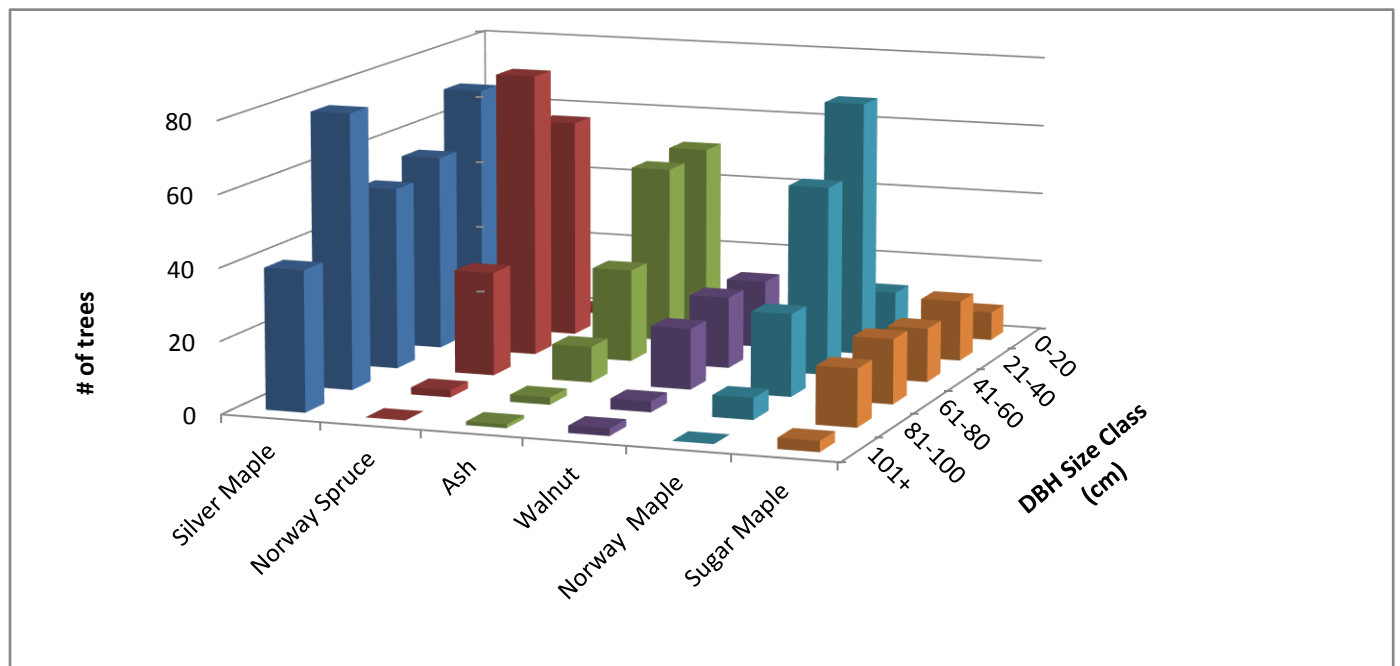
Figure 5.2. Number of trees by diameter distribution of most common species. (n=922)

Urban trees that are larger or poorly-maintained can be in conflict with public utility wires. Wire conflicts include hydro, cable/communications and telephone. For hydro lines, Haldimand Hydro (soon to be Hydro One) has a five-year maintenance schedule in Haldimand County. The five urban areas in Haldimand are scheduled for tree trimming and line clearance in 2016. Overall 46 percent of surveyed street trees were in conflict or had potential to be in conflict with utility wires. Sixty-seven percent of the wire conflicts were with the three maples that make up 63 percent of street trees (mostly older and larger). Only a few cemetery (20) and park (15) trees were or had potential to conflict with utility wires. Most streets with utility wires had current or potential wire conflicts.
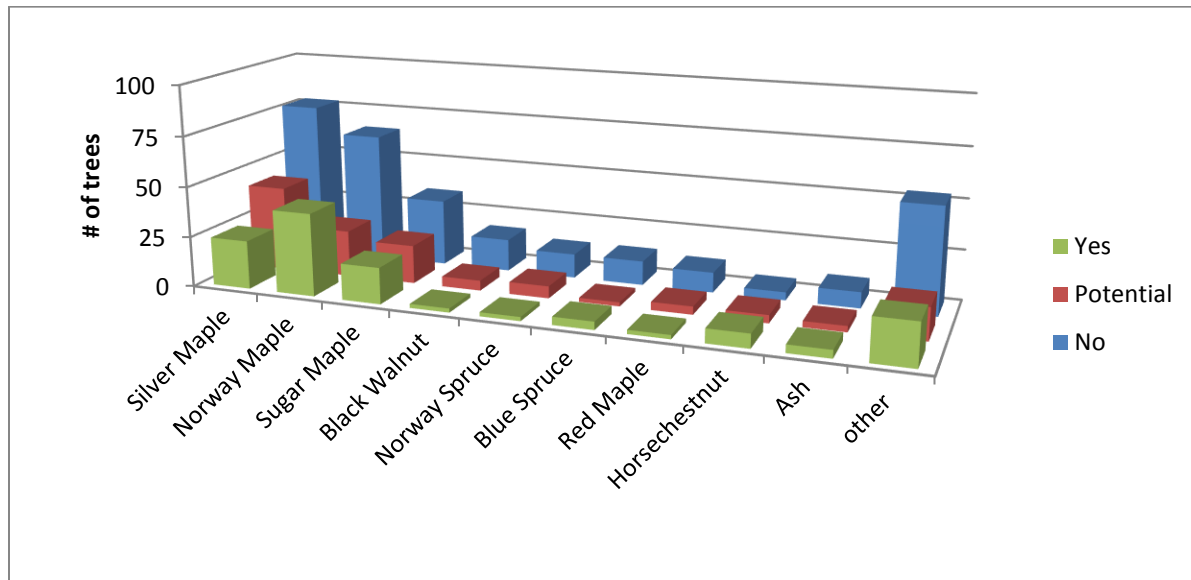
Figure 5.3. Number of street trees by common species with wire conflict. (n=538)

Figure 5.4 shows risk categories for most common species. A high risk tree is one where the possibility of a person or valued area/thing being obstructed by said tree is great and immediate. A low risk tree is unlikely to neither occur immediately nor cause significant damage. There are a number of high risk silver maples due to their age/size and location close to building or utility wires. Ash does not have many high risk trees because they were mostly smaller size and located in parks. However overall ash vigour is low (as is expected). The high-risk ash are street trees. Cedar and Norway spruce are low risk since most are in cemeteries and along the property borders. Maintenance needs are high among the large maple, both silver and Norway. Most maintenance work involves removing deadwood and various amounts of pruning.
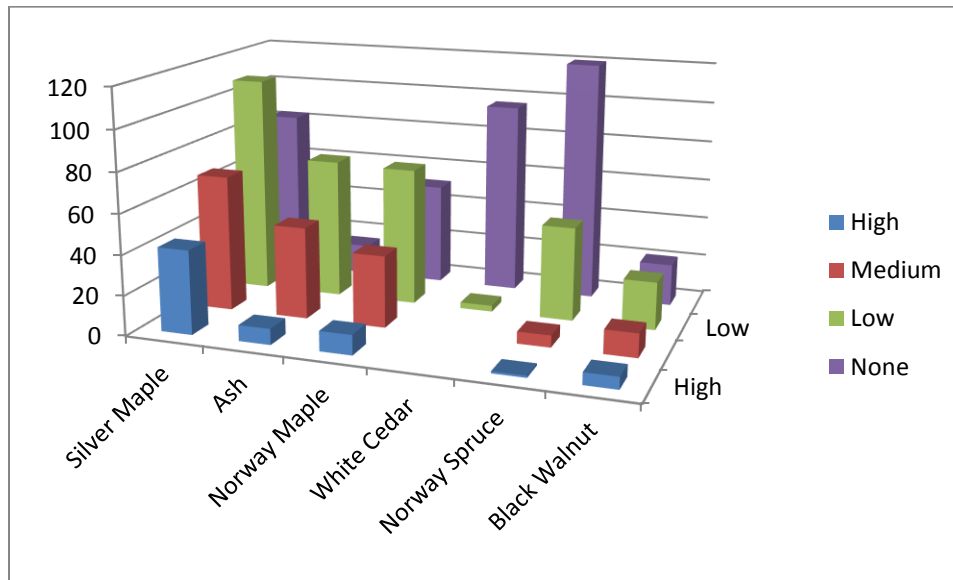
Figure 5.4. Risk categories of common species (n=943).

5.4 SUMMARY AND GENERAL OBSERVATIONS

Nearly 1,530 trees surveyed provide a reasonable indication of the urban forest population in the five urban areas. The Cemetery survey covered most of the important sites. Street trees surveyed covered only 7.5 percent of the streets although almost all of those surveyed were along streets with mature trees. Only 25 ha of park area were surveyed. No rural roads were surveyed.

The surveys indicated that Silver maple is the most common species (20% - primarily on streets), followed by Norway spruce (11% - most in parks & cemeteries), Norway maple (11 %) and Ash (9%, mostly in parks). Silver maple also had the highest number of large trees, most with maintenance needs. Silver maple has the most conflict with public utilities and because there are many large trees there are more maintenance requirements. Maintenance needs are high particularly on street trees.

The ash component will drop out within the next few years as ash are removed due to Emerald Ash Borer. There are only a few ash on the streets. Most are in parks and removal will generally be easier than for street trees. Removal of ash in areas of high concentration will result in a number of potential planting areas.

Although 56 species were identified, there is potential to plant other species. Other species could be planted in greater amounts. For example, there are very few Honey locust or Little leaf linden – both commonly planted urban tree – planted on County streets. Planting locations need to be identified.

6.0 CRITERIA AND INDICATORS FOR HALDIMAND COUNTY URBAN FOREST.

An important component of strategic planning is tracking of progress. In adaptive management, urban forest managers must be able to identify where specific goals or targets have been met and when adaptations to approaches appear to be necessary. Part of the development of strategies to achieve sustainable resource management has been the identification of criteria and indicators.

Kenney *et al.* (2011) have developed a comprehensive list of criteria and performance indicators for sustainable urban forest management. This list was derived from the work of Clark *et al.* (1997) and may be used to quantify progress in meeting key goals of a sustainable urban forest. They should be used to measure, monitor and evaluate the implementation of the Management Plan at the end of each 5- year period. The Tables found in Appendix D are a Baseline Assessment from 2016.

7.0 SUMMARY (WHAT DOES ALL THIS MEAN?)

Haldimand County covers a large area of southern Ontario above the northeast corner of Lake Erie and contains the lower channel and estuary of the Grand River. There are 45,200 people in five urban areas, numerous hamlets, Lake Erie and Grand River shoreline and an extensive rural area. Population projections predict population growth in the north closer to Hamilton and stagnant in the south. The County is rich in natural areas and has 14 percent tree cover. The County owns 695 ha of land, of which 155 ha is managed forest, 203 ha of parks and 31 ha of cemeteries, and approximately 1,500 km of roads and streets. Depending on location and public use, the County has varying responsibility to deal with tree management issues on its property. However, most maintenance and concern is with county-owned trees in urban areas because of their significant amenity contributions to the community and safety concerns.

The Official Plan pays little reference to trees and forests and most references apply to planting trees on private land. The County Urban Design guidelines apply mostly to private land and has funded Streetscape Plans that involve tree planting for urban areas and selected hamlets. A number of by-laws consider protection for established trees including Property Standards, Public Conduct on County Property, Cemeteries, Public Park and Facilities. There is a Forest Conservation by-law to regulate harvest of trees in areas greater than one hectare and Haldimand contracts Norfolk County to provide support for this by-law. In addition to municipal by-laws, some Conservation Authority regulations and provincial laws t may have some impact on management of County trees and forests.

Haldimand County has a Community Partnership Program that provides grants for planting trees for various purposes. The Rural Water Quality Program, a county-sponsored Conservation Authority program provides assistance for landowners to plant trees on their own properties. As well, the Conservation Authorities and Forests Ontario provide incentives for tree planting. Community groups are recognized and involved in various tree planting projects.

Five Divisions or Departments are involved in tree-related issues, including Facilities and Parks, Roads, Planning and Economic Development, Community Development & Partnerships and By-law Enforcement.

Presently tree establishment is mostly in new development on private lands (where design criteria are in place), streetscape plantings cemetery and park developments, and community projects. However there are no guidelines for tree placement, species, size, etc. on County-owned lands. Tree replacement is of particular concern with the anticipated and current removal of ash trees.

There is no comprehensive tree inventory of County-owned trees. A sample inventory was completed as part of this strategy and the contract arborist has collected some inventory information and on specific projects and as work orders are completed. An inventory is one of the most important tools to support policy and management actions.

Roads Operations is responsible for tree maintenance issues on 1,500 km of County right-of-way. Parks and Facilities Operations is responsible for tree maintenance in parks and cemeteries. Tree maintenance is conducted on a complaint and/or risk basis. Pruning is conducted on trees through customer service/work orders and generally contracted to a local tree service following direction of the Norfolk Contract Arborist. High risk or specialized work is contracted to a tree service company. There is no corrective/structural pruning program for young trees. Both Operations groups have had a substantial increase in work orders for tree work in the past few years. There is a serious backlog of tree pruning required. Utility line maintenance is carried out by Haldimand Hydro (change to Hydro One in 2016).

The County does not have a formal process to assess and catalogue risk, have a tree risk management policy, a post-storm inspection protocol or inspection process associated with publicly-owned trees. Tree risk issues are usually identified through customer service requests or observations by staff or contactors doing other tasks. With no assessment protocol, the County is potentially vulnerable when damage or safety issues arise.

Tree protection policy for construction near County-owned trees is not standardized. Generally trees in parks and cemeteries are protected through by-laws. The County has recognized that tree protection is required in development projects and infrastructure upgrades. A formalized policy would ensure some standard of protection and recognize the value of existing trees.

The benefits of urban trees and forests are well documented and include environmental, social, cultural, engineering and economic aspects. Trees are considered green infrastructure in urban communities. Unlike traditional municipal infrastructure such as transportation systems that depreciate, green infrastructure accrues in value and provides greater benefits to the community as time passes.

There are many threats and challenges to trees and forests in Haldimand County. Most of these are common issues for southern Ontario municipalities. Most large urban centers have developed inventory, policies and plans that recognize the value of the urban forest and identify measures to protect it. Presently Haldimand has limited policy to plan and manage the existing forest and forest renewal. There is a lack of information regarding County-owned trees. The sample inventory for this project indicated

that most of the tree cover is older, composed of a few species, and needs considerable maintenance work to mitigate risk associated with numerous structural and health problems. See Inventory Summary, Section 5.4.

New policies can help ensure placement of trees in the right location, protect existing trees during infrastructure work and development; increasing tree diversity; prescribe pruning and maintenance procedures; help deal with some plant, pest and pathogen issues; and give consideration for climate change and associated extreme weather events.. The most important potential impacts include drought stress, storm damage, and conditions that favour a proliferation of tree insects, diseases and invasive plant species. Some of these pests already occur in Haldimand and others are likely to become problems in the future. A proactive program that guides day to day operations and activities that improve the resilience of the urban forest, and a reactive program that can respond to extreme events such as ice storms, drought, wind, and insect and disease outbreaks will benefit the entire Haldimand community.

The development of a Forest Strategy and Management Plan for Haldimand indicates a high level of commitment to protecting trees, and it indicates a higher level of awareness about natural resource issues in general. The benefits of trees can be maximized when both professional management resources and an informed public coexist. The County will conduct a community engagement process to educate staff and citizens and to encourage involvement in protecting and building the County trees and forests. Other resources such as an informative website prove beneficial in informing the public.

Finally, adequate resources must be allocated to ensure necessary planning and implementation. Proactive planning and tree maintenance is more economical than dealing with contingencies and is an important investment. Sustained support for urban forest initiatives will be important to keeping Haldimand a vibrant and livable community, with due diligence over its urban forest assets.

8.0 NEXT STEPS

Development of Draft Management Plan
Main Components
      Sample Inventory Results and options for full inventory
            Urban tree asset management
      Using regulation to protect, manage and grow the forest
      Tree Health and Maintenance
            Pruning and maintenance
            Risk assessment and liability mitigation
            Tree removal guidelines
      Tree replacement protocol
            Tree species
            Tree establishment
      Promotion, Education, Stewardship & Partnerships
            Incorporate Public meeting results
            Outreach Using Public Websites and Social Media Marketing
            Stakeholder Engagement & Fostering Community Partnerships

        Funding Opportunities and Incentives
    Emerald Ash Borer Plan
        Impact of EAB on County land
    Urban Wood Waste and Revenue Opportunities
    Budget and Financial Implications
    Recommendations

Finalize Management Plan

Present to Council
Implementation of Management Plan

GLOSSARY OF TERMS

Adaptive Management is the systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In response to these imperfect predictions, planning and management strategies are modified frequently as better information becomes available.

Biodiversity is the total diversity of all organisms and ecosystems at various spatial scales (from genes to entire biomes).

Climate Change is a significant and persistent change in an area's average climate conditions or their extremes.

Hazardous Lands means property or lands that could be unsafe for development due to naturally occurring processes. Along the shorelines of the *Great Lakes - St. Lawrence River System*, this means the land, including that covered by water, between the international boundaries, where applicable, and the furthest landward limit of the *flooding hazard*, *erosion hazard* or *dynamic beach hazard* limits. Along *river*, *stream and small inland lake systems*, this means the land, including that covered by water, to the furthest landward limit of the *flooding hazard* or *erosion hazard* limits.

Hazard Tree is a tree that has structural defects in the roots, stem, or branches that may cause the tree or tree part to fail, where such failure may cause property damage or personal injury.

Heritage Tree
A heritage tree may consist of the following:
- A notable specimen because of its size, form, shape, beauty, age, colour, rarity, genetic constitution or other distinctive features;
- A living relic that displays evidence of cultural modification by Aboriginal or non-Aboriginal people, including strips of bark or knot wood removed, test hole cut to determine soundness, furrows cut to collect pitch or sap, or blazes to mark a trail;
- A prominent community landmark;
- A specimen associated with a historic person, place, event or period;
- A representative of a crop grown by ancestors and their successors that is at risk of disappearing from cultivation;
- A tree associated with local folklore, myths, legends, or traditions.
- A tree that has been designated under Part IV of the Ontario Heritage Act

Nuisance (tree)
Nuisance is largely an undefined term as it depends on individual interpretation. The closest definition would include "unnecessary hardship"

A **streetscape plan** identifies the specific places where investments will be made in the public realm to make the urban design Vision a reality. It usually includes a design concept for the public right of way

(streets and sidewalks) including urban amenities, such as lighting, street furnishings, and benches. In some instances, it also considers the façades of existing buildings, and the relationship between buildings and the street – such as patios.

Tree Risk Management is the process of inspecting and assessing trees for their potential to injure people or damage property. Trees will vary, ranging from low- to high-risk for failure and may require attention immediately or in the near future. The threshold of risk acceptable to liable parties is dependent upon their policies and objectives. Trees that surpass the level of acceptable risk are hazards from a programmatic viewpoint.

The two guiding principles of tree risk management programs are:
• Increase public safety
• Promote tree health and sustainability

Urban Design Guidelines are a tool used in the municipal decision-making process to ensure that space is developed to reflect the intended look and feel of a given setting. To make a vision real, it is necessary to have Urban Design Guidelines that quantify, regulate and monitor changes in the urban environment.

Urban Forest refers to the trees, forests, greenspace and related abiotic, biotic and cultural components in areas extending from the urban core to the rural fringe.

Urban Forest Sustainability is managing the naturally occurring and planted trees to provide the community with a continuing level of economic, social, environmental and ecological benefits today and into the future.

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APPENDICES

APPENDIX A. HALDIMAND COUNTY REPORT PED-GM-02-2015
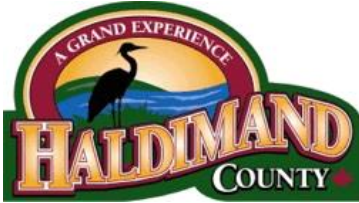
HALDIMAND COUNTY

REPORT PED-GM-02-2015
OF THE GENERAL MANAGER OF PLANNING AND ECONOMIC
DEVELOPMENT
FOR CONSIDERATION BY COMMITTEE OF THE WHOLE

RE: Haldimand County Tree Management

OBJECTIVE: To seek Council's approval for staff to further research tree management best practices across Haldimand County and report back with a proposed strategy.

RECOMMENDATIONS:

1. THAT Report PED-GM-02-2015 Re: Haldimand County Tree Management dated March 2, 2015 be received;

2. AND THAT staff be directed to bring forward a Tree Management Strategy to address inventory creation, timely maintenance, Emerald Ash Borer mitigation, revenue exploration and replanting matters for Council consideration;

3. AND THAT the County's Community Partnership Capital Grant Program be amended to include tree planting on municipal property as an eligible category of grant funding;

4. AND THAT revenues collected pursuant to the County's Forestry Conservation By-law and from harvesting of Haldimand County owned woodlots be held as a source of funding for expenditures needed to implement Haldimand County's Tree Management Strategy, as presented for consideration in future years' budgets.

Prepared by:

Zach Gable, MAES, EcD, CEcD
Research Technician
Date: March 2, 2015

Respectfully submitted: Approved:

Craig Manley, MCIP, RPP   Donald G. Boyle
General Manager   Chief Administrative Officer
Planning & Economic Development Department

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BACKGROUND:

In May of 2014, Council put forth the following motion:

> *"That prior to the 2015 budget, staff investigate and report back regarding options and financial implications and parameters of a program to encourage tree planting on street boulevards and other public lands in partnership with community stakeholders."*

Benefits of Trees to the Community

There is growing evidence of the benefits that trees can have on a community, with many economic, social, and environmental spin-offs. For instance, a recent study prepared for the City of Toronto indicated that its urban forest, of an estimated 10 million trees, has a perceived value of $7 billion when attributing a dollar value to the benefits they create for the City.

Some of the benefits associated with trees include:

- Trees make a positive aesthetic impact helping to boost community pride and place-making.
- Trees can help protect municipal infrastructure by absorbing precipitation.
- Trees provide rain, sun and heat protection for pedestrians thus encouraging walkability.
- Trees reduce the impacts of vehicle emissions for improved air quality.
- Reduction in temperature of asphalt and residences from shade trees which can lead to energy savings and longer pavement life.

Source: *Urban Street Trees, 22 Benefits* Dan Burden (2006)

- Conserve biodiversity, enhance or protect wildlife habitat, watersheds and other values, and reduce the build-up of greenhouse gases (a major cause of climate change).
- Support Ontario communities, provide recreation opportunities (hiking, hunting, fishing and more), and provide a healthy living environment.

Source: *Ministry of Natural Resources*

Trees are also an important element to the natural heritage of Haldimand County with the existence of Carolinian forest species which is unique to this part of the Province.

Scan of Other Tree Planting Programs

In accordance with the Council resolution of May 2014, staff investigated street tree planting programs undertaken by other municipalities and other organizations. These programs typically allow a resident, without any trees on the municipal right-of-way in front of their property, to request a tree which is then planted by municipal staff. Staff must ensure that there is an appropriate setback and that the tree will not interfere with utilities.

It became apparent through this review that these programs were undertaken by municipalities with dedicated forestry staff with forestry management plans and in some cases, municipal nurseries, which substantially lowers the cost of new plantings. The City of St. Catharines has a budget of $300,000 to be used strictly for the planting of trees on boulevards and parks.

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Sample Tree Planting Programs in Ontario

Program Type	Example Community	Process
Municipal Tree planting	City of St. Catharines, City of Brantford, City of Hamilton, City of Toronto	Residents request a tree to be planted on municipal right-of-way; tree is professionally installed.
Cost Sharing	LEAF program in Toronto	Backyard tree planting program in Toronto. City contributes and homeowner pays a reduced price for consultation, tree, delivery and planting.
Rebate	Peterborough Green-Up	Residents pick up a list of approved tree species from the Green-Up office, along with a coupon entitling them to a 50% rebate on the cost of purchasing a new tree (maximum rebate $50) .

While there are numerous economic, social and environmental benefits which could be obtained through the planting of new trees on municipal right-of-ways, cross-departmentally Haldimand staff agree that money spent on a tree planting program would be of greater benefit if used to undertake improved forestry management best practices in the County, to address existing conditions.

ANALYSIS:

Existing Tree Related Initiatives in Haldimand County

Private Lands:

Existing trees in woodlands in Haldimand County are protected by the Regional Municipality of Haldimand-Norfolk Forest Conservation By-law 15-00. This by-law pre-dates municipal restructuring however, remains in effect for regulating the cutting or destruction of trees in woodlands in Haldimand County.

"Woodlands" are any area of land, 0.2 hectares in size or larger, having a density not less than:
  i.   1,000 trees, of any size, per hectare; or
  ii.   750 trees, measuring over 5 centimeters in diameter, per hectare; or
  iii.   500 trees, measuring over 12 centimeters in diameter, per hectare; or
  iv.   250 trees, measuring over 20 centimeters in diameter, per hectare; and
  v.   Does not include a cultivated fruit or nut orchard, or a plantation established for the purpose of producing Christmas trees.

Haldimand has a contract with Norfolk County for Forestry Conservation and Management Services to enforce this By-law and provide other limited services. The cost of these services in 2014 was approximately $26,110. This contract management activity is administered by the Building Controls & By-law Enforcement Division. **Attachment 1** outlines the scope of work associated with the Forestry contract.

Haldimand County presently partners with a variety of organizations including the Grand River Conservation Authority, Niagara Peninsula Conservation Authority, Long Point Region Conservation Authority and Haldimand Stewardship Council Inc. for administration of the Rural

Water Quality Program (RWQP) which offers incentives for a variety of projects including tree planting and living snow fences. Launched in 2012, funds leveraged through the RWQP has aided in the planting of over 21,400 trees in rural areas of Haldimand County.

When new development is reviewed for approval by the County, trees are encouraged on all types of development through site plan approval. In new subdivisions, one tree is required to be planted per lot and two on corner properties. Please note that these trees are planted on private property, not municipal right-of-ways.

Public Lands:

Within the urban areas of Haldimand County, the Facilities and Parks Operations Division accepts donations for the planting of new trees on public lands. Given resource limitations, the work is currently completed by a contractor. To address potential liability issues, tree planting locations must be carefully selected to avoid damaging infrastructure. Plantings must be done with consideration of drainage, safety, crime prevention, maintenance, and the movement of people. Trees are removed when a public safety hazard is identified, however, there is no tree inventory or tree management program currently available. The cost to Haldimand County for a contractor to obtain locates and plant a tree of the required caliber is estimated at $400 - $500 per tree.

Currently, trees within the public road allowance are managed by the Roads Operations Division. As time permits, staff undertake tree removals and tree trimming but a significant portion of tree removal is contracted out. The Roads Operations Division budgets $109,000 per year for contracted tree removal services. Currently, there is no dedicated tree replacement program in place due to limited funding. The County presently does not have an inventory of trees on the public road allowance.

In the downtown areas, street trees have also been planted as part of recent streetscaping plans, with the downtown business associations partnering to undertake basic maintenance (i.e. watering). With the investments made to improve the quality of the downtown areas, there is increasing demands to replace dead trees in a timely manner. Additional trees have been planted on public property through the Community Development and Partnerships Division on a very limited basis as part of Community Beautification projects.

Existing Conditions of Trees Located on Municipal Property

There are growing indications that, throughout the County, existing trees on public lands are reaching end of life and are deteriorating. Once a tree dies it can become more brittle creating a hazard to the immediate area, and is more costly to remove. The County has an obligation to ensure trees on public property do not create a hazard. Over the past five years, there has been a noticeable increase in insurance claims where trees on public property are alleged to have caused damage to private property.

The Roads Operations Division has seen an increase in tree management activity. This Division receives requests from residents for trees to be assessed or removed, which creates a work order. In 2014, 253 work orders were created. This is an increase from 2013 which saw 230 work orders, which was a substantial increase from the 68 reported work orders in 2012.

The Facilities and Parks Operations (FAPO) Division has also experienced increased tree maintenance and removal costs in various parks and cemeteries. In 2014, $15,840 was spent by FAPO on contractors for tree maintenance and removal in parks and cemeteries; this is a sizeable increase from the $4,752 spent in 2010.

It is expected that these issues will be exacerbated by the recent arrival of the Emerald Ash Borer (EAB). Ash is a significant part of the Carolinian forest and Haldimand County appears on the list of regulated areas by the Canadian Food Inspection Agency with several confirmed cases of EAB infestation (See **Attachments 2** and **3**). EAB has killed millions of ash trees in Southwestern Ontario. Trees infected with EAB have a mortality rate of nearly 100%. Across the Province ash trees make up 10 - 40% of the canopy coverage. Without a tree inventory it is difficult to project the impact of the EAB County-wide, but it is anticipated to be significant. It is clear, however, that the combined impact of EAB and increasing public demands to address street tree conditions, particularly in the urban areas, will likely have major community and ecological impacts to the urban tree canopy within the next ten years.

EAB also could have a significant impact on the County's parklands. A recent (2014) inventory of the Lion's Park in Dunnville indicates that 329 of the 382 trees in the park (86%) are the ash species and are vulnerable to EAB. The arborist contracted by the County has examined these trees and has indicated that a quick decline in the park's tree health will likely occur this year and next.

The above information suggests that increasing demands to remove and maintain existing trees due to age, condition and infestation from the EAB, is straining existing resources and is creating liability issues. In addition, there is no program in place to replace trees that need to be removed in order to restore forest cover over time. Staff are of the opinion that the County needs to put in place a structured forestry management framework to address these issues. The first step in this process is to develop a Tree Management Strategy that defines the scope of the work, the cost, and the method of service delivery.

Tree Management Strategy

The development of a Tree Management Strategy will specifically consider the following forestry management activities to help address the issues identified above:

- **Obtaining Better Inventory Information**: There is currently a lack of information in regards to the number, species and condition of trees across the County outside of arborist reports for problem areas. In the short term, sample inventories of key areas would assist in better defining expected demands on resources by understanding and extrapolating information relating to the type, age and health of the species. This information can be used to understand shade cover and locations of future plantings. Species-age distribution can help model what the changes to County trees look like over time to help anticipate future needs. It is suggested that the focus should be on the major urban settlements, active parks and cemeteries, as this is where the impact of tree loss will be most evident, where risks to the public are highest and where environmental benefits from trees are highest. This inventory information would form the basis of subsequent maintenance programs. In the longer term a more comprehensive inventory could become part of the County's Geographic Information System (GIS) data to be used to prioritize resources. The tree management strategy will help identify priority

inventory areas, the necessary degree of tree asset evaluation and the resources required to undertake this work.

- **Program Funding**: Based on the tree inventory and tree condition analysis, the strategy will develop a program budget that includes consideration of existing expenditures in the Facilities and Parks Operations and Public Works functions for tree related matters and any additional funding or other resource needs that may be required to implement it. The program funding evaluation should also include an economic analysis of existing wood products from the active tree maintenance and removal. Revenue from these wood products could help offset some of the maintenance costs. By-products such as sawdust and wood chips have value as they can be repurposed as pellets or mulch. Large pieces of marketable wood could be sold as firewood or for use in furniture and wood-working. Finally, the program funding should include revenues collected pursuant to the County's Forestry Conservation By-law and from the periodic harvesting of Haldimand County owned woodlots to be held and applied as a source of funding for the program.

- **Tree Replacement on County Lands:** Current resources are used primarily to remove dead and dangerous trees. The County does not have a tree replacement policy or program in place. Norfolk County forestry staff have adopted a policy that when street trees on public lands in the urban areas are removed, one tree is required for every 10 centimeters of diameter at breast height (DBH) removed. Thus, the removal of a tree with a DBH of 100cm would require 10 replacement trees. The replacement trees are targeted to specific replanting areas in order to maximize the cumulative impact and to ensure that new tree planting takes place in appropriate areas. The tree management strategy will include an assessment of an appropriate municipal tree replacement policy and the associated costs required to include tree replacement as part of the overall framework.

- **Planting Partnerships:** There are a number of dedicated organizations devoted to the preservation and planting of trees in Haldimand County. The County's Community Partnership Program (CPP) could be used to encourage civic groups to invest in a public tree replacement program where it aligns with identified municipal needs. To address the May 2014 Council resolution, staff are recommending that the CPP program be amended to include tree planting on municipal property as an eligible category of grant funding within the current annual funding allocation limit.

BUDGET/LEGAL IMPLICATIONS:

Based on the foregoing information, the Planning and Economic Development Department is introducing a New Initiative for Council's consideration during the 2015 Operating Budget deliberation process to develop an overall asset management approach through a Tree Management Strategy. This strategy will address tree management on public lands by setting out policy frameworks related to inventorying, maintenance and replacement activity.

Once a strategy is adopted by Council, it will allow the County to identify and remove declining trees and/or EAB infected trees in the public road allowance and in active parks and cemeteries before they become a safety risk and hazard to residents, and where possible, ensure timely replanting of appropriate native species trees in suitable locations. If approved, this $30,000

one-time new initiative to create a tree management strategy will be funded from the Insurance Reserve. The volume of deteriorating trees on County property also has the potential to impact the County's liability insurance policy due to the potential risk. A more proactive approach to maintain existing trees would help mitigate the County's future liability.

The Tree Management Strategy will be used to develop tree maintenance and replacement costs that will be incorporated into future Budgets for review and evaluation within the corporate priorities. As this enhanced program is anticipated to be over and above the current service level, it will ultimately impact the County's existing long range capital funding plan and associated operating costs.

Currently, the County has a small sum of money ($2,700) resulting from enforcement of the Forestry Conservation By-law. On a very infrequent basis, the County also receives proceeds from the sale of timber from municipally owned woodlots (2014 saw proceeds of $21,000 from the harvest of woodlots, but this was the first sale of timber in many years given the limited number of County owned woodlots). Staff recommends that the revenues from these tree related activities be held as a source of funds to help offset the future cost of tree management initiatives.

INTERDEPARTMENTAL IMPACTS:

Currently, tree management is reactive and is distributed amongst three separate operating Divisions:

- Building Controls and By-law Enforcement Division – tree protection in woodlots;
- Roads Operations Division – trees within the public road allowance; and
- Facilities and Parks Operations Division – trees within parks and cemeteries.

There is no comprehensive approach taken to manage trees on public lands or to develop tree related policies and procedures. Currently, tree management matters impact resources in the Divisions of Roads Operations, Facilities and Parks Operations and Support Services, as well as, impacting all Divisions in the Planning and Economic Development Department.

LINKS TO STRATEGIC PLANS:

This initiative supports the Corporate Strategic Pillar of Community Vibrancy and Healthy Community, as well as Corporate Image and Efficient Government.

The project also aligns well with other County projects such as:

- Active Transportation
- Urban and Rural Streetscaping Plans
- Rural Water Quality Program

CONCLUSION:

With the growing evidence of deteriorating tree conditions and threats from invasive species, Haldimand County should work to establish a forestry management framework to include inventory creation, timely maintenance, and mitigation of the effects of invasive insects such as the Emerald Ash Borer, preservation and planting. The first step in this regard is to develop a

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tree management strategy. If Council approves the 2015 budget initiative to develop a long term approach, a future report will be presented outlining a proposed Tree Management Strategy. This strategy will then guide the development of future years' budgets required to implement this program

Appendix B.

Haldimand Contract with Norfolk County for Forestry Conservation and Management Services

1. Forest Conservation By-law Enforcement
- Notice of Intent (NOI) processing, Inspection, Summary Report
- Good Forestry Practices processing, Inspection, Summary Report
- Minor Exception processing, Inspection, Summary Report
- Statistical Development, Quarterly Reports
- Processing of General By-law inquiries from woodlot owners
- Forest Health Monitoring – Liaison with Provincial / Federal Agencies

2. Forest Management of County Owned Woodlots
- Forest Health Monitoring
- Boundary Delineation / Monitoring of Encroachment
- GIS Forest Stand Mapping
- Prescription Development, Tree Marking
- Tender Development
- Harvest Contract Supervision

3. Public Extension
- Client inquiries
- Liaison with the Woodlot Owners Association
- Development / Partnership on Landowner Extension / Education Workshops
- Resource Information Development Distribution

4. Site Inspections / Planning / Development Application Review
- Review Planning / Development Applications
- Summary Report / Comments
- On-site meetings
- Development of alternative models / mitigation resources

5. Professional Arborist Consultation
- Review Planning / Development Applications
- Summary Report / Comments
- On-site meetings
- Development of alternative models / mitigation resources

Additional Services within Contract
6. Single Tree Assessment
- Provision of single tree assessments
a) to County - typically for trees that have shown excessive decay or appear
structurally unsound, i.e. parks, roads and other County lands
b) to citizens of the County (where approved by the municipality)
- The use is dependent on demands which relate to development pressure, natural
catastrophes (i.e. ice or wind event), and natural decline

7. Giant Hogweed Control
- Site investigation and identification of Giant Hogweed
- Trained staff to provide recommendations and/or eradication
- Licensed pesticide applicators and appropriate equipment to destroy

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Appendix C. Haldimand Tree Inventory. Selected variables collected with description

See Table 5.2 for complete list of variables.

VARIABLE	Data Type	Description/units
Structure	Text	**Good**: Growing straight without competing leaders, forks and or low branches. This can be dependent on specie. **Fair**: Tree is growing in a manner that corresponds to that individual specie and site conditions. **Poor**: Numerous defects and abnormalities are affecting the growth of the tree.
Vigour	Text	**Good**: Tree appears to be growing well with no significant stress or health factors. **Fair**: Tree shows normal stress and health factors for its specie and site conditions. **Poor**: Tree is demonstrating high levels of stress/health damaging defects and is growing slowly. **Dead**
Risk	Text	**High**: The possibility of a person or valued area/thing being obstructed by said tree is great and immediate. **Medium**: The possibility of a person or valued area/thing being obstructed by said tree is likely to occur eventually with variability in damage. **Low**: The possibility of a person or valued area/thing being obstructed by said tree is unlikely to neither occur immediately nor cause significant damage.
Risk Problem	Text	There is variability in potential hazards a tree might possess towards a person or valued area/thing such as hanging branches, deadwood, etc.
Maintenance Required	Text	There are several options available for removing or limiting risk problems a tree may have. This can vary from pruning, crown reduction, deadwood removal, etc.
Maintenance Priority	Text	**High**: The risk problem associated with said tree can potentially cause significant harm or damage and must be dealt with immediately. **Medium**: The risk problem associated with said tree has the potential to cause harm or damage and should be dealt with in a timely manner. **Low**: The risk problem associated with said tree is minor in severity and will unlikely be an issue any time soon.
Wire Conflict	Text	Hydro, Phone/Cable - **No conflict**: No aspect of the tree will interfere with wires. **Conflict**: Some aspect of the tree is interfering with the wires such as branches are touching wires. **Potential conflict**: No immediate hazards but as a tree develops its branches may interfere with the wires or the tree itself could fall on them.

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Appendix D

Criteria and Indicators for Haldimand County urban forest.
These Criteria and Indicators should be used to measure, monitor and evaluate the implementation of the Management Plan at the end of each 5- year period. The Tables are a Baseline Assessment from 2016. Criteria without shading either could not be measured or are not a goal of this Strategy and Plan.

Table A1-1. Criteria and performance indicators for the Vegetation Resource					
Vegetation Resource					
Criteria	**Performance Indicators**				Key Objectives
	Low	**Moderate**	**Good**	**Optimal**	
Relative canopy cover		The existing canopy cover equals 25-50% of the potential.	The existing canopy cover equals 50-75% of the potential.	The existing canopy cover equals 75-100% of the potential.	Achieve climate-appropriate degree of tree cover, community-wide
Age distribution of trees in the community	Any Relative dbh (RDBH) class (0-25% RDBH, 26-50% RDBH, etc.) represents more than 75% of the tree population.	Any RDBH class represents between 50% and 75% of the tree population	No RDBH class represents more than 50% of the tree population	25% of the tree population is in each of four RDBH classes.	Provide for uneven-aged distribution city-wide as well as at the neighbourhood level.
Species suitability	The existing canopy cover equals 0-25% of the potential**.**	50% to 75% of trees are of species considered suitable for the area.	More than 75% of trees are of species considered suitable for the area.	All trees are of species considered suitable for the area.	Establish a tree population suitable for the urban environment and adapted to the regional environment.
Species distribution	Fewer than 5 species dominate the entire tree population city-wide.	No species represents more than 20% of the entire tree population city-wide.	No species represents more than 10% of the entire tree population city-wide.	No species represents more than 10% of the entire tree population at the neighbourhood level.	Establish a genetically diverse tree population city-wide as well as at the neighbourhood
Condition of Publicly-owned Trees (trees managed intensively)	No tree maintenance or risk assessment. Request based/reactive system. The condition of the urban forest is unknown	Sample-based inventory indicating tree condition and risk level is in place.	Complete tree inventory which includes detailed tree condition ratings.	Complete tree inventory which includes detailed tree condition and risk ratings.	Detailed understanding of the condition and risk potential of all publicly- owned trees
Publicly-owned natural areas (trees managed extensively, e.g. woodlands, ravine lands, etc.)	No information about publicly-owned natural areas.	Publicly-owned natural areas identified in a "natural areas survey" or similar document.	The level and type of public use in publicly-owned natural areas is documented	The ecological structure and function of all publicly-owned natural areas are documented and included in the city-wide GIS	Detailed understanding of the ecological structure and function of all publicly-owned natural areas.
Native vegetation	No program of integration	Voluntary use of native species on publicly and privately- owned lands; invasive species are recognized.	The use of native species is encouraged on a project-appropriate basis in both intensively and extensively managed areas; invasive species are recognized and their use is discouraged.	The use of native species is required on a project-appropriate basis in both intensively and extensively managed areas; invasive species are recognized and prohibited.	Preservation and enhancement of local natural biodiversity

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Community Framework

Criteria	Performance Indicators				Key Objectives
	Low	**Moderate**	**Good**	**Optimal**	
Public agency cooperation	Conflicting goals among departments and or agencies.	Common goals but no cooperation among departments and/or agencies.	Informal teams among departments and or agencies are functioning and implementing common goals on a project-specific basis.	Municipal policy implemented by formal interdepartmental/ interagency working teams on ALL municipal projects.	Insure all city department cooperate with common goals and objectives
Involvement of large private and institutional land holders	Ignorance of issues	Educational materials and advice available to landholders.	Clear goals for tree resource by landholders. Incentives for preservation of private trees.	Landholders develop comprehensive tree management plans (including funding).	Large private landholders embrace city-wide goals and objectives through specific resource management plans.
Green industry cooperation	No cooperation among segments of the green industry (nurseries, tree care companies, etc.) No adherence to industry standards.	General cooperation among nurseries, tree care companies, etc.	Specific cooperative arrangements such as purchase certificates for "right tree in the right place"	Shared vision and goals including the use of professional standards.	The green industry operates with high professional standards and commits to city-wide goals and objectives.
Neighbourhood action	No action	Isolated or limited number of active groups.	City-wide coverage and interaction.	All neighbourhoods organized and cooperating.	At the neighbourhood level, citizens understand and cooperate in urban forest management.
Citizen-municipality-business interaction	Conflicting goals among constituencies	No interaction among constituencies.	Informal and/or general cooperation.	Formal interaction e.g. Tree board with staff coordination.	All constituencies in the community interact for the benefit of the urban forest.
General awareness of trees as a community resource	Trees seen as a problem, a drain on budgets.	Trees seen as important to the community.	Trees acknowledged as providing environmental, social and economic services.	Urban forest recognized as vital to the communities environmental, social and economic well-being.	The general public understanding the role of the urban forest.
Regional cooperation	Communities cooperate independently.	Communities share similar policy vehicles.	Regional planning is in effect	Regional planning, coordination and /or management plans	Provide for cooperation and interaction among neighbouring communities and regional groups.

Table A1-3. Criteria and performance indicators for the Resource Management Approach					
Resource Management Approach					
Criteria	**Performance Indicators**				Key Objectives
	Low	**Moderate**	**Good**	**Optimal**	
Tree Inventory	No inventory	Complete or sample-based inventory of publicly-owned trees	Complete inventory of publicly-owned trees AND sample-based inventory of privately-owned trees.	Complete inventory of publicly-owned trees AND sample-based inventory of privately-owned trees included in city-wide GIS	Complete inventory of the tree resource to direct its management. This includes: age distribution, species mix, tree condition, risk assessment.
Canopy Cover Inventory	No inventory	Visual assessment	Sampling of tree cover using aerial photographs or satellite imagery.	Sampling of tree cover using aerial photographs or satellite imagery included in city-wide GIS	High resolution assessments of the existing and potential canopy cover for the entire community.
City-wide management plan (PLAN IN DEVELOPMENT)	Plan in Development/No plan	Existing plan limited in scope and implementation	Comprehensive plan for publicly-owned intensively- and extensively-managed forest resources accepted and implemented	Strategic multi-tiered plan for public and private intensively- and extensively-managed forest resources accepted and implemented with adaptive management mechanisms.	Develop and implement a comprehensive urban forest management plan for private and public property.
Municipality-wide funding	Funding for reactive management	Funding to optimize existing urban forest.	Funding to provide for net increase in urban forest benefits.	Adequate private and public funding to sustain maximum urban forest benefits.	Develop and maintain adequate funding to implement a city-wide urban forest management plan
City staffing	No staff.	No training of existing staff.	Certified arborists and professional foresters on staff with regular professional development.	Multi-disciplinary team within the urban forestry unit.	Employ and train adequate staff to implement city-wide urban forestry plan
Tree establishment planning and implementation	Tree establishment is *ad hoc*	Tree establishment occurs on an annual basis	Tree establishment is directed by needs derived from a tree inventory	Tree establishment is directed by needs derived from a tree inventory and is sufficient to meet canopy cover objectives (see Canopy Cover criterion in Table 1)	Urban Forest renewal is ensured through a comprehensive tree establishment program driven by canopy cover, species diversity, and species distribution objectives
Tree habitat suitability	Trees planted without consideration of site conditions.	Tree species are considered in planting site selection.	Community-wide guidelines are in place for the improvement of planting sites and the selection of suitable species.	All trees planted in sites with adequate soil quality and quantity, and growing space to achieve their genetic potential	All publicly-owned trees are planted in habitats which will maximize current and future benefits provided to the site.

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	Performance Indicators				Key Objectives
Criteria	**Low**	**Moderate**	**Good**	**Optimal**	
Maintenance of publicly-owned, intensively managed trees	No maintenance of publicly-owned trees	Publicly-owned trees are maintained on a request/reactive basis. No systematic (block) pruning.	All publicly-owned trees are systematically maintained on a cycle longer than five years.	All mature publicly-owned trees are maintained on a 5-year cycle. All immature trees are structurally pruned.	All publicly-owned trees are maintained to maximize current and future benefits. Tree health and condition ensure maximum longevity.
Tree Risk Management	No tree risk assessment/ remediation program. Request based/reactive system. The condition of the urban forest is unknown	Sample-based tree inventory which includes general tree risk information; Request based/reactive risk abatement program system.	Complete tree inventory which includes detailed tree failure risk ratings; risk abatement program is in effect eliminating hazards within a maximum of one month from confirmation of hazard potential.	Complete tree inventory which includes detailed tree failure risk ratings; risk abatement program is in effect eliminating hazards within a maximum of one week from confirmation of hazard potential.	All publicly owned trees are safe.
Tree Protection Policy Development and Enforcement	No tree protection policy	Policies in place to protect public trees.	Policies in place to protect public and private trees with enforcement.	Integrated municipal wide policies that ensure the protection of trees on public and private land are consistently enforced and supported by significant deterrents	The benefits derived from large-stature trees are ensured by the enforcement of municipal wide policies.
Publicly-owned natural areas management planning and implementation	No stewardship plans or implementation in effect.	Reactionary stewardship in effect to facilitate public use (e.g. hazard abatement, trail maintenance, etc.)	Stewardship plan in effect for each publicly-owned natural area to facilitate public use (e.g. hazard abatement, trail maintenance, etc.)	Stewardship plan in effect for each publicly-owned natural area focused on sustaining the ecological structure and function of the feature.	The ecological structure and function of all publicly-owned natural areas are protected and, where appropriate, enhanced.

Resource Management Approach

Appendix E. Summary of Public Engagement

The County received 34 responses to the online survey. The table below shows the questions with summary data and comments. Reponses at the public meeting and by staff are found below without the questions repeated.

Ward #	1	2	3	4	5	6	na
What area of Haldimand County do you currently live in?	6	6	8	6	1	2	3

Are you male or female?	Male		Female	
	15		19	

What is your age?	21-29	30-39	40 49	50-59	60 +
	2	2	6	10	14

Vision	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q4. Haldimand County-being committed to preserving our natural beauty-values and is dedicated to protecting and managing its urban and rural forest. The County recognizes these forests provide environmental, economic, community and health benefits these forests provide to its residents	29	3				2
Comments	• What about 'increasing' the urban and rural forest as part of the vision??? Trees are being cut in the lakeshore area but there is no plan to replace these! • I don't feel this vision statement was followed in the past but I am hoping it holds true for the present and the future. I am optimistic but it needs to be proven. • roadside tree planting needed where road allowance permits					
Q5. Haldimand County will, in partnership with its residents, businesses and stakeholders, work to promote and increase urban forest coverage that is a diverse, healthy and sustained asset for future generations.	27	4	1			2
Comments	• Again proof is in the pudding as they say. Many homeowners cannot afford the cost of purchasing trees and having trees maintained. Perhaps an incentive program for homeowners would help.					

Guiding Principles	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q6. Increased understanding of the County's urban forest will support more effective management	28	1	1			4
Comments						
Q7 Trees are municipal infrastructure and managed within an integrated asset framework. Trees are part of the green infrastructure and considered a capital asset along with buildings, sewers, roads, etc.	25	3	1	1		4
Comments	• Although sewer work can kill trees. I have seen a beautiful 100 year old tree have to be cut down because of sewer work.					
Q8 The County strives to have efficient and cost-effective management of its urban forest.	20	6	3			5
Comments	• A forest strategy policy would be a great first step. • Hopefully Haldimand will have its own Forestry division instead of using Norfolk department. • Efficient, cost effective management needed for ALL county assets. Active management of trees more important for trees then most other infrastructure.					
Q9 County trees are maintained in a healthy and safe condition through good management practices such as pruning and mulching.	21	9				4
Comments	• To date, trees are managed only when necessary. There is no apparent proactive program. • And Regular Routine Inspection. • Pruning of trees and hedgerows is not well done. Often a hacking job and trees are cut around obstacles that then makes them lop sided and top heavy requiring more pruning or complete cut down in a few years. • I would like to see the County actually start pruning trees. Right now they just cut them down when they are dead. Many beautiful trees could have been saved with proper maintenance.					
Q10. The right tree is planted in the right place to establish and maintain an optimal level of age and species diversity, and to maximize benefits and minimize hazard, nuisance, hardscape damage, and maintenance costs.	25	5				4
Comments	• Many of the existing trees on county property are of inappropriate size and species. • However, does "right tree" mean an emphasis on 'native species' which will also assist our birds and insect life with their ongoing loss of habitat; need to add emphasis on native species					
Q11. The community is engaged in the support of the conservation, management and stewardship of the local urban forestry program.	21	3	4		1	5
Comments	• What does this mean in practical terms? • County should work with local horticulture groups and businesses. • I am not sure how this is working. I am not aware of any community initiatives where trees are concerned, just gardens and planters. They may be there and I just don't know it. • See answer to # 3 can only be accomplished when citizens are engaged as continuing participating partners.					
Q12. County trees are monitored and assessed periodically.	23	2	2	3		4

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Comments	• Monitoring would prevent hazardous situations with fallen limbs or trees. • County trees should be inspected, monitored and assessed, particularly in the urban areas, regularly on a routine inspection schedule basis. • Not specific enough; monitor for what? How often, remediation plans. • and inventoried • Not done by Haldimand but Norfolk • see # 3 • What is the minimum maintenance standard? 5 year inspection intervals? If so this standard should be adhered to. • I don't think that this is happening right now, but I would like to see it happen. The County should hire an arborist to assess the trees to ensure they are being properly maintained.					
Q13. An adaptive management approach is used to adjust management practices as needed using current information and research.	25	2	1	1		5
Comments	• To our knowledge, there has been little attention or research to threats regarding our county trees					
Q14. Well-managed privately owned trees contribute in large amount to the urban forest.	28	2				4
Comments	• We observe greater value placed on urban forests in surrounding cities than in Haldimand County.					
Q15. Work towards optimal levels of tree/canopy cover to maximize urban forest benefits.	28	1	1			4
Comments	• Educational workshops would be beneficial to Haldimand residents. Incentives such as provided by Haldimand County Stewardship Council are positive. • As privately owned trees are outside of the county's control, I don't believe they should be considered within the urban forest - owner could clear cut their property. • All County employees when travelling around in the course of their employment should be alert to trees being cut down on private land. • As said above, it takes money to maintain trees and many homeowners do not have extra to spend on arborists. I believe programs that reduce the cost of purchasing trees, educating homeowners on the right trees to plant for their property and providing free or discounted mulch by the county for homeowners would help. • Communication and citizen engagement important.					
Q16. New technologies are used to integrate trees in existing and new developed settings.	20	4	5			5
Comments	• Hopefully Haldimand County will see an opportunity with the new housing developments within their jurisdiction. • What is a new technology? • What does this mean • not sure what these technologies are					
Q17. Heritage tree policies are considered important.	29	2			1	5
Comments	• Given the opportunity, community members would likely submit suggestions. A contest or some means of recognition would help. • Nice statement but how does it apply in practical terms • Very important. • I don't believe heritage trees were considered important in the past. Just as I believe architecture of heritage value should be preserved, I sincerely hope that every effort will be used to preserve these trees.					

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Goals	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q18. To undertake an inventory of County-owned urban and roadside trees and forests to create an understanding of the age, composition and quality of trees and implications for maintenance, removal and replacement;	25	3	2			4
Comments	• Thank you for the opportunity for public input.					
Q19. To develop a policy framework, infrastructure and procedures for trees on County lands with respect to tree maintenance, removal practices and replanting so that the urban forest is recognized as green infrastructure and a municipal/community asset.	28	1	1			4
Comments	• It would be nice to see a replanting policy when a tree is removed. This is not the case now. I would also like to see developers have to replace all the trees that they cut down for their new housing projects.					
Q20. To improve the resilience of the urban forest to current and anticipated stressors, including climate change, pests and diseases by implementing policies and management practices that optimize tree species diversity, structure and age classes, with appropriate monitoring.	27	2	1			4
Comments	• Tree management is becoming increasingly important.					
Q21. To utilize human resources efficiently and effectively to address the tree-related activities.	26	2		1		5
Comments	• Community volunteers and organizations would be willing partners given leadership from their municipal council. • How would the human resources be utilized and at what anticipated cost? Using hydro crews to prune may not be the best use or correct use of resources. • community groups, schools Earthday each year tree planting throughout Haldimand					
Q22. To prioritize protection and maintenance of mature, healthy trees and preservation of older large-canopied species to the greatest extent possible.	28	1	1			4
Comments	• A priority. Preserve existing healthy trees. Stop destruction of trees solely for convenience or selfish gain. • I absolutely agree!! • many large farms, and those that are rented wide swaths of trees, wind rows, fence lines being removed, loss of habitat, only to use larger equipment but removing often very old growth that has withstood years of parasite, drought etc. *** should be discussed					
Q23. To transition towards proactive tree establishment and replacement whereby all potential plantable spots on the County lands are explored and apply "right tree, right place" principles, except where policy requires that new trees be planted on adjacent private property development	29	3				5
Comments	• Educational workshops, publications, seminars, news releases. Most importantly: municipal example. • I do not understand the statement • Why wouldn't the same policy be applied on both properties? • Would like more detail on requiring new trees on private property?					

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	• Nurture partnerships with adjacent property owners and engage in formal agreements were appropriate.					
Q24. To build awareness and engagement among County staff and the community, regarding the importance and value of the urban forest and the County's efforts to sustain this resource.	26	1	2			5
Comments	• Seminars, workshops organized by municipal staff are offered on tourism. Businesses and residents would benefit from the same effort on tree management. • schools					
Q25. To expand stewardship initiatives, and develop more partnerships that support the urban forest with initiatives such as tree planting and maintenance.	25	2	1			4
Comments	• Hopefully the county of Haldimand will develop along with the numerous MAPS, comprehensive brochures on tree and forestry initiatives using the Williams & Associates information. • Community groups capable of assisting in providing healthy trees at a much lower cost, utilize this contribution, currently county practice is to spend a lot on a tree for a warrantee!!! Why spend $1000 when a community group can provide same tree for $100 for reputable grower.					
Q26. To use new technologies in selected areas for integration of trees in hardscapes such as downtown and parking lots.	24	3	2			5
Comments	• In the past many unsuitable trees were unknowingly planted by well-intended folks. A comprehensive guide published by Haldimand County would be helpful. • Again I don't understand what a new technology is. However I'm all for planting and protecting trees in downtown cores. • As long as it is adding to, not taking away. • More green, an easier way to beautify concrete. • Although you may need to use a force field for the poor trees in front of the Victoria Hotel in Dunnville that where torn up last spring. Sad. • when the tree is planted, it can't be for forgotten needs regular watering first year, the uprights that support it, need to be adjusted, removed as trees grow, current streetscaped trees have gouging because rubber/wire uprights put on were forgot about never adjusted, neglected causing permanent damage on tree trunks.					
Q27. Based on the current plan, in year four, update the Forest Management Plan and associated Operating Plans to ensure the Forest Management Plan and operating budgets are updated on a regular basis.	27	2			1	4
Comments	• Follow-up to the study conducted by Williams & Associate is critical; otherwise, taxpayer's money has been wasted. County council is to be commended for contracting the study. • Hedgerows and trees located alongside public thoroughfares should also be included. • I think it is about time that the County realize the value of their trees and recognize how beautiful they make the community.					

Summary of Public presentation

Are you male or female?	Male		Female		
	7		2		

What is your age?	21-29	30-39	40 49	50-59	60 +
				3	6

Vision	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q4.	9					
Comments	• Google "Financial Post" and "Claire Brownell" and "Toronto Urban Forest is worth $7-billion". • Give this presentation to Grade 5 students. • Haldimand County can definitely use a keen attention to increasing tree management.					
Q5.	9					

Guiding Principles	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q6.	9					
Q7	9					
Q8	9					
Comments	• I have not seen this as principle advocated by most Councilors. • I do not think this is the current practice.					
Q9	9					
Comments	• Providing jobs perhaps.					
Q10.	9					
Comments	• Educated workshops possibly? Available through municipality.					
Q11.	8	1				
Q12.	9					
Comments	• If funding is an issue, I suggest partnership with appropriate organizations be established.					
Q13.	7	1	1			
Comments	• Humans are a threat also.					
Q14.	8		1			
Q15.	9					
Comments	• Privately owned trees (Ash) that HAVE to come down should be replanted with help					

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	from the county!!!!					
Q16.	7	2				
Q17.	8	1				
Comments	• Very important.					

Goals	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q18.	9					
Q19.	9					
Q20.	9					
Q21.	8	1				
Comments	• Include the use of Haldimand Wood Lot Assoc. & Stewardship for their help. • How is this to be done?					
Q22.	9					
Q23.	9					
Q24.	9					
Comments	• Very important. • I encourage publicity of Council's plan and hope that response is good.					
Q25.	9					
Comments	• Publicity is crucial. Educational effort essential.					
Q26.	7	1	1			
Q27.	9					
Comments	• Excellent presentation. • A well organized plan!!!					

Summary from Staff and Council

Are you male or female?	Male		Female		
	9		4		

What is your age?	21-29	30-39	40 49	50-59	60 +
	1	3	5	4	

Vision	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q4.	9	3		1		
Comments	• "Protecting" sets a mindset with residents & we already have many complaints from residents that see a green tree & don't understand that it is not healthy or is a liability to property.					
Q5.	10	3				
Comments	• Would like to eventually see canopy % targets for communities to engage in and aim for.					

Guiding Principles	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q6.	12	1				
Comments	• I think it makes sense to get buy in for private trees as well					
Q7	8	5				
Q8	8	5				
Q9	11	2				
Comments	• Based on the presentation-training on proper pruning techniques is required. • Resources will need to be committed to this. • This will be extremely costly. Training is required and increased staffing level.					
Q10.	12	1				
Comments	• The decisions need to be made by a qualified person educated in forestry. • Good idea to try to have more trees on private property and less in the road allowance area. 100% agree with parks and cemeteries • Need in house expertise in tree species, maintenance procedures					
Q11.	11		1	1		
Comments	• Caution in that "squeaky wheel" (tree hugger) will be the main body that is heard. • I think the community should support a good program.					
Q12.	10	1	1		1	
Comments	• As budgeting allows. • The management plan needs to outline who is responsible for what as there are so many cross divisional things happening in relation to trees • Again, an increase in funding and staffing levels, and training is required					
Q13.	10	1		2		

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Q14.	11		1	1		
Comments	• See comment on first page. • I think some of the tree canopy and replacement needs to take place on private property to minimize cost impacts an maintenance long term.					
Q15.	13					
Comments	• Support for private trees is needed. Be it educational to start					
Q16.	8	4	1			
Q17.	8	3	1	1		
Comments	• We should be including a heritage tree policy in this plan. It is an important part, and involves public safety... as many trees are not removed because we 'think' they may be heritage and a clear program would help with that					

Goals	I agree	I can live with it	I have no opinion	I don't like it	I funda-mentally disagree	Skipped
Q18.	10	2				1
Comments	• Will need to hire a specialist to manage this plan.					
Q19.	8	3				2
Q20.	8	3	1			1
Q21.	9	2	1			1
Comments	• Increased staffing					
Q22.	9	2		1		1
Comments	• Statement should include where the location is safe (Roadside Safety audit)					
Q23.	4	3		1	3	2
Comments	• Obviously not planting trees everywhere. • There needs to be a balance between open space & treed areas. • Not all possible locations • Think it should try to influence and encourage private plantings as well					
Q24.	8	3		1		1
Comments	• "All potential plantable spots" - interpretation by public could be wrong.					
Q25.	10	1	1			1
Q26.	8	4				1
Q27.	6	5	1		0	1
Comments	• Follow-up to the study conducted by Williams & Associate is critical; otherwise, taxpayer's money has been wasted. County council is to be commended for contracting the study. • Hedgerows and trees located alongside public thoroughfares should also be included. • I think it is about time that the County realize the value of their trees and recognize how beautiful they make the community.					

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Haldimand County Management Plan

November 2016

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Preface

Haldimand County engaged Williams & Associates, Forestry Consulting Ltd. (W&A) to develop a Forest Strategy and a Forest Management Plan, guided by a Working Committee made up of County and W&A staff and support personnel. The Forest Strategy describes the vision, guiding principles and goals for the Forest Management Plan; reviews the background, current policies, and current standards and practices used by Haldimand; and puts forward a strategy for the County to manage its forests. The proposed Strategy includes developing an inventory of County trees in urban areas which supports recommended policies, practices, administrative structures and service delivery. The Strategy also discusses benefits of the urban forest, threats and challenges to it, a community engagement process, and Criteria and Indicators for the urban forest.

This Management Plan provides a comprehensive review of the ways Haldimand and other municipalities manage their forest and recommendations appropriate for Haldimand, which can be used to improve its forest/tree management and to provide the community and environmental benefits received from forests and trees. Recommendations include the development of a real-time inventory of County trees in urban areas; a policy, budgetary and regulatory environment; maintenance standards for trees; emerald ash borer (EAB) mitigation; wood waste management; tree planting and replacement; and community communications, education, and stewardship.

A sample urban tree inventory was conducted to characterize Haldimand's street, cemetery and park tree population. Trees at specified locations in five urban centres were assessed for information on tree species, size, condition and maintenance needs. This information was used to develop recommended management strategies, and policy and regulatory infrastructure to maintain a productive and safe forest. The recommendations represent a more proactive approach with practices to keep the- urban forest healthy and to deal with forest health problems like EAB, including community interest and goals associated with the urban forest.

The sample inventories and the members of the Forest Strategy and Management Plan Working Committee provided the baseline information and assessment of current condition to begin developing a Forest Strategy, and Forest Management Plan. W&A researched current practices and developed a recommended set of policies and practices appropriate for Haldimand. These recommendations identified financial, staff and equipment needs, budgets and schedules appropriate for Haldimand County and its resources.

Acknowledgements

The Haldimand County Forest Strategy and Management Plan was developed with the input and support of the County's Forest Strategy and Management Plan Working Committee. Committee members included:

Working Committee
Sheila Wilson, Committee Co-Chair Manager, Community Development & Partnerships
Justin Miller, Committee Co-Chair, County Planner
Sam Bono, Supervisor, Roads Operations
Adam Chamberlin, Arborist, Norfolk County
Randy Charlton, Manager, Building Controls & By-Law
Brent Hammond, Manager, Roads Operations
Phil Mete, Manager, Facilities & Parks Operations
Peter Minkiewicz, Supervisor, Development Services
Phil Nie, Supervisor, Facilities & Parks Operations

Also
Katrina Schmitz, Community Partnership Liaison
Mike King, Project Manager, Municipal Infrastructure
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Vision Guiding Principles and Goals

Vision

The Vision Statement was developed in consultation with the Forest Strategy and Management Plan Working Committee to meet the needs of the County for County-owned trees and forests.

Haldimand County, being committed to preserving our natural beauty, values and is dedicated to protecting and managing its urban and rural forest, for the environmental, economic, community and health benefits these forests provide to its residents.

Haldimand County will, in partnership with its residents, businesses and stakeholders work to promote and increase urban forest coverage that is a diverse, healthy and sustained asset for future generations.

Guiding Principles

Guiding Principles are intended to guide the development of the Forest Strategy, Management Plan and implementation of the Plan. These statements represent best practices in the urban and rural forest in Haldimand County.

I.	Increased understanding of the County's urban forest will support more effective management.
II.	Trees are municipal infrastructure and managed within an integrated asset framework.
III.	The County strives to have efficient and cost-effective management of its urban forest.
IV.	County trees are maintained in a healthy and safe condition through good management practices.
V.	The right tree is planted in the right place to establish and maintain an optimal level of age and species diversity, and to maximize benefits and minimize hazard, nuisance, hardscape damage, and maintenance costs.
VI.	The community is engaged in the support of the conservation, management and stewardship of the local urban forestry program.
VII.	County trees are monitored and assessed periodically.
VIII.	An adaptive management approach is used to adjust management practices as needed using current information and research.
IX.	Well-managed privately owned trees also contribute to the urban forest.
X.	Work towards optimal levels of tree/canopy cover to maximize urban forest benefits.
XI.	New technologies are used to integrate trees in existing and new developed settings.
XII.	Heritage tree policies are considered important.

Goals

Based on the Guiding Principles, Haldimand County accepted the following goals to support the implementation of this Management Plan. The County will develop adequate human, capital and operational resources for urban forest management, planning and monitoring in order to achieve goals identified here.

1. To undertake an inventory of County-owned urban and roadside trees and forests to identify tree species, age, condition and recommendations for maintenance, removal and replacement.

2. To develop a policy framework, infrastructure and procedures for trees on County lands with respect to tree maintenance, removal and replanting practices so that the urban forest is recognized as green infrastructure and a municipal/community asset.

3. To improve the resilience of the urban forest to current and anticipated stressors, including climate change, pests and diseases by implementing policies and management practices that optimize tree species diversity, structure and age classes, with appropriate monitoring.

4. To utilize human resources efficiently and effectively to address the tree-related activities.

5. To prioritize protection and maintenance of mature, healthy trees and preservation of older large-canopied species to the greatest extent possible.

6. To transition towards proactive tree establishment and replacement whereby all potential plantable spots on the County lands are explored and apply "right tree, right place" principles, except where policy requires that new trees be planted on adjacent private property development.

7. To build awareness and engagement among County staff and the community, regarding the importance and value of the urban forest and the County's efforts to sustain this resource.

8. To expand stewardship initiatives, and develop more partnerships that support the urban forest with initiatives such as tree planting and maintenance.

9. To use new technologies in selected areas for integration of trees in hardscapes such as downtown centres and parking lots.

10. Based on the current plan, in year four, update the Forest Management Plan and associated Operating Plans to ensure that the Forest Management Plan and Operating Budgets are updated on a regular basis.

Executive Summary

Chapter 1 Introduction

Haldimand County has the responsibility of managing trees on its own lands, ensuring public safety, and maintaining the urban and rural forest for the health of the forest and residents of the County. Haldimand County engaged Williams & Associates, Forestry Consulting Ltd. (W&A) to develop a Forest Strategy and Management Plan. The Management Plan provides a comprehensive review of the ways to manage the forest. It includes recommendations appropriate for Haldimand, which can improve its forest/tree management and the community and environmental benefits from forests and trees.

To prepare for this plan, the County identified issues through Report PED-GM-02-2015 and a County Steering Committee that set the terms of reference for a Request for Proposal to develop the Forest Strategy and Management Plan.

Chapter 2 Tree Inventory

A tree inventory is an important first step of the planning and management process. A comprehensive inventory is recommended as the best method to support effective accounting/management of the urban forest. Inventory data should be collected and compiled in electronic data files so the data on each tree is linked to the tree's location (a data point) on a GIS mapping system. A sample inventory was done on streets and in parks and cemeteries in parts of five urban areas, using methods that would be used in a "comprehensive" inventory". The sample inventory and its results are discussed below.

A total of 1,523 trees inventoried providing a reasonable indication of the condition of the urban forest population in the five urban areas. The street trees (538) were surveyed on 7.5 percent of the streets although almost all of those surveyed were along streets with mature trees. Twenty five ha of park area were surveyed. From the sample inventory, it is estimated that there are about 6,000 street trees in the five urban areas.

The inventories indicated that silver maple was the most common species (20% - primarily on streets), followed by Norway spruce (11% - most in parks & cemeteries), Norway maple (11 %) and Ash (9%, mostly in parks). Many of the large trees were silver maple which also had the most risk factors, suggesting a more rigorous assessment to specify maintenance needs. The ash component will disappear within the next few years as ash are removed due to emerald ash borer (EAB). Removal of ash in areas of high concentration will result in a number of potential planting areas. Most ash required maintenance (or removal) but most are low risk because they are in the parks. Most maintenance work involves removing deadwood and various amounts of pruning. About 50 percent of the trees surveyed needed some pruning work to ensure longer survival and better health.

Although 56 species were identified, there were only a few individuals of many species and there is much potential to improve tree diversity. For example, there were very few honey locust or little leaf linden and no sycamore, hackberry, or tulip tree – all commonly planted urban trees. There were few or no small-stature trees such as ironwood, redbud, serviceberry, or Canada plum.

Chapter 3 Service Delivery Framework

Tree maintenance is currently conducted on a complaint and/or risk basis. Complaints are processed through work orders most of which are to Roads Operations (RO). Depending on complexity of the situation, work is done by RO or contracted to a tree service. The RO has seen an increase in tree management activity; the number of work orders increased from 68, to 230, 253 and 220 from 2012 to 2015 respectively. The budget for this work in Roads Operations is $110,000 annually with an additional $234,000 added as a capital project in 2016 to address the current backlog of work orders, which continues to grow. The Facilities and Parks Operations (FAPO) Division has also experienced increased tree maintenance and removal costs in various parks and cemeteries.

The service request backlogs are due to numerous trees with maintenance needs, and emergency service requirements (e.g., from significant storm events) and limit staff's ability to respond to new requests in a timely fashion. The County also does not have a consistent approach to addressing tree replacement, pruning, inspections etc.

To provide a more focused and consolidated effort and to address the immediate needs described in the Management Plan, a Forest Manager, working in the FAPO Department is a feasible option to implement the Plan. This position would be involved in all aspects of the forest and would interact with all County departments. A Forest Working Group would advise on some components of the Plan. Services for complex tree removal and for tree maintenance would continue to be contracted out. Tree planting would be completed under a variety of scenarios.

Chapter 4 Using Regulation to Protect, Manage and Grow the Urban Forest

Protecting, managing and growing the urban forest requires policy, regulation and resources, with support from the community. Regulatory approaches include: official plans; by-laws and policy documents that explicitly guide activities such as tree planting or tree removal. The adoption and enforcement of various forest management policies and guidelines can support a change away from crisis management and reactive, to a more proactive, professional management response.

The lack of appropriate policies can result in poor management because of inefficient duplication or overlapping of efforts, gaps in service and unmet needs. Without policies agencies tend to operate with conflicting or inadequate urban forest management standards or direction. This also leaves no measure by which to judge whether the community objectives are met or not.

Changes are suggested to the Official Plan to define the urban forest, identifying it as a high priority for protection, and describing it as "green infrastructure" which should be actively managed. A by-law for public trees can protect trees during development and construction, provide for tree planting and

maintenance to reduce risk. Protection can be enhanced further through policies that specify planting and maintenance standards in new developments and municipal works, safe work practices, nuisance trees, planting site location and lists of approved and prohibited tree species.

Chapter 5 Tree Health Maintenance and Risk Assessment

A tree maintenance plan is important for large property owners such as local governments. Ideally, tree maintenance starts with planting stock selection, followed by planting, then tending (e.g. watering, fertilizing, and mulching) to give the new trees a good start. Pruning to correct form problems is one of the most important maintenance practices for new and smaller trees. Haldimand has generally not conducted pruning for tree maintenance or health, but in response to problems or complaints. This has resulted in many trees with heavy branching, poor form, and/or weak forks. Pruning strategies must be designed for both young trees and for mature trees.

A block or grid cycle is most commonly used where trees in an area receive maintenance pruning periodically. For example, the County could be divided into seven sectors and tree maintenance would be conducted over seven years, one year in each zone. Over time, emergency needs are reduced, trees are healthier, costs are reduced and the public is safer as a stronger emphasis is placed on systematic pruning. There will always be a number of trees that need immediate attention because of tree failures and issues identified by staff or citizens.

Before a proactive pruning program can be initiated Haldimand must deal with the existing high-risk situations, identified through an inventory. Tree risk management involves inspecting and assessing trees for their potential to injure people or damage property and mitigating the problem in a timely fashion. Tree risk mitigation can extend the life of a tree that might otherwise be considered a risk. Structural pruning on young trees and proactive maintenance will significantly reduce risk in the future. Developing and implementing a tree risk plan will improve public safety, reduce woody debris loads generated by storms, and move Haldimand towards a proactive urban forestry program.

Invasive pests and plants pose a serious threat to forest health. Problems brought on by invasive pests are often compounded by insufficient management practices. Consequently, infestations commonly result in a substantial loss of canopy cover and associated ecosystem services, an increase in municipal maintenance costs, a loss of species diversity, and a shift to younger age classes. The greatest current threat to North America's forests is the EAB, which will eliminate most of the ash tree population. However, other insects such as Asian long-horned beetle and hemlock woolly adelgid are likely to become a concern. Non-native diseases have struck down American chestnut and the elm species, and are causing mortality in beech, butternut and flowering dogwood. There are numerous invasive plants such as buckthorn, Norway maple, garlic mustard and dog strangling vine that are prevalent in the urban forest.

Chapter 6 Tree Removal, Replacement and Establishment Protocol and Guidelines

Tree removal, replacement and establishment is a high priority in Haldimand. As a result of mortality from the EAB and the demise of other high risk older trees, some streets and parks will have fewer trees

than desired. Tree removal and planting spots, identified during the course of inventory and forestry operations should be included to plan tree replacement and ensure that no available sites are overlooked.

Removing tree should be the last resort and conducted only when other corrective actions cannot reduce the level of risk to an acceptable level at a reasonable cost. However, trees of all ages and conditions may be candidates for removal because of construction or development projects. Candidate trees for removal should be evaluated to assess condition and hazard by an experienced certified arborist. Where the arborist recommends that a tree should be removed because of safety or other reasons, the work may be done by County staff where appropriate or by a contracted tree service where the volume of work or specialized skills and equipment is required. The visual and emotional effects of removing a tree can be substantial, so communications to neighbours or the community in general can be important.

Wood waste generated by urban tree management program has very limited marketability and generally represents a cost to operation. However, costs can be minimized by using many practices already employed by the County (e.g., making wood/chips available to the community) and some innovative marketing. Logs and wood from county-owned forests and natural parks can be marketed to forest products companies.

Preservation of existing trees and canopy should be a higher priority than replacement, partly because of the greater benefits provided by a single large tree compared to many smaller ones. Replacing trees and maintaining forest cover in urban centers is challenging, especially along roads and in parking lots. A tree replacement policy directs the number, sizes and species of trees to be planted to replace those removed. The policy would support the continued growth and development of the urban forest by providing that where trees are removed or damaged, that there will be funds available for this purpose. With few exceptions this would apply to all County urban trees. Replanting of trees may not occur within the area/spot a tree has been removed. Replacement may occur anywhere in the community or County where there is a need.

Current planting policy in new developments is to plant required trees on private lots/lands rather than the road allowance, to reduce county tree maintenance costs. However, this can result in limited planting success because of poor planning, planting and maintenance, with little assurance that these new trees will be retained in the long run. Replacement strategies vary across municipalities; it is suggested that in new developments, a 'tree fee' be collected from the developer and that the species, location, planting and maintenance be completed by the County to ensure successful growth.

Planting or replacement on road right of ways can be done in-house or through contractors. Volunteers or neighbours can be involved through maintenance such as watering or mulching. However fertilization and pruning should be done by qualified staff.

The principle of "right tree right place" emphasizes matching trees species to site conditions, considering soil/site issues, and physical limitations like wires and other hard infrastructure. It is a critical step in the successful urban forest management. The soil volume available for root growth is one of the most important factors in long-term health and growth of urban trees and is a major impediment to long-lived healthy trees on boulevards, in downtown areas and in parking lots.

The Urban Site Index (USI) is a process developed in Ohio to assess street and soil characteristics to enable local species selection decisions resulting in a planting plan. Using the USI, a tree from a County planting list would be matched with a group of plantable spots based on soil, height and hardscape limitations. Implementation of the USI process in concert with the development of a tree inventory would help to reduce costs and effort, and provide an outstanding model for the County.

Another challenge is to ensure that newly planted trees survive to maturity. The planting stock should meet required criteria and be planted according to specifications. Maintenance needs include watering, fertilizing, mulching, weed control, pruning, support systems, tree guards and pest and disease control. This should be backed up with regular inspections and good record keeping.

Chapter 7 Education and Promotion, Stewardship, Partnerships and Funding Opportunities

A robust communication plan is important to recruit volunteers, announce events, educate the public or celebrate achievements. It can include development and circulation of flyers, publishing inserts or press releases for the local newspaper, electronic communications or door hangers to inform about tree planting, pruning or maintenance activities. The plan should identify key messages and the best delivery methods. In addition to providing information, the community may also need incentives, support and encouragement to increase their engagement as stewards of the urban forest.

Websites are a primary and cost-effective tool to educate, promote and inform citizens about County forestry and urban forestry programs and to support better management of private trees in urban areas. They commonly reduce the number of calls to staff and can be used as a way to immediately refer the public to information on policy, programs and issues. Better electronic access to tree-care information for County residents helps residents to understand and support public activities and improve management of private trees.

A stewardship approach helps sustain the quality and quantity of urban forests and requires ongoing involvement across the community. Urban forest stewardship should be fostered by engaging residents, the business community, and homeowners to plant trees and care for their growth and development. To increase community awareness of the benefits of trees, the County should encourage community involvement and create a shared sense of responsibility for the urban forest. Involvement in community activities is important to individuals and the community. Reaching out to community organizations, schools and businesses helps build both the community and the urban forest. Volunteers can be engaged in tree planting, monitoring forest health, inventory, pruning, watering and mulching small trees, and committee work. It is just as important to educate and promote forestry programs to all staff through staff information systems, training and regular updates.

Potential partner organizations or companies should be made aware of the Forest Strategy and Management Plan. Businesses can be encouraged to support outreach programs directing them to plant more trees on their properties or targeted to sponsor tree planting on in a park or other public location. Partnerships with tree nurseries and garden centers could be especially fruitful and could be encouraged to stock more native trees.

Additional fiscal resources may be necessary to implement many of the recommendations in this Plan. The Community Beautification Fund of the Community Partnership Program could have an expanded scope to enhance more tree planting opportunities. A Forest Recovery Fund could receive funds from developers, damage compensation, private contributions, wood sales and external funding. Some external funding opportunities include Forests Ontario, Tree Canada, and Trillium Foundation.

Chapter 8 Emerald Ash Borer Management Plan

The greatest current threat to North America's urban forests is EAB, which has the potential to eliminate the most of the ash population. It is expected that 99 percent of ash trees in urban and rural areas will be killed unless they are protected with pesticides. The loss of ash from the landscape will cause significant economic and environmental distress. Ash mortality is currently obvious in urban and rural areas throughout Haldimand.

There are no control methods for EAB. However, important individual trees can be retained by treatment with insecticides. Specific objectives for EAB Management in Haldimand are to; minimize costs associated with EAB, liability from dead trees, minimize environmental impacts and increase tree species diversity. Removal of dead and dying ash will be a priority for the next few years as more succumb to EAB and become hazardous. Haldimand is in the mid- to later-stages of EAB-induced ash mortality, where tree removal costs may triple over normal levels due to ash mortality. Ash street trees are the biggest concern and the highest cost for removal. Parks and cemeteries are also important and in these situations are less expensive to remove. The sample inventory suggests there remain about 200 ash street trees, perhaps 50 to 60 in cemeteries and several hundred in parks and other areas.

Chapter 9 Cost Estimates for Haldimand Forest Management Plan

Urban forestry program budgets are typically presented on an annual basis for a period of five to ten years. The budget estimate developed for this project outlines the costs for 2017 and 2018 with projections to 2021, including completing the inventory, and tree maintenance and removal (including EAB) and tree replacement. Budgets for the recommended pruning and planting cycles were phased in over time as the costs for reducing the maintenance/removal backlog are cleared up.
The current budget estimate was compiled by estimating expenditures from the various departments conducting tree maintenance work, mostly FAPO and RO. Estimates for the first three years are generally higher than current because they include ash removal efforts that are currently underway and completing the tree inventory for the County. Each year also include the cost estimates for a recommended Forest Manager position, which may be a new position or be created through contractual arrangement.

The budgets estimate generally exceeds current levels because the plan recommends more comprehensive activities than currently practiced. This consideration recognizes that the urban forest is green infrastructure that requires maintenance and renewal rather than ad hoc-responses to problems. Green infrastructure requires management and renewal, the same as grey/hard infrastructure.

Recommendations

Recommendations/Action FM = Forest Manager	Priority	2017	2018	2019	2020	2021	2022 - 2026	Source
Multi year								
2.4a - Complete an inventory for County-owned trees during the first two years of the management plan. Inventory priority should be street trees, park trees, rural roads, and County-owned cemeteries and County-managed cemeteries. Include attribute space in the database for management actions taken post-inventory.	High	x	x					Contract
3.4.2 - Develop budget projections on an annual basis within the next five annual Operating Plans for inventory updates, tree maintenance, and removal and replanting. Create a cost accounting system for urban forestry-related activities.	High	x	x	x	x	x	x	FM and Finance
6.1b - Remove trees as required based on inventory and risk management policy.	High	x	x	x	x	x	x	Contract
8.4.3 - Continue ash removals between 2017 and 2019. Priority is to remove dead and dying larger trees on the streets, high-use park trail and cemeteries followed by medium risk and smaller size tree on streets, parks, high-use park trails and cemeteries, and woodland trails. Roads Operations will do low risk trees and most trees on rural roads.	High	x	x	x				Contract and Roads
8.4.4 - Identify and treat candidate prominent healthy trees for treatment. Signage should be developed to identify treated trees and their benefits to the public.	High	x		x		x	x	Contract
2.4d - Ensure that the inventory is maintained by updating the data as work is conducted. This work would include when trees are pruned, removed or planted.	High	x	x	x	x	x	x	FM
6.2 - Replace trees that are removed from streets, with a new tree (6 to 10 cm caliper) for every 20- cm of diameter in trees that are removed. Replace trees from parks and cemeteries at a 2:1 ratio. Replacement trees should be of appropriate native species and non-invasive exotic species and planted in locations determined in the inventory.	High	x	x	x	x	x	x	Contract/ volunteers with FM
6.3.3b - Consult and cooperate with local nurseries, arborists, landscapers, etc. (urban forestry services) to embrace County urban forest goals and objectives. Establish a nursery growing contract with more than one grower to supply trees for County plantings and trees used in public planting initiatives. Work with volunteer groups to the same end.	High		x	x	x	x	x	FM

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	Priority	2017	2018	2019	2020	2021	2022 - 2026	Source
8.4.5a Replace **ash** trees that are removed from streets, with a new tree (6 to 10 cm caliper) for every 20+ cm of diameter in trees that are removed. Replace ash trees from parks and cemeteries at a 2:1 ratio. Replacement trees should be of appropriate native species and non-invasive exotic species and planted in locations determined in the inventory.	High	x	x	x	x	x	x	Contract/ volunteers with FM
5.1.1.2a - Establish and implement a seven-year pruning cycle and a "grid" pruning program for street, park and cemetery trees to shift from a reactive to a proactive maintenance mode.	High			x	x	x	x	Contract
7.1.2b - Increase public awareness about threats to the urban forest, best forest management practices, the forest ecosystem and tree conservation.	Medium	x	x	x	x	x	x	FM and Commun- ications
3.4.5 - Monitor the progress of the Management Plan, by applying Criteria and Principles as proposed by Kenney et al. (2011,) every five years.	Medium		x	x	x	x	x	FM
2017	**Priority**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022 - 2026**	**Source**
3.4.1 - Option 1 - Create a permanent Forest Manager position to manage the County forest program and to coordinate tree/forest issues. Option 2 - Create a Forest Manager position for a five-year period to manage the County forest program and to coordinate tree/forest issues. Option 3 - Contract a Forest Manager for a three-year period to manage the County forest program and to coordinate tree/forest issues.	High	x						SMT
2.4b - Compile the tree inventory data in a format that is compatible with GIS, work-order and other software used by the County. Develop an approach that provides input into other programs that monitor tree canopy (i.e., UTC GIS Toolbox (ESRI).	High	x						Contract
3.4.3 - Create a forest designated operating budget for all forest activities; policy development, inventory and updates, tree maintenance, removal and replanting, to be managed by the Forest Manager. Funds to be used for contracting and inter-department work.	High	x						Finance
3.3 - Develop a MOU among Roads Operations, Community Development and Partnerships, Facilities and Parks Operations, Engineering Services, Planning and Development and Communications (others) to identify and collaborate on urban and rural forest related issues.	High	x						FM and staff

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	Priority	2017	2018	2019	2020	2021	2022 - 2026	Source
8.4.2 - Conduct a windshield inventory to locate and determine general size and condition of ash trees throughout roads, parks and cemeteries.	High	x						Contract
5.4.3.4a - An Urban Forest Risk Management Policy should be developed regarding tree inspections, and maintenance practices that identifies, prioritizes and resolves potentially hazardous situations associated with County trees and forests.	High	x						Contract
6.1a - Develop and adopt standard practices for tree removal based on a risk management approach.	High	x						FM
8.5a. - Identify an EAB Coordinator who will be responsible for the communications, coordination and activities among staff and the public.	High	x						FM and Commun-ications
8.5b - Create an EAB/Ash section on the web site with links to information management resources on the internet to support landowner with ash trees on their property.	High	x						FM and Commun-ications
6.1.3.3.3 - Work with the HAWOA to market small or specialty wood and saw logs.	Medium	x						FM
7.4.1a - Establish a Forest Recovery Fund to support forestry initiatives. Funds could be received through initiatives such as damage compensation, permit and plan review and inspection fees, development fees, utility company fees, private donations and corporate sponsorships, memorial and honor trees, and firewood, mulch, and wood sales.	Medium	x						Finance
2018	**Priority**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022 - 2026**	**Source**
6.3.1 - Adopt tree planting guidelines based on recommended arboricultural practices such as ISA standards regarding tree planting and tree planting technical details.	High		x					FM
6.3.3a - Develop an Urban Forest Renewal Plan that guides tree planting and maintenance to encourage diversity of tree species and age classes in each community.	High		x					FM
6.4 - Adopt technical planting and maintenance standards for new planting such as those found in the Markham Streetscape Manual, 2009.	High		x					FM
7.1.2a - Develop a simple forestry website that can be expanded to provide public access to information about Haldimand's forest. In the longer term build a more comprehensive website to focus on customer service, with seasonally appropriate information about the urban forest, provide information about upcoming forestry events and provide updates related to forest strategy objectives.	High		x					FM and Commun-ications

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7.1.4 - Explore mechanisms to improve inter-departmental coordination regarding proper protection, maintenance and replacement of the County's green infrastructure (i.e. its trees) and inform staff about tree protection guidelines, policies and best practices.	High		x					FM
4.2b - Update the Forest Conservation Bylaw to current standards and consider measures that affect woodlands of all sizes and natural areas that do not meet the definition of a woodland, and to prevent pre-development clearing of trees and woodlands.	High		x					FM and Enforce-ment
6.3.5 - In new developments, a 'tree fee' be collected from the developer and that the species, location, planting and maintenance be completed by the County to ensure successful growth.	High		x					FM
6.3.1.1 - In conjunction with a tree inventory, the County should use the Urban Site Index process to guide new plantings in along urban streets, and in County parks and cemeteries.	High		x					Contract
6.1.3.3.2 - Formalize a policy that describes procedures for disposal of wood waste from urban forest tree management This would include: • Public salvage of wood/chips left at the work site • Delivery of wood/chips to private owners and institutions. • Public removal of chips and wood from public facilities (including signage and monitoring) • Marketing of wood from County facility • Disposal of unmarketable/unsalvageable wood from County facilities.	High		x					Waste Manage-ment
3.4 - Establish a Forest Working Group that includes representatives from County departments involved in tree issues and from agencies and organizations or citizens with an interest in tree/forest management.	Medium		x					FM and staff
5.1.1.2c - Train staff (particularly the Facilities and Parks Operations Division) in proper pruning and maintenance practices.	Medium		x		ongoing			Contract
5.4.3.5c - A risk management policy for woodland trails should include signage at the entrances of County owned woodland trails that direct users to stay on the trails and enter at their own risk. Maintained woodland trails should be inspected every five years and after significant storm events to recommend tree pruning or removal of trees within falling distance of the trails.	Medium		x					FM and staff
5.4.4 - Develop a directed emergency response plan within the broader Haldimand County Emergency Response Plan to ensure that risks are mitigated as required and that the necessary resources are allocated to the planning-through-recovery stages of a significant storm event.	Medium		x					Staff team
7.3c - Engage local Service Clubs in tree planting and reforestation projects.	Medium		x					FM

	Priority	2017	2018	2019	2020	2021	2022 - 2026	Source
7.4.1b - Improve promotion of the Community Beautification Fund and participation of citizen and business groups. Annually transfer unused funds into the Forest Recovery Fund to improving communications, workshops, subsidies for trees on private properties, and young tree maintenance.	Medium		x					CDP and Finance
7.1.3 - Explore options for providing support and coordination of ongoing and potential volunteer activities related to Haldimand's forest.	Medium		x					FM
2019	**Priority**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022 - 2026**	**Source**
5.1.1.1. - Hire contract/seasonal technicians for a minimum two-year period to conduct tree maintenance and structural pruning on young trees.	High			x	x		x	Contract
4.1a - Ensure that all policy revisions and updates, such as the Official Plan, define the urban forest, identify it as a high priority for protection, and describe it as "green infrastructure" which needs to be actively managed.	High			When scheduled				Planning
5.3 - In conjunction with grid pruning operations develop communications tools, such as door hangers, to advise the public of impending tree work.	High			x				FM and Commun-ications
4.2a - Develop a comprehensive tree bylaw that protects public trees in general, and during development and municipal works, and provides for replacement, planting and maintenance of new trees.	High			x				Contract
6.3.2a - Soil volume specifications should be adopted for use in downtown areas and new developments.	High			x				FM
4.3.2 – For tree protection in site development, require that a comprehensive tree preservation and/or landscape plan-is part of the plan/site review process and ensure that the Forest Manager has an official role in all phases—from application review to final approval and construction. .	High			x				FM and Planning
4.3.3 - For all County projects where trees are present, require that a comprehensive tree preservation and/or landscape plan be developed. This plan would show how trees are being retained, protected and restored, and would be completed by an approved professional (e.g., Certified Arborist, RPF)	High			x				FM
2.4c - Evaluate different inventory management software that fit with the current and potential County asset management software.	Medium			x				FM

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	Priority	2017	2018	2019	2020	2021	2022 - 2026	Source
4.1b - Develop a Tree Operations Protocol for Roads, Parks, Engineering and Planning to utilize when addressing tree issues in the field, ~~and~~ during municipal works and the development process.	Medium			x				FM and staff
5.1.1.2b- Develop guidelines for tree maintenance and other practices to support the preservation of large canopied trees that can be consistently applied to County properties and projects.	Medium			x				FM
7.4.2 - Explore external sources to identify funding opportunities to support tree planting.	Medium			x				FM
6.3.2b - Develop and implement policies to support improved tree habitat by retaining native topsoil, or other means (e.g., cultivation or soil amendments) on-site post development to improve the quality of tree planting sites.	Medium			x				FM
6.3 - Investigate alternative planting locations that will aid in increasing canopy cover.	Low			x				FM
2020								
4.3.1a - Update the Haldimand County Design Criteria (Section O) to latest ISA standards. This includes more detailed information on stock selection process and setting standards for retention of native topsoil, increased soil volumes and soil quality to support improved tree habitat.	Medium				x			FM
4.3.1b - Specify minimum professional requirements for those developing tree-planting plans (e.g., Certified Arborist, RPF)	Medium				x			FM/ staff
4.3.4 - Adopt a "nuisance tree" policy that can be equitably applied and enforced County-wide.	Medium				x			FM/staff
5.2 - Consideration should be given to cabling and bracing high value trees when they are identified.	Medium							As needed
2021								
7.1.1 - Develop and implement a comprehensive communication strategy to facilitate public understanding of urban forest management. Ensure that the strategy is coordinated by Communications staff and all County departments participate in its development so that initiatives are coordinated and can be rolled out smoothly in the appropriate season. Ensure that new policies and guidelines are included.	High					x		FM and Communications

	Priority					x	Responsibility
3.4.4 - Update a Strategic Forest Management Plan with a 20-year period with five-year Operating Plans and associated Annual Operating Plans.	High					x	FM
6.3.5 - Investigate means such as soil cells, pavement bridges and open planters to grow healthy trees in downtown areas.	Low -			As opportunities arise			FM
Next plan period							
7.2 - Consult and cooperate with citizens at the community/neighbourhood level to embrace County urban forest goals. Develop community/neighborhood tree plans within the context of the larger plan.	High					x	FM
4.3.5 - Develop a plan to identify and designate heritage trees based on the approach of the Ontario Heritage Tree Alliance.	High					x	FM
5.4.3.4b - County trees on streets and developed areas of parks and cemeteries should be assessed on an average of seven to eight years regarding safety and maintenance issues, and the inventory updated to reflect current conditions.	Medium					x	FM and staff
7.3a - Consult and cooperate with large private landholders and business owners to embrace County urban forest goals and objectives and particularly to increase tree cover and improve tree health and tree care in commercial and industrial zones.	Medium					x	FM
7.3b - Encourage the development community to actively steward the urban forest. Revise brochures and other communications for the development community to explain their roles in protecting and the urban forest by using best development and construction practices. Outline the importance of the urban forest.	Medium					x	FM
5.5 - Develop and implement a strategy to monitor forests for existing and potentially invasive and exotic species that can affect natural ecosystems and impact tree health and maintenance requirements.	Low					x	Contract

Table 9.2 Cost estimates for tree related activities for 2017 to 2021

Activity	2017 Cost/tree ($)	# of trees	Total cost ($)	2018 Cost/tree ($)	# of trees	Total cost ($)	2019 est. Cost/tree ($)	# of trees	Total cost ($)	2020 est. Cost/tree ($)	# of trees	Total cost ($)	2021 est. Cost/tree ($)	# of trees	Total cost ($)	Five year cost
Ash tree removal and stump grinding - Contractor	650	100	65,000	680	100	68,000	715	100	71,500							204,500
Ash tree removal/stump - County RO	650	200	130,000	680	200	136,000	715	200	143,000							409,000
[1]Ash tree treatment - Contractor	220	25	7,500				220	25	5,500				220	25	5,500	18,500
[2]Pruning - Contractor	250	100	25,000	260	100	26,000	275	1,000	275,000	290	1,000	290,000	300	1,000	300,000	916,000
Structural pruning (<15 cm trees) - Contractor							60	200	12,000	63	200	12,600	65	100	6,500	31,100
[3]Inventory - Contractor	5.5	8,000	44,000	5.5	7,000	38,500										82,500
[4]Inventory update - County	5.0	675	3,375	3.5	905	3,168	3.5	1,925	6,738	3.5	1,650	5,775	3.5	1,575	5,513	24,568
[4a]Windshield Survey for ash(rural) - Contractor			6,000													6,000
[5]Assessment & removal/maintenance of high risk trees - Contractor	500	200	100,000	525	200	105,000	550	100	55,000	575	50	28,750	600	50	30,000	318,750
Stump grinding and cleanup	250	200	50,000	260	200	52,000	275	100	27,500	290	50	14,500	300	50	15,000	159,000
[6]Tree planting	300	50	15,000	315	240	75,600	330	240	79,200	345	340	117,300	365	340	124,100	411,200
Tree Planting Beautification - County	300		0	315	65	20,475	330	60	19,800	345	60	20,700	365	60	21,900	82,875
[7]Forest Manager (FM)			110,000			110,000			110,000			110,000			110,000	550,000
[8]FM operating			20,000			20,000			21,000			21,000			22,000	104,000
[9]Training and Policy development- Contractor			13,000			7,000			15,000							35,000
Total			588,875			661,743			841,238			620,625			640,513	3,352,993

Notes: Most activities are dependent on inventory results. Estimates are mostly based on contractor rates. Costs are increased appoximately 5% per year rounded.

[1]Ash tree treatment refers to insecticide application to retain some ash trees for the long term. Based on 40 cm tree and $5.50 per cm of diameter. Includes $2,000 for identification and assessment.

[2]Pruning assumed mostly larger high-risk trees in 2017 and 2018.
Pruning rates based on a 3-person crew doing 10 large trees/day and doing >50 cm dhb trees.

[3]Assumes inventory for street trees complete in 2017. Inventory for parks, rural roads and other facilites in 2018.

[4]Inventory updates based on removals, maintenance and new plantings. Extra in 2017 to update 2016 inventory.

[4a]Windshield Inventory. Survey of rural roads to identify extent of ash inventory.

[5]Tree removal, stump grinding and tree planting based on separate operations. Planting is less expensive if done in same operation. Price of tree not included.

[6]Tree planting is back-end loaded to ensure diversity of tree species can be achieved. Numbers are based approxmately on tree removals. Does not include developer planting.
Planting based on 2:1 replacement and assumes some County planting and some volunteer planting; ratio to be determined. Increased planting will extend beyond 2021.

[7]Forest Manager salary based on Grade 8 scale with benefits.

[8]Forest Manager operating assumes vehicle, equipment, training needs and other.

[9]Policy contracts for risk management ($10,000), public tree by-law ($15,000), for inventory preparation ($1,000), Urban Site Index ($2,000) and training staff pruning ($5,000).

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1.0 Introduction

Haldimand County has the responsibility of managing trees on its own lands, ensuring public safety, and maintaining the urban and rural forest for the health of the forest and residents of the County. As detailed in the Forest Strategy, forests and trees provide many values that contribute to the quality of urban and rural environments, including community health and aesthetics; shade, shelter and energy savings; environmental quality and wildlife habitat; and ameliorating climate change by absorbing carbon and reducing fuel consumption. A high priority for Haldimand is maintaining the health and safety of trees in public-use areas such as roadsides, cemeteries and developed parks. Safety concerns with trees in County-owned woodlands that are along trails and near property lines adjoining developed private properties are also important.

This Management Plan describes how to implement the Forest Strategy. The Strategy provides purpose, definition, rationale, vision, guiding principles, goals, current regulatory and operational situations, benefits and threats, community engagement and the results of preliminary sample inventory. This Management Plan details recommendations for the goals to support the forest; including developing a tree inventory, service delivery, regulatory policies and procedures tree maintenance standards and risk management, tree removal, replacement and establishment protocols, recommendations for communication, education, and stewardship, wood waste management, an EAB mitigation plan, and identifies the financial resources and timelines to see the Management Plan implemented for a five-year period.

Haldimand County, like many Ontario municipalities, is dealing with emerald ash borer (*Agrilus planipennis*) (EAB) an insect that is killing ash trees that have not been protected with pesticides. EAB-induced changes in urban forests and woodlands are forcing municipalities to revise their forest management plans, even if it is just to deal with changes due to EAB. Developing plans/policies and methods to assess threats and impact from EAB and other invading pests is important to maintain tree and forest health in the community.

To prepare for this plan, the County identified issues through Report PED-GM-02-2015 and a County Steering Committee that set the terms of reference for a Request for Proposal (RFP) to develop the Forest Strategy and Management Plan.

The County's RFP laid out the scope of work for the project.

> **Phase 1**
> Establish a Forestry Strategy that includes but is not limited to:
> - A vision;
> - Guiding principles;
> - Strategic goals; and
> - Utilizes community engagement with the community and staff.

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Phase 2
Develop a Forestry Management Plan based upon the Forestry Strategy that includes but not limited to:

- Establishing an approach to inventory trees located on County roads, parks, cemeteries in major urban centres – to estimate and project demand and resources;
- Establishing policy and procedures for tree maintenance on County land;
- Identifying the impact of emerald ash borer on County land and implications for tree removal/replacement;
- Exploring and identifying revenues sources with respect to tree removal practices and replacement;
- Establishing a tree replacement protocol with respect to tree removal on County land – ratio, location, partnership options etc.; and
- Establishing an estimated operating budget to move forward in 2017 and 2018 with a projection to 2021.

Objectives Forestry Strategy and Management Plan:
The following provides an outline of the anticipated objectives for the Forestry Strategy and Management Plan.

- Undertake sample inventories in major urban centres as noted within this RFP to create a high level understanding of the age, composition and quality of trees and implications for maintenance, removal and replacement;
- Develop a policy framework and procedures for trees on County lands with respect to tree removal practices, maintenance and replanting;
- Develop an operating budget and potential sources of revenue to offset costs for tree removal;
- Develop a recommended service delivery framework and accountabilities relating to tree management for the County; and
- Establish a Risk & Liability mitigation approach to tree removal/maintenance.

A sample inventory was required and a list of urban street, cemetery and park locations was provided.

Sample Requirements

- Sampling inventory to include age, number of trees, species, size and health;
- Based on sampling recommended removal plan for 2016 within existing operating budget and projected budget for 2017 addressing emerald ash borer first and risk and liability mitigation with timelines and estimated costing (expenditures and revenue potential);
- Based on sampling recommended removal plan for 2018 to 2021 in order of urban centre downtowns, parks, cemeteries and roads;
- Establish a maintenance plan with timelines and estimated costing within the 2016 existing operating budget and projected for 2017;

- Establish a replanting plan identifying who, species, location, timelines and costing for 2017 and 2018 in order of urban centre downtowns, parks, cemeteries and roads; and
- Policy development and procedures addressing further inventory creation, maintenance, emerald ash borer mitigation and budget implications with timelines extending out over the next 5 years.

Tree inventory background information and results of the sample inventory are found in Chapter 2. Chapter 3 discusses a framework for service delivery in Haldimand. Regulatory approaches to protect, manage and grow the urban forest using official plans, tree protection by-laws and policy documents are found in Chapter 4. Tree maintenance, particularly through pruning and risk management, is addressed in Chapter 5. In Chapter 6, tree removal and tree replacement guidelines along with tree establishment programs are described. Potential for revenue or cost savings with waste wood is found in the same Chapter. Chapter 7 talks about education, stewardship, partners and funding. Chapter 8 is the emerald ash borer plan. Finally, Chapter 9 describes the budgetary situation with costs for a five-year period. Throughout each chapter recommendations are found in each section and are summarized at the end.

2.0 Tree Inventory

2.1 Value of a Tree Inventory

A tree inventory is an important part of the planning and management process. It provides a snap shot of the urban forest by identifying and collecting information on the trees of interest; in this case, County-owned urban trees. An inventory has information on the trees, including; their location, size, species, condition, and other information. Summaries are used to characterize the forest, plan activities and identify potential problems. Using the inventory, managers can effectively plan for and track information regarding maintenance, removals, replanting and the resources required. The tree attribute and location data are generally collected by qualified arborists or technicians using handheld computers, geographic information systems (GIS) data, and/or geographic positioning systems (GPS) equipment.

There are a variety of software programs that exist to help track local inventory and urban forests management activities. Maintaining the inventory requires staff who update the inventory as work is conducted (e.g., tree removals, maintenance, planting). Regular tree monitoring and inventory updates enable managers, and planners to evaluate the urban forest resource and develop initiatives which can in turn provide substantial cost savings and mitigate safety issues.

2.2 Types of Inventory

Inventories should be designed to meet the needs of the owners. For example, some inventories collect a bit of information on some or all of the trees for a particular purpose like identifying ash street trees in a community, or collecting limited information on all the trees in the area, (e.g., species and location). The sample inventory conducted for this project was a comprehensive inventory that collected fairly detailed information on each tree. A comprehensive inventory facilitates better planning, program management and forest renewal. Four types of inventories are described below.

"Windshield" Surveys – A windshield survey is a simple method of evaluating trees, and may be a good first step for crisis management or a scoping exercise to collect simple information on the trees and forest. To perform a windshield survey, the surveyor, and perhaps an assistant, drives along roads recording certain tree characteristics. Windshield surveys are most efficient when the arborist is looking for only a few particular tree characteristics, such as species, size, or obvious damage. In Haldimand, this approach can be used to inventory trees along rural roads specifically looking for ash trees or following a storm to determine cleanup.

Sample-Based Inventories – A sample-based forest inventory is a cost-effective way to obtain an overall picture of the state of the forest. Usually, obtaining data from between three to six percent of street miles and/or public property acreage will produce results that are accurate to within 10 percent of what a complete inventory would produce. They are more appropriate for determining general forest characteristics, estimated numbers and types of trees, or benefits of the forest. The "i-tree Eco" (previously known as U-Fore) program developed by the USDA Forest Service (USDA-FS) is used by

many municipalities in the United States and Canada to estimate economic and environmental benefits from urban forests.

Partial Inventories – Partial inventories (similar to the sample inventory for this project) collect tree data on trees in a defined area such as, right-of-way kilometres or hectares, but only in specific areas of a community. This approach is effective when current budgets are limited or there is a specific need in an area. Staff decides which defined areas of the municipality are inventoried: particular wards, neighborhoods, districts, historic areas, etc. Using partial inventories allows the municipality to spread the inventory process over time, aggregating the data as new areas are inventoried. However, this practice obviously doesn't provide and help with areas not inventoried.

Complete Inventories – A complete comprehensive inventory is the best method if the municipality requires effective accounting/management of the urban forest in the community. An example of this type, suggested for Haldimand, would inventory and assess all County-owned trees in urban areas. The inventory could also include identification of potential planting sites throughout the area. Trees along rural roads can be added later.

2.3 Inventory Analysis

A significant component of an urban forest management plan includes the summary and analysis of the tree inventory data. Maintenance and planting priorities are developed and overall management recommendations are made for a multi-year period based on that analysis. The inventory data analysis would consider:

Population Characteristics
- The urban forest is a complex, inter-related system of trees, site conditions, and infrastructure components. By understanding population characteristics such as species, size, location and condition of trees, managers can forecast trends, anticipate maintenance needs, budget for tree related expenditures, and develop a basis for long-range planning. This allows proper and timely action to be taken for safety risk-reduction on the public rights of-way, preventive maintenance to reduce storm damage and planning for needed tree planting operations.

Maintenance Recommendations
- One objective of an urban forest management plan is to direct appropriate maintenance standards and practices for the tree population and to prioritize work. Typical maintenance recommendations are: pruning, removal, stump grinding, green waste disposal, fertilization, insect and disease treatment, grate and guard repair, mulching, and watering. The highest priority maintenance recommendations of removal and pruning that protect public safety. Other maintenance recommendations are practices directed at improving the overall health, longevity, and aesthetics of the urban forest.

Insect and Disease Threats and Control
- Taking a proactive approach to insect and disease threats and control can enable Haldimand County to address public and private needs in an efficient and effective manner. Careful analysis

of local conditions and species composition can help to mitigate existing or potential insect and disease infestations. With the inventory and forest management plan as a guide, staff can endeavor to distribute the costs associated with significant tree loss and damage from insects, disease and natural disasters over a manageable time period.

Planting Programs
- The tree health, age and structure information in the inventory support planning for annual removal and replacement needs. During the inventory process, potential planting spots can be identified that can receive replacement or new trees. Decisions of what kind of tree to plant and where to plant it are critical due to their long-term impact. The tree inventory can indicate the number of vacant planting sites, the size and types of these locations, the current species distribution, and other pertinent data.

Budgets
- This forest management plan includes a multi-year, prioritized program for urban forestry activities and provides costs associated with the recommended activities. These budget figures are based on local contractual charges for maintenance and planting tasks, examples from local communities and in-house costs for performing the needed services.

2.4 Tree Inventory and Inventory Management

Urban tree inventories are conducted using many methods of data collection, data management and mapping. These days, inventory data is collected or compiled in electronic data files and the data on each tree is linked to the tree's location (a data point) on a GIS mapping system. Municipalities use various methods to link and update the inventory data to reflect tree management activities like planting, pruning or removals. With a good inventory, a forest manager can anticipate work planning well into the future, considering elements like maintenance needs, canopy cover and benefits, species, age and size distributions across the area, and plan for forest renewal.

Larger municipalities often use commercial purpose-built software or develop their own inventory programs. These programs often link with the work order management system and are integrated with asset management systems (e.g., roads, sewers, and other utilities). These integrated programs are expensive to acquire and manage, and require substantial technical resources to maintain. Examples of these are Hansen and City Works. They are not designed specifically for tree inventory although some larger municipalities "make them fit" for tree inventories.

Smaller municipalities with inventories often use a spreadsheet program to maintain the inventory data and manually update the inventory as changes occur through work orders, planting or assessments. The spreadsheet can be easily exported to, or imported from, a GIS system like ArcMap which is currently used by Haldimand and many other municipalities. This approach is economical and works well as long as the inventory is updated continuously so that the inventory reflects current conditions.

Other programs are often used by municipalities to develop information on their forest. i-Tree (formerly UFORE) was developed by the USDA Forest Service to help determine the environmental and economic

contributions of urban forest and vegetation. It is a plot-based program that assesses tree and shrub components throughout an urban forest (public and private property) and generates information on carbon cycling in and affected by the forest, and the value of ecosystem services provided by the forest. i-Tree is not a tree inventory program and can't really be used as one. However, the program uses many types of data, including tree inventories, as inputs to the program.

A practical Ontario-grown inventory system is Neighbourwoods© (2014) developed at the University of Toronto. Neighbourwoods is a comprehensive and standard tree inventory protocol, to assist communities and professionals in collecting the tree information they need to strategically plan and manage their urban forest. One of the benefits of using this system is that it can be done by volunteers. The Neighbourwoods program has two broad objectives:
   a) to ensure the collection of standardized information that could be used by tree professionals and non-professionals alike, and
   b) to allow for sophisticated tree analysis necessary for advanced interpretation and management.

The developers of Neighbourwoods encourage neighbourhood and small community volunteers to take the training and build the inventory for their community, including private-owned trees. A number of small communities in southern Ontario including, Centre Wellington, Cobourg, Dundas and Mitchell have used Neighbourwoods to build their communities' inventory.

TreeKeeper® is Davey Resource Group's (2016) tree management software. It has been used in the industry for more than 15 years. TreeKeeper is designed to manage tree inventories, service calls, and workload, create reports and provide an integrated mapping component

Once an inventory is in place, it is important to regularly update tree inventory data as day-to-day arboricultural operations are conducted. When updates are conducted regularly, it can be undertaken at minimal cost. Ideally, the database entry for each tree should be updated when a tree is maintained, removed, or impacted by development and construction or when a new tree is planted. An up-to-date inventory will enable the County to build up a long-term profile of the urban forest to incorporate into ongoing management planning decisions, enable accurate budget forecasting for future maintenance programs, and proactively plan tree removal and replacement activities.

Managing and updating inventory data requires a significant investment of time and money, so managers need to identify those responsible for managing the inventory and what outputs are desired, then select software and data management approaches compatible with current and planned capabilities and procedures.

The sample inventory conducted for this management plan (Section 2.5) collected a comprehensive set of 23 variables on each tree. This data was collected on portable tablet computers within a GIS system, and analyzed with spreadsheet software. This approach can work well for the County with its current resources and the structure of the data will allow it to be exported to any other software if the County infrastructure changes. Several items will have to be added to the database to accommodate information collected following the inventory such as removals, pruning and updates to structure and vigour.

Recommendation 2.4.a

2.4a - Complete an inventory for County-owned trees during the first two years of the management plan. Inventory priority should be street trees, park trees, rural roads, and County-owned cemeteries and County-managed cemeteries. Include attribute space in the database for management actions taken post-inventory.

Recommendation 2.4.b

Compile the tree inventory data in a format that is compatible with GIS, work-order and other software used by the County. Develop an approach that provides input into other programs that monitor tree canopy (i.e., UTC GIS Toolbox (ESRI)).

Recommendation 2.4.c

Evaluate different inventory management software that fits with the current and potential County asset management software.

Recommendation 2.4.d

Ensure that the inventory is maintained by updating the data as work is conducted. This work would include when trees are pruned, removed or planted.

2.5 Sample Inventory

2.5.1 Introduction

A sample inventory was conducted in 2016 that assessed trees in selected sections of urban areas in Haldimand County. The purpose of the sample inventory was to generate an estimate of Haldimand's tree population and condition, help develop recommendations for a full inventory and for cost-effective inventory management systems within County resources. The foundation of an effective urban forest management program is a functional tree inventory that supports a tree inspection cycle and proper tree maintenance and hazard abatement. Effective tree monitoring enables park managers, urban foresters and planners to evaluate the forest resource and develop short- and long-term initiatives which can in turn provide substantial cost savings and mitigate safety issues.

2.5.2 Sample Inventory Procedure

Sample inventory locations were provided by the County, consisting of cemeteries, parks and on County-owned streets in Caledonia, Cayuga, Dunnville, Hagersville and Jarvis as shown in Table 2.1. Data specified in the Terms of Reference and additional recommended information was collected from all trees in the specified areas. The tree inventory attributes were developed based on the inventories in Norfolk County and other municipalities and are shown and described in Table 2.2. Initial surveys began January 6, 2016 and were conducted variably until February 4, 2016. A final survey review was completed in late May and early June to assess tree health and vigour. Further explanation of attributes such as structure, vigor, risk, maintenance priority is found in Appendix I. Data was collected using Motion tablet computers with ArcPad™ software. Data was mapped and analyzed using ArcGIS 10.3.1™ and MS Excel™.

Table 2.1. Location of sample inventory in the five urban areas.

Town	Siting	Location
Cayuga	Street	Winnett St. from Hill St. to Brant St.
Cayuga	Street	Echo St. from Ottawa St. to Johnson St.
Cayuga	Park	Cayuga Kinsmen Park, 61 Ouse St. (lower Kinsmen)
Cayuga	Cemetery	Riverside Cemetery, 65 Cayuga St. South
Caledonia	Street	Caithness St. East from Edinburgh Square to Aberdeen St.
Caledonia	Street	Sutherland St. East from Edinburgh Square to Banff St.
Caledonia	Street	Wigton St. from Argyle St. to Haddington St.
Caledonia	Park	Caledonia Kinsmen Park, 49 Caithness St.
Caledonia	Cemetery	Caledonia Cemetery 150 Wigton St.
Dunnville	Street	Broad St. from George St. to Ramsey Dr.
Dunnville	Street	Alder St. from Niagara St. to George St.
Dunnville	Street	Pine St. from Main St. to Concession St.
Dunnville	Park	Dunnville Kinsmen Park, 985 John St.
Dunnville	Cemetery	Riverside Cemetery, Main St. West
Hagersville	Street	Howard St.
Hagersville	Park	Hagersville Park, 38 Sherring St. North
Hagersville	Cemetery	Ballsville Cemetery, 4488 Hwy #6
Hagersville	Cemetery	Hagersville Cemetery, 8904 Indian Line
Jarvis	Street	Talbot St. East and West
Jarvis	Street	Mary St.
Jarvis	Park	Jarvis Park, 1 James St.

Table 2.2. Haldimand tree inventory variables collected with description.

Attributes	Data Type	Description/units
FID	Numeric	Computer generated number
SHAPE	Numeric	Represents point location of tree
ID	Numeric	Tree number (assigned individual value given to each tree).
Street Name	Text	Street name of tree location.
Municipal Number	Numeric	Street Address # or 911 #
Township	Text	Not used
Town	Text	Urban area.
Siting	Text	Boulevard, residential (between sidewalk and building), park, woodland or cemetery.
Ownership	Text	County, Private Landowner, shared/unclear.
Access	Text	Notes on access/location and aerial imagery.
Specie	Text	Menu of 242 species common and scientific name.
DBH	Numeric	Cm – measured-Diameter at Breast Height (1.3m).
Height	Numeric	Meters – Ocular Estimate of total height.
Crown Diameter	Numeric	Meters – Ocular Estimate.
Structure	Text	Poor, Fair, Good:
Vigour	Text	Dead, Poor, Fair, Good:
Risk	Text	Low, Medium, High (estimate of potential risk to people or property associated with the tree
Risk Problem	Text	Noted risk elements with the tree, such as hanging branch, deadwood, poor structure etc.
Maintenance Required	Text	Options for removing or limiting risk problems – includes pruning, crown reduction, deadwood removal, etc.
Maintenance Priority	Text	Low, Medium, High
Wire Conflict	Text	Hydro, Phone/Cable - No conflict, Potential conflict, Conflict
Insects	Text	EAB, Gypsy moth, other.
Date Survey	Date	Survey date.
Date Review	Date	Date of 2nd visit.
Surveyors	Text	Name of Surveyor
Comments	Text	Notes of useful information about said tree.

2.5.3 Sample Inventory Results

The sample inventory assessed 1523 trees in the specific locations and fifty-six species were identified. The inventory covered 10.9 km of streets (7.5 percent of the total length of 145 km of all streets) in the five urban areas and inventoried 538 trees. The inventory included approximately 16 and 13 percent of streets in Dunnville and Jarvis respectively, eight percent of Cayuga streets, and two and three percent of streets in Hagersville and Caledonia respectively. The number of street trees inventoried ranged from 297 in Dunnville to 13 in Hagersville (Table 2.3). In a separate survey using aerial photography, a random sample of 11 percent of streets in the five urban areas was undertaken. This sample indicated there were approximately 6,000 street trees.

The sample inventory also included 17 ha of cemeteries and 25 ha of parks. The cemeteries assessed, included the largest and most developed County-owned cemeteries with the exception of Dunnville Woodlawn Cemetery. Trees at five parks (25 ha) were assessed. All had sports fields except at Cayuga Kinsmen Park. Caledonia Kinsmen Park is owned by the Grand River Conservation Authority but maintained by Haldimand.

Table 2.3. Number of trees surveyed by site and urban area and sample estimate of street trees.

Urban Area	Cemetery	Park	Street	Inventory Total	Estimate Total # of Street Trees
Caledonia	168	105	95	368	1,700
Cayuga	155	30	85	270	870
Dunnville	96	77	297	470	2,060
Hagersville	111	135	13	259	1,170
Jarvis	-	108	48	156	200
Inventory Total	**530**	**455**	**538**	**1,523**	**6,000**

Figure 2.1 shows the distribution of most common trees on the three main sites; streets, parks and cemeteries. Silver maple was the most common species in the inventory, accounting for 20 percent of all trees surveyed. However silver maple was more common among street trees where it was 26 percent of trees surveyed. The four maples (Norway, red, silver and sugar) accounted for 66 percent of all street trees. These maples were only 21 percent of trees in parks and cemeteries and silver maple accounts for most of that. Ash was the most common species in parks, however this will soon be reduced to near zero. Norway spruce and white cedar were most common in cemeteries because they are used as screens and windbreaks. Latin names for all trees and shrubs are found in Appendix II.

Figure 2.2 shows the number of trees by diameter class of the four most common species and black walnut. Silver maple, in addition to being most common, had the highest number of large trees. Many ash were smaller trees - less than 20 cm, while Norway maple and Norway spruce had many medium-sized trees in the 21 to 60 cm size range.

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Street Trees (538)

Other 17%
Ash 3%
Horsechestnut 3%
Silver Maple 26%
Red Maple 3%
Blue Spruce 3%
Norway Spruce 4%
Black Walnut 4%
Sugar Maple 13%
Norway Maple 24%

Park Trees (455)

Other 22%
Ash 22%
White Cedar 5%
Norway Maple 5%
Silver Maple 22%
Manitoba Maple 6%
Black Walnut 6%
White spruce 6%
Willow 6%

Cemetery Trees (530)

Other 27%
Spruce, Norway 28%
Oak, English 4%
Ash 4%
Cedar, White 14%
Juniper 5%
Hickory, shagbark 7%
Maple, Silver 11%
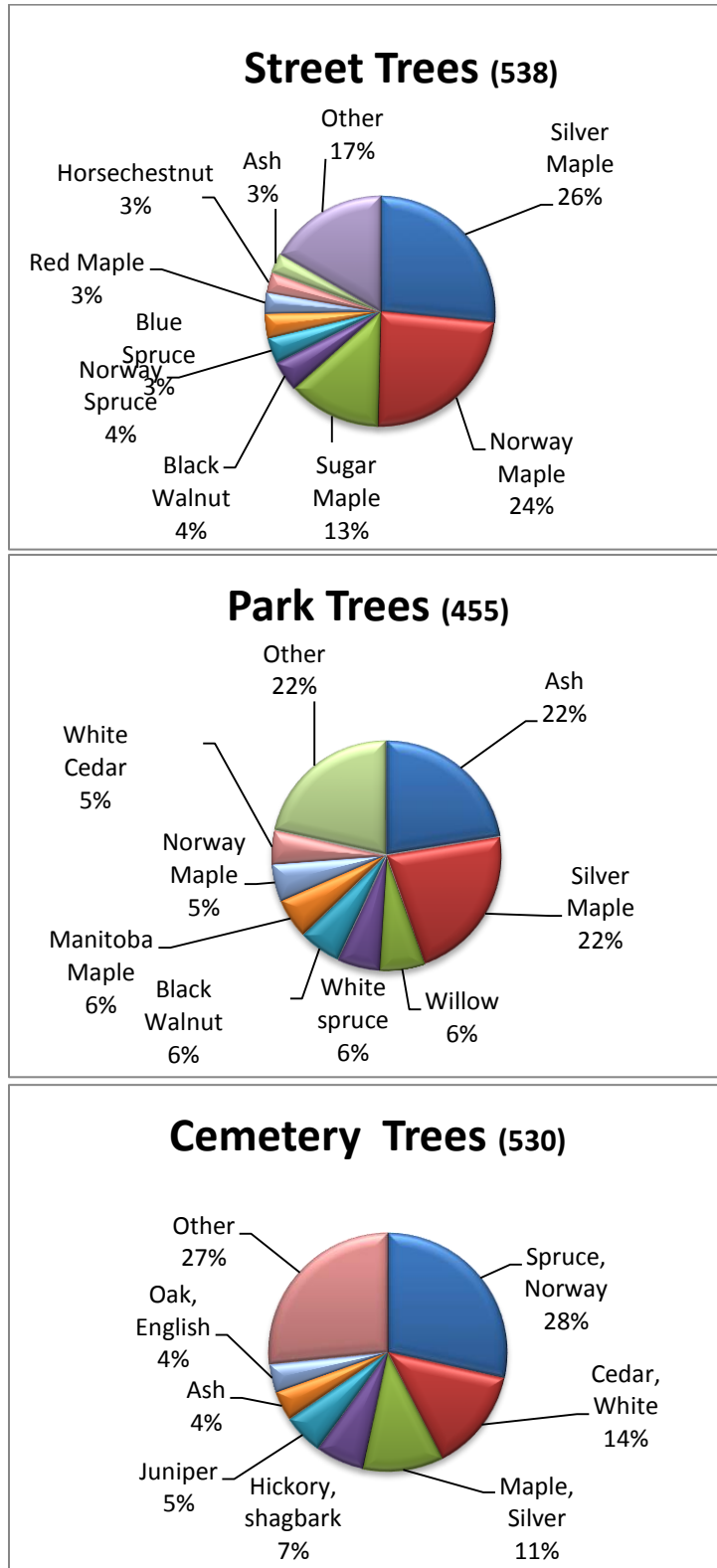
Figure 2.1. Main tree species on streets, in parks and cemeteries in the five County urban areas.

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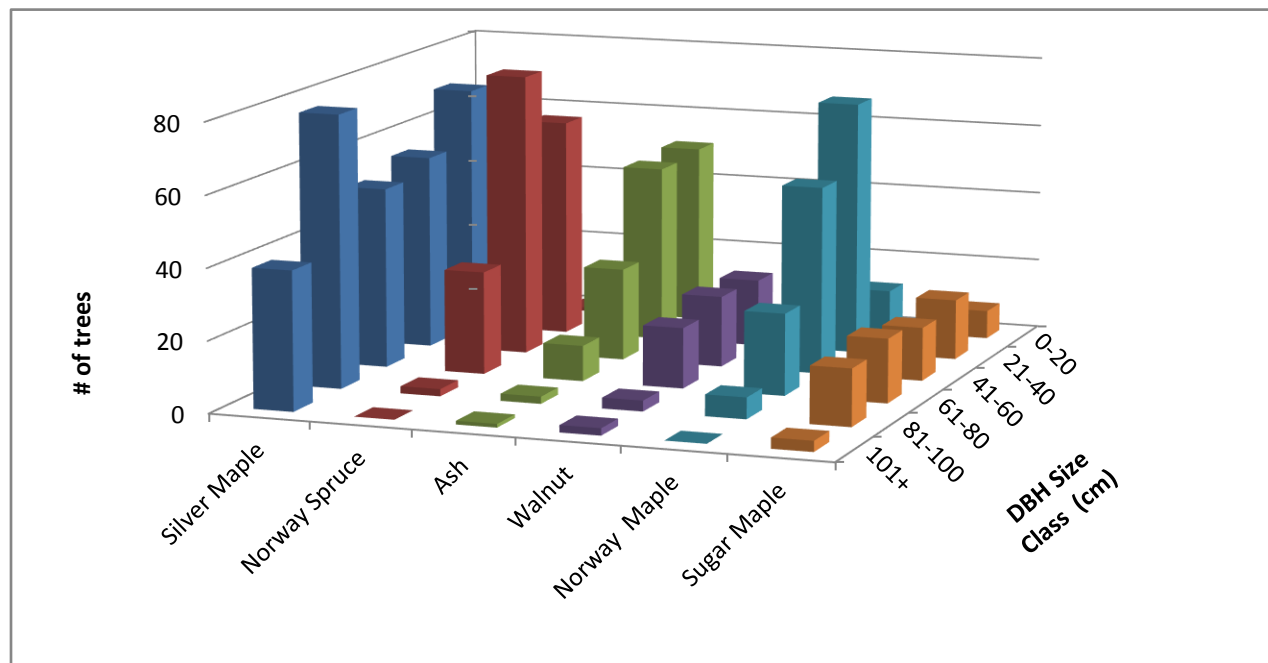
Figure 2.2. Number of trees by diameter distribution of most common species. (n=922)

Overall, 46 percent of surveyed street trees were in conflict or had potential to be in conflict with utility wires (Figure 2.3). Sixty-seven percent of the wire conflicts were with the four maples that make up 66 percent of street trees (mostly older and larger). Only a few cemetery (20) and park (15) trees were or had potential to conflict with utility wires. Most streets with utility wires had current or potential wire conflicts.
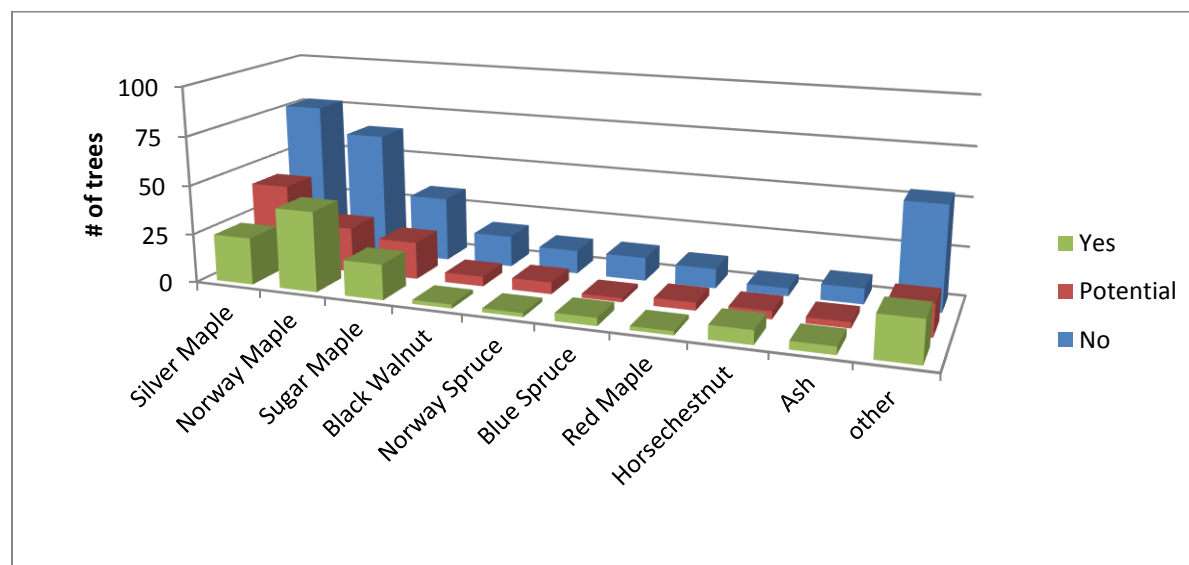
Figure 2.3. Number of street trees by common species with wire conflict. (n=538)

Figure 2.4 shows risk categories for most common species. Overall, there were 349 medium and high risk trees in the inventory and 228 trees or 65 percent of those are street trees. Silver maple had 32 percent of the medium and high risk trees while sugar and Norway maple had 12 and 13 percent respectively. Ash does not have many medium and high risk trees (13 percent) because they were mostly smaller in size and located in parks. However overall ash vigour was low (as is expected). The high-risk ash are street trees. Cedar and Norway spruce were low risk since most are in cemeteries and along the property borders.
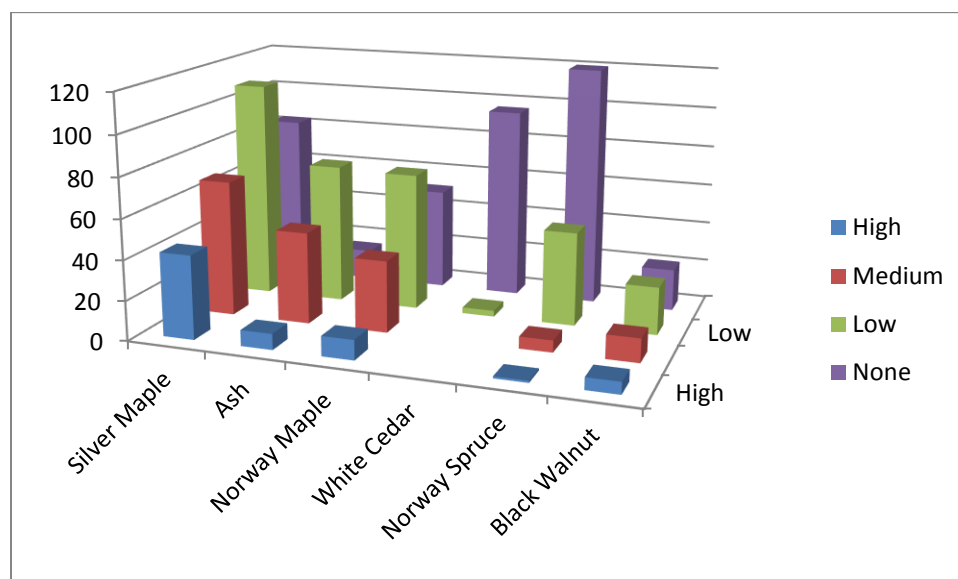
Figure 2.4. Risk categories of common species (n=943).

Table 2.4 shows the entire list of approximately 56 species in the sample inventory. It also shows the percentage of those trees that are medium or high maintenance priority. As well as Norway, red, silver and sugar maple, other species such as horse-chestnut, white birch, black walnut, Manitoba maple, catalpa, white and bur oak, have a medium or high maintenance priority. Medium and high maintenance trees account for 26 percent of all trees in the inventory.

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Table 2.4. Count of all species in sample inventory and percent of each species with medium or high maintenance priority. There are 1,523 trees in total and 392 in the medium or high maintenance category.

Species	# of Trees	High or Medium Maintenance (%)
Maple, silver	302	40
Spruce, Norway	174	3
Maple, Norway	166	41
Ash spp.	140	36
Cedar, white	99	1
Maple, sugar	78	59
Walnut, black	63	27
Maple, Manitoba	46	41
Spruce, white	42	5
Hickory, shagbark	38	3
Juniper	34	
Spruce, blue	31	3
Willow, weeping	26	8
Oak, bur	25	28
Catalpa, northern	21	29
Oak, English	21	
Maple, red	17	47
Pine, eastern white	16	13
Horse-chestnut	15	60
Cherry, black	14	7
Basswood	14	
Oak, red	14	21
Locust, black	13	
Apple spp.	11	18
Locust, honey	9	33
Oak, white	9	33
Linden, little leaf	8	0
Birch, white	8	38

Species	# of Trees	High or Medium Maintenance (%)
Cottonwood	6	
Hickory, bitternut	6	33
Poplar, Carolina	6	67
Pine, Austrian	6	17
Pine, Scots	5	20
Willow	4	50
Birch, European white	4	
Yew, Canadian	3	
Elm, American	3	
Sycamore	2	
Sumac, staghorn	2	
Elm, Siberian	2	100
Pine, red	2	
Hawthorn	2	
Lilac, Japanese tree	2	
Mountain ash, European	2	
Maple, black	1	
Mulberry, white	1	
Buckeye, Ohio	1	
Cherry spp.	1	
Hackberry	1	
Redwood, dawn	1	
Douglas fir	1	
Spruce	1	
Mountain ash, oak-leaf	1	
Fir, balsam	1	
Blue beech	1	
Oak, swamp white	1	100

2.5.4 Summary and General Observations

The 1,523 trees surveyed provided a reasonable indication of the condition of the urban forest population in the five urban areas. The cemetery survey covered most of the important sites. Street trees surveyed covered only 7.5 percent of the streets although almost all of those surveyed were along streets with mature trees. Only 25 ha of park area were surveyed; only a small portion of all parkland. No rural roads were surveyed. Sample estimates indicated there are about 6,000 street trees in the five urban areas.

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The surveys indicated that silver maple was the most common species (20% - primarily on streets), followed by Norway spruce (11% - mostly in parks and cemeteries), Norway maple (11 %) and ash (9%, mostly in parks). Silver maple also had the highest number of large trees. There were numerous high risk silver maples requiring maintenance due to their age/size and location on streets, close to buildings or utility wires. No difference was made between Freeman maple and silver maple. Red maple was separated out when recognized.

The ash component will disappear within the next few years as ash are removed due to emerald ash borer. There were only a few ash on the streets. Most were in parks and removal will generally be easier than for street trees. Removal of ash in areas of high concentration will result in a number of potential planting areas.

A distinction should be made between high risk trees and those requiring maintenance. A high risk tree is one where the possibility of a person or valued area/thing being obstructed by said tree is great and immediate. A low risk tree is unlikely to neither occur immediately nor cause significant damage. There is generally correlation between risk and maintenance. There are numerous high risk silver maples requiring maintenance due to their age/size and location close to buildings or utility wires. Most ash trees require maintenance (or removal) but most are low risk because they are in the parks. Most maintenance work involves removing deadwood and various amounts of pruning. About 50 percent of the trees surveyed need some work to ensure longer survival and better health.

Urban trees that are larger or poorly-maintained can be in conflict with public utility wires. Wire conflicts included hydro, cable/communications and telephone. For hydro lines, Haldimand Hydro (soon to be Hydro One) has a five-year maintenance schedule in Haldimand County. The five urban areas in Haldimand were completed for tree trimming and line clearance in 2016.

Although 56 species were identified, there is potential to plant other species in greater amounts. For example, there were very few honey locust or little leaf linden and no sycamore (London plane tree), hackberry, or tulip tree – all commonly planted urban trees – planted on County streets. There were few or no low-stature trees such as ironwood, redbud, serviceberry, or Canada plum. Planting locations need to be identified and can be done through the inventory process.

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2.6 Recommendations/Actions

Goal: To undertake an inventory of County-owned urban and roadside trees and forests to identify tree species, age, condition and recommendations for maintenance, removal and replacement.

Recommendations/Action	Priority	Time Frame	Cost 2017-2021	Source
2.4a - Complete an inventory for County-owned trees during the first two years of the management plan. Inventory priority should be street trees, park trees, rural roads, and County-owned cemeteries and County-managed cemeteries. Include attribute space in the database for management actions taken post-inventory.	High	2017-2018	82,500	Contract
2.4b - Compile the tree inventory data in a format that is compatible with GIS, work-order and other software used by the County. Develop an approach that provides input into other programs that monitor tree canopy (i.e., UTC GIS Toolbox (ESRI)).	High	2017	1,000	Contract
2.4c - Evaluate different inventory management software that fits with current and potential County asset management software.	Medium	2019		Forest Manager
2.4d - Ensure that the inventory is maintained by updating the data as work is conducted. This work would include when trees are pruned, removed or planted.	High	2017 - 2021	24,568	Forest Manager and to contract work

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3.0 Service Delivery Framework

3.1 Current Service Delivery

In Haldimand, tree maintenance is conducted on a complaint and/or identified risk basis. When staff or public identifies a tree problem and contacts the County, Customer Service generates a work order. The work order is delivered to the appropriate department work location. For street trees, Roads Operation (RO) Division staff operating out of the Cayuga, Dunnville, Oneida or Walpole Yards, is assigned to review the work order and contact the contract arborist if appropriate. The contract arborist assesses the tree as requested and determines maintenance or removal requirements. If tree removal can be conducted without risk to property (e.g., buildings, utility lines) or the public, the RO staff will fell and remove the tree. If the work has risk or requires specialized equipment, arboricultural expertise or requires stumping, the work is contracted to a local tree service. The RO Division has seen an increase in tree management activity; the number of work orders increased from 68, to 230, 253 and 220 from 2012 to 2015 respectively. The current response time is 6 to 12 months, with an annual operating budget of $110,000, plus an additional $234,000 added as a capital project in 2016 to address the current backlog of work orders, which continues to grow.

Facilities and Parks Operations (FAPO) contracts the Norfolk arborist to assess any trees in question by staff or the public. The recommendations of the arborist are implemented and the majority of tree maintenance or removal issues are contracted out. The FAPO Division has also experienced increased tree maintenance and removal costs in various parks and cemeteries in recent years.

Service request backlogs, due to so many trees with maintenance needs, and emergency service requirements (e.g., from significant storm events), combine to limit staff's ability to respond to new requests in a timely fashion.

3.2 Service Delivery in Other Communities

In Brampton the Urban Forestry Department (2007) has increased the time and resources directly involved in the collection and analysis of tree inventory data. Tracking completion rates, types of calls and mortality information, should ultimately enable staff to create proactive maintenance strategies to increase overall urban forest sustainability. Service request tracking allows forestry staff to monitor the abilty to respond to the concerns of the residents. The increased gap between customer's requests and the ability to respond not only helps initiate programs such as block pruning but also illustrates the need to consistently review trends within the business.

Analysis of inventory and service data can be used to direct the activities of all contractors and staff. The initial focus in Brampton (2007) is to alleviate the backlogs of service requests in activities where the demand is the highest (eg. medium pruning and elevation.). Other activities such as block pruning will focus on proactively pruning other trees which have not been brought to the City's attention through service requests from residents, reducing the number of service received by staff. Information from the

inventory plays a key role in promoting a healthier urban forest by enabling intuitive response to the needs of the trees and the residents.

Most large municipalities in Ontario conducted urban forest management using the model of joint municipal and contracted service provision. This model is applied in cities such as Windsor, Hamilton, Oakville, Mississauga, London, Toronto, and Burlington. Most important is the relative distribution of specific operations between contractors and staff. In most examples, municipal staff and contractors share the tasks of routine maintenance such as pruning and tree removals. Planting is often conducted as part of capital projects and development, with additional infill planting undertaken by the municipality or contractors by tender.

Some smaller communities rely wholly on contracted service provision. Brantford's urban forest management staff is comprised of two urban forestry staff, who supervise the maintenance or inspection by contractors of approximately 60,000 trees on a relatively short five-year pruning cycle and the annual establishment of approximately 900 trees, and who work with other City staff to address issues which may affect the urban forest. Most small municipalities do not have staff that prune or remove trees, but rely on contractors to this sort of work.

In a 2014 a survey of municipalities in the United States municipalities in the 25,000 to 49,999 population range, found a median of 5.2 full time equivalents involved with the municipal tree management program. In 42 percent of these municipalities, the responsible person held the title of arborist or forester. (Hauer and Peterson, 2016). This same group of municipalities had a mean 10,451 street trees and 25,819 total public trees.

3.3 Coordinating Staff

In many municipalities urban forest operations are conducted by several departments. The division of responsibility depends on the size of the municipality, departmental structure and commitment to urban forest care. Larger municipalities may have an interdepartmental team/committee with a focus on tree and tree related issues. A Memorandum of Understanding (MOU) is a valuable means to ensure understanding of Divisional duties. In Haldimand this can include Roads Operations, Community Development and Partnerships, Facilities and Parks Operations, Engineering Services, Planning and Development to identify and collaborate on urban and rural forest related issues. It can provide a better environment for communications among staff and departments, improve the general knowledge and expertise, and ensure consistent application of municipal standards and adherence to policies. The MOU would:

- Define department roles and responsibilities that detail planning, management and maintenance and reporting functions in annual work plans.
- Develop a Tree Operations Protocol for all departments to utilize when addressing tree issues in the field and during the development process.
- Ensure Forestry representation in development application review, and capital project planning so that opportunities for tree protection and/or planting are identified at the outset of the process. Circulation of building permit applications to appropriate departments where trees may be impacted should follow a similar protocol.

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- Involve Risk Management, Fire/Police, Legal, Finance, By-law, and Community Services.
- Multi-disciplinary perspective;

Tree maintenance requirements and expectations can be addressed in part through progressive implementation of a proactive tree maintenance program where County trees in urban areas are pruned every seven years (as described in Chapter 5). Over time, this should reduce tree service response time from the current 6 to 12 months to 3 to 6 months; and will improve public awareness of proper tree care and maintenance techniques. An associated maintenance program for young trees will reduce tree mortality (increase survival) in new street tree plantings and help reduce maintenance costs in the future.

Using contractors to conduct pruning programs for smaller municipalities is known be most cost efficient than doing the work in house due to lower economy of scale. Tendering tree maintenance contracts for three to five years can make service delivery more efficient.

Operational and strategic changes are required to increase effectiveness:
- Data analysis using inventory and identifying trends in service calls (Chapter 2)
- Improved inspection response times and customer satisfaction
- Supportive policy (e.g., tree and woodland by-laws) (Chapter 4)
- Tree maintenance - block/area pruning program(Chapter 5)
- Public education (Chapter 7)

Recommended Communications structure:
- Service Haldimand
- Forest Manager
- Appropriate department/individual for assessment if applicable
- Appropriate department/contractor for resolution if applicable

Service delivery of tree/forestry matters;
- Service Haldimand forwards work order to Forest Manager
- Forest Manager matches work order to appropriate staff.
- Good communications among staff
- A tree maintenance program
- Customer satisfaction
- Contract vs municipal staff
- Inventory update

Recommendation 3.3

> ***Develop a MOU among Roads Operations, Community Development and Partnerships, Facilities and Parks Operations, Engineering Services, Planning and Development and Communications (others) to identify and collaborate on urban and rural forest related issues.***

3.4 A Potential Framework for Forestry in Haldimand

A Forest Working Group (chaired by the Forest Manager) comprised of staff and community groups and organizations with an interest in tree/forest management is beneficial to advise on plan components and to work in partnership with the County on the Plan. This group would share information and expertise, provide input to plan development, and advise on and contribute to urban forest management plan implementation in such areas as public education, coordination of stewardship initiatives, raising community awareness, encouraging community stewardship, collection and distribution of information to community organizations.

Recommendation 3.4

> ***Establish a Forest Working Group that includes representatives from County departments involved in tree issues and from agencies and organizations or citizens with an interest in tree/forest management.***

There are a few department locations that a Forest Manager can be placed. Parks Operations or Public Works are most common locations in mid-sized Ontario communities. Larger municipalities have their own forestry department. In the same United States survey referenced above, Public Works (35%), Parks (27%) and Forestry (20%) were the most common departments with the primary responsibility for public trees in the 25,000 to 49,999 population range (Hauer and Peterson, 2016). In reality though, many departments share responsibilities for urban forest management. The potential structure described below shows the Forest Manager in Parks Operations. See box for benefits of having a staff Forest Manager.

3.4.1 Departmental Roles

Facilities and Parks Operations
- Maintains park, cemeteries and open space lands
- Plans, designs and constructs County-owned parks, and off-road trails within open spaces and natural areas

With Forest Manager (See box for minimum qualifications and skills)

- Maintains the Forest Plan and prepares annual plans.
- Maintains the existing tree inventory and acquires as-built information of subdivision plantings to incorporate into the existing inventory.
- Administers urban forest maintenance (street tree pruning and removal) contracts.
- Implements urban forest health maintenance and monitoring activities.
- Manages tree establishment and replacement requests:
  o in assumed subdivisions following capital construction;
  o in capital roads projects.
- Organize staff training related to urban tree management.
- Reviews and imposes conditions on proposed development, which may include tree planting or protection.
- Conducts inspections of plantings in new subdivisions to ensure compliance with approved landscape drawings and standards.
- Supports all aspects of forest and tree management with other County departments and staff.
- Manages the development and implementation of strategic urban forest initiatives.
- Leads organization and implementation of public education initiatives and community tree planting events.
- Manage the emerald ash borer program.

Roads Operations
- Consult with Forest Manager for tree issues for construction projects or property management.
- Conduct tree removal operations where specialized skills or equipment are not required.

> **The benefits of having a staff member as the Forest Manager.**
> A staff person is available to the public and staff. He/she can build relationships among departments, other staff with the community,
> He /she can be proactive with:
> - Development projects
> - Construction
> - Infrastructure renewal
> - Responding to public calls
> - Tree maintenance and renewal
> - Public education/communication
> - Building institutional knowledge of program with community.

Planning and Development
- Seek reviews and comments from Forest Manager on development applications as they relate to urban forestry on public lands (i.e., street trees, woodlot conveyance, naturalized channels and storm water management ponds, natural open space conveyed to the County).
- Work with Forest Manager to establish policies, regulations and standards guiding land use and development, which may affect the existing and future urban forest.
- Reviews and imposes conditions on proposed development, which may include tree planting or protection in consultation with Forest Manager.

Community Development and Partnerships (working with the Forest Manager)
- Provide grants to community volunteers for tree planting efforts.

Engineering Services
- Maintains municipal infrastructure and works with Forest Manager in matters affecting or benefiting existing and future trees).

Administration
- Accept, tracks and forwards work orders to Forest Manager.

Building Controls and By-law Enforcement (working with the Forest Manager)
- Enforce the Forest Conservation By-law.
- Enforce the Public Tree By-law.

Minimum Qualifications and Skills of a Forest Manager.

Forest professional or technician/Arborist diploma with 2 to 3 years municipal experience with preference for a Registered Professional Forester with specialization in Urban Forestry.

Knowledge and skills include but are not limited to:
- Theoretical and practical knowledge of all aspects of urban tree care
- Understanding of techniques and treatments to promoter plant health
- Ability to communicate and administer an urban forest program to help staff, elected officials, and citizens make wise decisions and get the most for their investment in trees.

Internal resources needed for tree management programs include ongoing clerical support, hardware and software support, and staff training. External resources include program development, program customization, report writing and network administration. A key part of the recommendation is to have qualified personnel, appropriate equipment and budgets available to assess and prioritize the program.

Options are provided below for hiring to manage the Forest Plan. Advangates for Option 1 are noted above. Option 2 (below) is similar except the County is committed to the five year term only. The Manager may be more inclined to leave near the end of the term to seek other opportunities. All experience will be lost. Option 3 is least desirable The plan will not be completed. Disadvantages include contractors are bound by the specifications of the contract; their work assignments are not as flexible, they may not be as quick to respond to emergencies as in-house crews and they may have less control over budgets and field operations. The cost would be higher by another 30 percent.

Recommendation 3.4.1

> *Option 1*
> *Create a permanent Forest Manager position to manage the County forest program and to coordinate tree/forest issues.*
>
> *Option 2*
> *Create a Forest Manager position for a five-year period to manage the County forest program and to coordinate tree/forest issues.*
>
> *Option 3*
> *Contract a Forest Manager for a three-year period to manage the County forest program and to coordinate tree/forest issues.*

Recommendations 3.4.2

> *Develop budget projections on an annual basis within the next five annual Operating Plans for inventory updates, tree maintenance, removal and replanting. Create a cost accounting system for urban forestry-related activities.*

Recommendation 3.4.3

> *3.4.3 - Create a forest designated operating budget for all forest activities; policy development, inventory and updates, tree maintenance, removal and replanting, to be managed by the Forest Manager. Funds to be used for contracting and inter-department work.*

Recommendation 3.4.4

> *Update a Strategic Forest Management Plan with a 20-year period with five-year Operating Plans and associated Annual Operating Plans.*

Recommendation 3.4.5

> *Monitor the progress of the Management Plan by applying Criteria and Principles as developed by Clark et al. (1997) and updated by Kenney et al. (2011) every five years.*

3.5 Recommendations/Actions

Goal: To utilize human resources efficiently and effectively to address the tree-related activities.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
3.3 - Develop a MOU among Roads Operations, Community Development and Partnerships, Facilities and Parks Operations, Engineering Services, Planning and Development and Communications (others) to identify and collaborate on urban and rural forest related issues.	High	2017		Forest Manager and staff
3.4 - Establish a Forest Working Group that includes representatives from County departments involved in tree issues and from agencies and organizations or citizens with an interest in tree/forest management.	Medium	2018		Forest Manager and staff
3.4.1 - Option 1 *Create a permanent Forest Manager position to manage the County forest program and to coordinate tree/forest issues.* *Option 2* *Create a Forest Manager position for a five-year period to manage the County forest program and to coordinate tree/forest issues.* *Option 3* *Contract a Forest Manager for a three-year period to manage the County forest program and to coordinate tree/forest issues.*	High	2017	550,000 or 550,000 or 150,000 annual	Operating or Operating or Contract

Goal: Based on the current plan, in year four update the Forest Management and associated Operating Plans to ensure that the Forest Management Plan and operating budgets are updated on a regular basis.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
3.4.2 - Develop budget projections on an annual basis within the next five annual Operating Plans for inventory updates, tree maintenance, and removal and replanting. Create a cost accounting system for urban forestry-related activities.	High	Annual		Forest Manager and Finance Division
3.4.3 - Create a forest designated operating budget for all forest activities; policy development, inventory and updates, tree maintenance, removal and replanting, to be managed by the Forest Manager. Funds to be used for contracting and inter-department work.	High	2017 to 2021		Finance Division

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3.4.4 - Update a Strategic Forest Management Plan with a 20-year period with five-year Operating Plans and associated Annual Operating Plans.	High	2021		Forest Manager
3.4.5 - Monitor the progress of the Management Plan, by applying Criteria and Principles as proposed by Kenney et al. (2011,) every five years.	Medium	Annually from 2018		Forest Manager

4.0 Using Regulation to Protect, Manage and Grow the Urban Forest

Protecting, managing and growing the urban forest require policies, regulations and resources, with support of the community. Regulatory approaches include 1) official plans, 2) tree protection by-laws and 3) policy documents that explicitly guide activities such as tree planting or tree removal. All three work together to enforce standards and obtain complete buy-in from the entire community.

For activities like tree maintenance and planting, appropriate internal policies regarding urban forest management can aid in the development and sustainability of a program. Clear and reasonable policies encourage independent departments, other governmental agencies, utility companies, businesses, and even the citizens to interact and function cooperatively with each other. The adoption and enforcement of various urban forest management policies and guidelines can support a change away from a problem specific, crisis management, and reactive approach to a more proactive, professional management response.

The lack of appropriate policies can result in poor management because of inefficient duplication or overlapping of efforts or gaps, where areas of responsibility and needs go unmet. The lack of policies can enable agencies to operate with conflicting or inadequate standards or direction. The lack of a policy also means there is no measure by which to judge whether community objectives are met or not.

4.1 Official Plan Policies

The Ontario *Planning Act RSO 1990* provides municipalities with the power to develop official plans and regulate development, including requiring landscaping with trees and shrubs on the site and parkland dedication. The Provincial Policy Statement, (2014) provides guidance for land use planning, protection for significant woodlands, and encourages jurisdictions to integrate green infrastructure, including the urban forest. The Growth Plan for the Greater Golden Horseshoe (Ontario, 2013) legislation encourages planning authorities to;

- identify natural heritage features and areas that complement, link, or enhance natural systems;
- develop a system of publicly accessible parkland, open space and trails, including shoreline areas;
- establish an urban open space system within built-up areas, which may include … public parks.

When there is a conflict between this and the PPS with regard to natural environment then the direction that applies the most protection to the natural environment prevails.

The Official Plan (OP) is an important document to express policies and sets the tone for how other policies and guidelines are established. The Province has mandated that municipalities consider policies for protection of Natural Heritage. The Haldimand OP has specific policies for development and site alteration required to protect the Natural Environment as mandated by the Provincial government including Provincially Significant Wetlands and Habitat for Endangered and Threatened Species and

adjacent lands. The OP includes general policies for protecting other significant natural environmental features but, none that apply to the urban forest or Significant Woodlands.

Over the past decade many southern Ontario communities have developed some sort of urban tree policies in their official plan. Many are very comprehensive; others are cursory but may apply urban forest policies through by-laws or policy statements. Policies from other municipal OPs that might apply to Haldimand are provided below. There are many other municipalities with strong Official Plan policies.

The City of Guelph (2001) has some of the more comprehensive policies in its OP, covering topics such as tree protection during development, restoration of degraded forest, increasing canopy cover by tree planting, and urban design.

Most of Norfolk County's OP policies (2001) apply to protecting woodland and wooded areas and using woodlands for forestry purposes including ensuring good forest management, woodlot size and non-severability. Landowners are encouraged to plant native trees and shrubs along road allowances. With regard to new developments, the County encourages conservation or replanting of roadside and fence line shrubs and trees. The County "shall encourage tree retention or tree replacement" in development related proposals. All of these measures are included to improve air quality.

The City of Hamilton has a number of general policies in its OP (2015). This one is notable; "development shall not be encouraged where it adversely affects or has the potential to adversely affect the character or attributes of a heritage road, such as the removal of distinctive tree lines and tree canopies, fence lines or hedgerows or the placement or introduction of berms, screens, gateway or entrance features or other unsympathetic barriers".

The City of St. Catharines OP (2010) as a number of statements regarding increasing canopy cover, reducing the heat island effect, two for one public tree replacement, urban design, allocating three percent of road projects for greening purposes, integrating natural features into development projects and encouraging property owners to plant more trees.

The Town of Blue Mountain has policies in its Official Plan (2016) to support the protection and enhancement of the tree canopy, to provide resiliency to climate change, and to provide high levels of carbon sequestration. This applies particularly to new development and on municipally-owned land including requiring tree planting in areas of extensive surface parking and, promoting development that maximizes areas for tree planting. They also require reimbursement, in the form of new trees or financial compensation, for all healthy trees proposed to be removed in development applications, and, encourage tree planting by local residents and organizations, and educate residents about the benefits of planting trees on their property and the environmental impact of removing trees.

Recommendation 4.1a

> *Ensure that all policy revisions and updates, such as the Official Plan, define the urban forest, identify it as a high priority for protection, and describe it as "green infrastructure" which needs to be actively managed.*

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Recommendation 4.1b

> ***Develop a Tree Operations Protocol for Roads, Parks, Engineering and Planning to utilize when addressing tree issues in the field, during municipal works and the development process.***

4.2 Public Tree By-laws

Municipal by-laws that protect public and/or private trees in the urban forest, are enabled by the Municipal Act. Burlington, Halton Hills, Hamilton, Kingston, London, and Oakville have by-laws to protect trees on public land. Toronto, Oakville and Guelph have by-laws that regulate removing individual trees on private property. Some by-laws such as Hamilton and Kingston are very prescriptive with everything laid out in the by-law. Others such as Oakville and London provide minimal guidance, with deferral to the authorized manager.

By-laws are best implemented with an education/compliance approach, rather than a strictly regulatory/enforcement model. These bylaws can provide opportunities to advise homeowners, developers, and builders on how best to protect or manage trees and natural areas, resulting in the preservation of trees that may otherwise have been injured or destroyed. Where tree retention is not possible, the by-laws can require replacement planting, ensuring the maintenance of canopy cover.

The goals of tree protection by-laws can include:
• Reducing tree loss during development
• Reducing damage to standing trees during construction
• Providing for replacement of trees lost during construction
• Providing for planting trees where none occurred previously
• Providing for the maintenance of preserved trees after construction is completed
• Maintaining large stature or heritage trees

Fewer municipalities have enacted by-laws for trees on private property in the urban area and this topic is not part of this Plan. The planting and protecting of trees on new developments is discussed in section 4.3.2.

The Haldimand Forest Conservation By-law, that regulates harvest or destruction of trees on private land greater than 0.2 hectares, is 2000 vintage. Section 135 of the *Municipal Act, SO 2001* gives the County the power to pass by-laws prohibiting or regulating the destruction or injuring of trees in a woodland. As well there are a number of housekeeping changes to bring the by-law to current standards.

Recommendation 4.2a

> ***Develop a comprehensive tree bylaw that protects public trees in general, and during development and municipal works, and provides for replacement, planting and maintenance of new trees.***

Recommendation 4.2b

> *Update the Forest Conservation Bylaw to current standards and consider measures that affect woodlands of all sizes and natural areas that do not meet the definition of a woodland, and to prevent pre-development clearing of trees and woodlands.*

4.3 Policy Guidelines and Specifications

Examples of urban forestry issues and responsibilities that might be the subject of official policies are:

- Use of current industry planting and maintenance standards for public works projects, private contractors, and citizens alike; (Chapter 5 and 6)
- Criteria for public tree removal; (Chapter 6)
- Lists of approved and prohibited tree species that can be planted on public property; (example lists in Appendix III)
- Planting site location standards to avoid conflict with utilities, sight distances, signs, and other potential obstacles; (See references below)
- Utility company activities;
- Safe work practices and work sites;
- Nuisance trees; (Chapter 4.3.4, below)
- Interdepartmental plan review and approval and communication. (Chapter 3)

4.3.1 Haldimand County Design Criteria

Haldimand County Design Criteria for Street Tree Planting (Section 0) was revised in 2015. It requires that in new developments street trees be planted on private lands although some may be located on public lands. It does not specify professional requirements for those developing planting plans, and describes in very general terms locations and spacing, time of planting, types of trees, quality and source, installation and use of trees as screens. There is very little detail or specifics although reference is made to the landscape plan and to the Ontario Landscape Contractor's Standards (2004).

Recommendation 4.3.1a

> *Update the Haldimand County Design Criteria (Section O) to the latest ISA standards with this includes more detailed information on stock selection process and setting standards for retention of native topsoil, increased soil volumes and soil quality to support improved tree habitat.*

Recommendation 4.3.1b

> *Specify minimum professional requirements for those developing tree-planting plans (e.g., Certified Arborist, RPF)*

4.3.2 Policies Regarding New Developments

Policies regarding new developments should include tree retention/removal, new plantings (i.e., numbers, species standards); and on warranty, security and fees associated with tree retention and planting. More

technical/engineering requirements such as curb and boulevard setbacks, utility restrictions and clearances, tree spacing are also important.

Many municipalities have developed reference guidelines for technical aspects of urban forestry. Markham has developed a technical Streetscape Manual (2009) that provides;

> "Focus on Development applications for Site Plan and Subdivision as well as Town boulevard tree planting. …The purpose of this document is to make sure adequate replacement and increased number of new tree plantings occurs in a sustainable manner. Providing specifications, details and education for staff, developers, contractors and residents will ensure this manual will be a significant resource and tool to guide successful tree planting throughout the Town of Markham."

The City of Barrie (2010) has a Tree Protection Manual which describes processes for tree preservation and removal in development areas, street tree protection, heritage tree criteria, mitigation measures for construction near trees and appraisal methods.

Consideration should be made for assessing and protecting trees from the initial stages of new development or infill projects. There is often pressure to remove natural features like trees, old fence rows or forest edges during development because it simplifies the process. However, many natural features can be incorporated successfully into developments with effective pre-development assessment and consideration, prior to draft plan development. Infill projects often have trees in yards or along lot borders that can be retained with proper planning. Inventories and assessment should be required before project approval to enable important trees to be retained where feasible. The same guidelines used in protecting trees during municipal works should be used in developments. See the next section for details.

Recommendation 4.3.2
> ***For tree protection in site development, require that a comprehensive tree preservation and/or landscape plan is part of the plan/site review process and ensure that the Forest Manager has an official role in all phases*** —from application review to final approval and construction.

4.3.3 Tree Protection during Municipal Works

Most cities have some policies or guidelines around protecting public trees during construction projects. Oakville (2009), Burlington (2013), Thunder Bay (2016) and Hamilton (no date) have extensive documents readily available on their websites. They outline procedures to be taken before, during and after construction. Oakville's policy also refers to protecting private trees. Useful guidelines are provided for performing urban forestry related activities and create consistency in operations as staff turnover occurs.

A sample of key features in these policies includes:
- Purpose and scope of policy;
- Tree protection zone, or setback from the tree with increasing setback depending on tree size;
- Tree protection permit or agreement;
- A tree protection plan with standards for grading, service plan, tree protection zones, with graphics;
- Signage;
- Having an arborist on site for approval of tree works;
- Arborist report required;
- Guidelines for tree repair - root or branch pruning;
- Security deposits to secure protection of trees;
- Audits of tree impact, mitigation, replanting; and
- Responsibilities,

The Oakville policy describes procedures if a tree has to be removed.

> "Town trees required to be removed as a result of construction activities must receive approval by the Town Forester or designate. If approval is granted for removal of town owned trees, the applicant will assume all costs involved and shall either: 1) pay the amenity value of the tree(s) calculated in accordance with the most recent International Society of Arboriculture Guide for Plant Appraisal; or 2) plant the equivalent number of trees based upon a **"no net loss or canopy cover"** objective as determined by the Town Forester or designate. Where tree relocation is approved, the applicant will assume all relocation and establishment costs."

The following references provide technical guidelines regarding tree protection during construction. See Bibliography for website.
- Town of Oakville. 2009 Procedure EN-TRE-001-001 Tree Protection During Construction
- City of Burlington. 2013. Specifications index for tree protection and preservation.
- Thunder Bay Parks & Open Spaces Section Standards and Specifications. 2016 edition.
- Johnson, G. R. 1999. Protecting trees from construction damage: a homeowner's guide. U. of Minnesota Extension.

Recommendation 4.3.3
> *For all County projects where trees are present, require that a comprehensive tree preservation and/or landscape plan be developed.* This plan would show how trees are being retained, protected and restored, and would be completed by an approved professional (e.g., Certified Arborist, RPF)

4.3.4 Identification and Management of Nuisance Trees

Most municipalities have a policy or philosophy that tries to preserve rather than remove public trees wherever possible. Trees should be removed only when they pose hazard to people or property. The most common reasons for tree removal are that the trees is dead, or near death, due to insect or disease problems, or the tree represents a significant hazard to people or property. Trees can be pruned to remove many hazard or nuisance factors.

A City of Brampton policy also states: "In order to not negatively affect the health or structure of a tree, the City may recommend other actions to lessen a particular problem or nuisance." See box for examples of requests for tree removal.

Examples of requests for tree removal.
They are not reasonable grounds for removing a tree:

Leaves/fruit/seeds of the tree are a nuisance
Leaves fill the eaves troughs and are a nuisance
Leaves from the tree are plugging the catch basin
Seeds from the tree are unsightly
Residents are unable to clean up the leaves/fruit/seeds because of age or physical ability
Insects attracted to the tree are a nuisance
The tree is shading the garden/patio/turf
The tree is blocking the streetlight
The tree is obstructing a view
The tree roots are growing into the water/sewer line
The tree roots are damaging a walkway/driveway
The tree does not meet private landscaping plans
The tree roots come through the lawn, interfering with lawn mowing
City of Brampton

The City of Toronto's (undated) policy considers removal of nuisance trees only in the context of presenting safety hazards, and requires payment for tree removals by the person placing the request. The policy recognizes fruit drop as a potential slip hazard. Fruit trees may be removed due to fruit falling on a hard surface. Requests for removal must be made in writing and there is a $350 fee for tree removal. City staff will remove the tree and a replacement tree will be planted by the City. Some municipalities may decide that the tree removal fee be based on the size of the tree being removed.

Home ownership changes frequently, while trees live for decades. This is reflected in the philosophy that one owner's view of nuisance should not be the only factor considered when determining how to deal with a nuisance complaint. Therefore, if a policy is be developed on the premise that the property owner is requesting the action on the "nuisance", and if the action is deemed appropriate by the County, the property owner should be responsible for all associated costs. These include, but are not limited to; costs of inspection, removal, stumping, and replanting. Replanting with alternate species is a necessity to preserve the tree cover throughout the County so replanting provisions must be included in the policy. A recommendation of specifics, *e.g.,* the replacement tree should be planted as close to the original tree as possible—preferably the same lot frontage— should be included.

Policies for tree maintenance, tree removal and tree replacement are found in their respective chapters.

Recommendation 4.3.4

> ***Adopt a "nuisance tree" policy that can be equitably applied and enforced County-wide.***

4.3.5 Recognition of Heritage Trees

Municipalities and citizens alike are interested in identifying, assessing, protecting and celebrating heritage trees. The Ontario Heritage Tree Alliance (undated) has produced a toolkit for communities concerned with heritage trees and forests. In Haldimand a complete inventory will help identify potential heritage trees. In a number of municipalities in southern Ontario public surveys show support for a tree protection by-law on private property – specifically to protect rare or unusual specimens, to protect "heritage trees", or to protect trees of a certain size.

Recommendation 4.3.5

> *Develop a plan to identify and designate heritage trees based on the approach of the Ontario Heritage Tree Alliance.*

4.4 Recommendations/Actions

Goal: Develop a policy framework, infrastructure and procedures for trees on County lands with respect to tree maintenance, removal and replanting practices so that the urban forest is recognized as green infrastructure and a municipal/community asset.

Recommendations/Action	Priority	Time Frame	Cost 2017-2021	Source
4.1a - Ensure that all policy revisions and updates, such as the Official Plan, define the urban forest, identify it as a high priority for protection, and describe it as "green infrastructure" which needs to be actively managed.	High	At Official plan renewal		Planning staff in house
4.1b - Develop a Tree Operations Protocol for Roads, Parks, Engineering and Planning to utilize when addressing tree issues in the field, during municipal works and the development process.	Medium	2019		Forest Manager and staff
4.2a - Develop a comprehensive tree bylaw that protects public trees in general, and during development and municipal works, and provides for replacement, planting and maintenance of new trees.	High	2019	15,000	Contract
4.2b - Update the Forest Conservation Bylaw to current standards and consider measures that affect woodlands of all sizes and natural areas that do not meet the definition of a woodland, and to prevent pre-development clearing of trees and woodlands.	High	2018		Enforcement
4.3.1a - Update the Haldimand County Design Criteria (Section O) to latest ISA standards. This includes more detailed information on stock selection process and setting standards for retention of native topsoil, increased soil volumes and soil quality to support improved tree habitat.	Medium	2020		Forest Manager

4.3.1b - Specify minimum professional requirements for those developing tree-planting plans (e.g., Certified Arborist, RPF)	Medium	2020		FM/Staff
4.3.2 – For tree protection in site development, require that a comprehensive tree preservation and/or landscape plan-is part of the plan/site review process and ensure that the Forest Manager has an official role in all phases —from application review to final approval and construction.	High	2019		Planning and Forest Manager
4.3.3 – For all County projects where trees are present, require that a comprehensive tree preservation and/or landscape plan be developed. This plan would show how trees are being retained, protected and restored, and would be completed by an approved professional (e.g., Certified Arborist, RPF)	High	2019		Forest Manager
4.3.4 - Adopt a "nuisance tree" policy that can be equitably applied and enforced County-wide.	Medium	2020		Forest Manager and staff
4.3.5 - Develop a plan to identify and designate heritage trees based on the approach of the Ontario Heritage Tree Alliance.	High	Next Plan period		

5.0 Tree Health Maintenance and Risk Assessment

A tree maintenance plan is an important management tool, especially for large property owners such as local governments. The maintenance program/plan is a schedule of tending existing and newly-planted trees. This plan establishes policy and standards for tree maintenance, and is based on local conditions, information on the general age and health of the trees (i.e., from an inventory), and the owner's objectives.

The tree maintenance plan may be part of an urban forestry management plan or a stand-alone document. A maintenance plan may include:
- Tree inventory – collect/update information on trees: such as location, species distribution, size (age), condition, hazards;
- Current conditions – current needs for tree maintenance from inventory information;
- Maintenance cycles – establish maintenance cycles or frequency for planting, pruning, watering, and other maintenance activities that will meet owner's objectives;
- Work plans – prepare immediate, annual, and cycle work plan based on maintenance needs;
- Budget – develop an annual budget to meet projections of maintenance needs;
- Maintenance performed – decide how maintenance work will be performed, for example bidding, contract, or in-house;
- Evaluation - re-inventory, re-assess, and adjust work plans as necessary.

Ideally, tree maintenance starts with planting stock selection, followed by planting, then tending practices such as watering, fertilizing, and mulching to give the new trees a good start. Pruning is one of the most important maintenance operations for new and established trees. . However in most cases pruning has not been done for many years for tree maintenance or health, but in response to problems or complaints. The result is that many trees have heavy branching, poor form, and forks with included bark. Pruning strategies must be designed for young trees and for mature trees.

5.1 Pruning

5.1.1 Types of Pruning

The type of pruning to be used depends upon the purpose of the pruning.
- **Structural pruning** encourages the development of one strong leader (stronger branch/trunk development) in younger trees to improve structure in the future.
- **Cleaning** removes dead, diseased, broken, and weakly attached branches to reduce hazardous conditions.
- **Crown Reduction** decreases height and/or spread to provide clearance for utilities and structures and to minimize potential for failure.
- **Thinning** reduces the density of live branches. Trees may need thinning if branches are too heavy or if there is a foliar disease problem (thinning can increase airflow and light within the canopy). Other benefits of thinning include enhanced appearance of the tree and increased storm resistance.

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- **Raising** provides vertical clearance so people and vehicles can move easily under a tree.

Pruning should be done by or at the direction of an ISA Certified Arborist at the appropriate time according to individual species requirements.

5.1.1.1 Pruning Young Trees

Pruning of young trees is recognized as one of the best investments in the health of the future urban forest. Early proactive pruning will result in trees with good structure that will have fewer pruning and safety problems in the future. The savings that result are healthier, mature trees that need less pruning, provide greater benefits, have less probability of failure, and increased prospects for long-term tree survival. (Town of Milton, 2014)

Proper structural pruning of trees begins in the nursery and shapes the tree early, reduces the need for severe pruning later and limits subsequent hazards. Structural pruning of young trees has several goals:
- Developing a strong vertical leader and eliminating co-dominant stems;
- Establishing well-spaced branches;
- Removing branches with included bark;
- Removing branches that rub other branches.

Pruning young trees requires an understanding of the site and purpose of the tree as well as the growth pattern of the species itself. Frequency of pruning depends on the species, age of the tree and location. Young trees need regular pruning to develop a strong branching structure. The amount of pruning needed is also related to the tree's location. Trees located near overhead utility lines or sidewalks need more frequent attention. Choosing a species that is compatible with the site (i.e., planting the right tree in the right place) can reduce pruning costs.

Structural pruning is inexpensive because it is done when the trees are less than 10 years old from the ground and using hand saws, and pruners, rather than climbing or using expensive equipment. A large number of trees can be pruned quickly and it greatly reduces future liability and maintenance costs. Typically only five to eight pruning cuts are required during each pruning round.

In Thunder Bay trees are pruned at a young age; typically in years 3 and 7 after planting and with tree diameters less than 15 cm. (Davey Resource Group, 2011). In Milton, the management plan suggests that annual planting lists should be used to direct the pruning, which should take place three times within 10 years of planting. (Town of Milton, 2014.)

Recommendation 5.1.1.1

> ***Hire seasonal/contract technicians for a minimum two-year period to conduct tree maintenance and structural pruning on young trees.***

5.1.1.2 Mature Tree Pruning

The current system of tree care in Haldimand is reactive, in response to a call from citizen or staff. The County generates a work order and the tree is then assessed and prioritized by the contract arborist. The arborist responds to County staff with a report detailing the required maintenance on each tree identified by the County. The tree is put in the queue for pruning or removal depending on the risk. With reactive management significant safety problems remain unidentified with potentially damaging consequences. This type of reactive service is inefficient, may have significant risk and may not adequately meet public expectations.

A proactive system of tree management is based upon regular inspection and response cycles and will identify the management requirements of the urban forest. It recognizes current needs and anticipates future requirements. Resources can be targeted in the most efficient way toward achieving the objectives of the Management Plan. Over the long term, a planned and cyclical approach can provide significant cost savings over reactionary pruning and tree maintenance.

An optimal pruning cycle for mature trees is to conduct maintenance pruning every five years. However, few municipalities can meet that schedule and a more common/realistic maintenance cycle period is every seven or eight years. Pruning cycles are often interrupted and restarted following severe weather events when many trees are pruned to mitigate storm damage. The box describes why pruning is required.

> **Pruning Recommendations**
>
> Tree defects such as dead and/or broken branches can occur even when the rest of the tree is sound. In these cases, pruning the branch or branches can correct the problem and reduce the risk associated with the tree.
>
> Pruning is recommended when:
> A branch is dead, but trunk condition is still acceptable.
>
> A branch of sufficient size and/or weight is cracked or decayed.
>
> A weak branch union exists and one of the branches can be removed.
>
> Branches have poor form, sharp angles, a twist, or bend.
>
> A branch is lopsided or unbalanced.
>
> A broken branch is lodged in the crown (hanger).
>
> A branch is improperly pruned or topped.
>
> A branch is obstructing the view of signs, signals, or limit visibility of traffic.

A block or grid cycle is most commonly used where trees in different parts of the municipality receive maintenance pruning each year of the cycle. For example, in Haldimand, the County could be divided into seven sectors (e.g., urban areas or parts of larger ones) and tree maintenance would be conducted over seven years, one year in each zone. This means that seven management zones will need to be developed that include a balanced number of trees. Some consideration should be given to making adjustments for tree sizes in each zone as well. Trees along entire blocks will be assessed for pruning needs and the work performed along each block. This greatly minimizes set-up times and improves overall tree health as each tree is visited, assessed, and possibly pruned once every seven years.

Over time, emergency needs are reduced, trees are healthier and the public is safer as a stronger emphasis is placed on systematic pruning. During the transition to a block system and through the cycle, there will always be a number of trees outside of the current working zone that need immediate, high priority

attention because of issues identified by staff or citizens. For these situations, the response would be similar to the current work order procedure described above. The assessment by the Arborist will determine whether the work needs to be done immediately or soon, or if it can be deferred to the next pruning cycle for the area. Table 4.1 shows the number of trees that can be pruned based on tree size class comparing on request pruning with systematic pruning.

Table 5.1. Pruning productivity guidelines for the City of Toronto 1999 season. Number of trees are those pruned per crew per day (Halstead, 1999).

Type of Pruning	Congested Area		Non-congested area	
	On Request Basis	**Systematic Pruning**	**On Request Basis**	**Systematic Pruning**
For large trees (>50 cm. diameter) using a 3 person crew combined unit	2 to 3 trees	4 to 6 trees	3 to 4 trees	6 to 8 trees
For medium trees (30 to 50 cm. diameter) using a 3 person crew combined unit	4 to 6 trees	8 to 10 trees	6 to 8 trees	8 to 10 trees
For small trees (<30 cm. diameter) using a 3 person crew combined unit	8 to 10 trees	12 to 16 trees	12 to 16 trees	15 to 23 trees

Burlington's 'Mature Tree Pruning & Fertilizing Standards' outline specifics on safety, tools, standards, traffic control, public relations and more. (City of Burlington, 2006)

In Mississauga the street tree program focuses on providing the minimum required clearances between tree branches, roads and sidewalks, and typically begins when trees are between 10 and 20 years of age. The program is intended to operate on an eight-year cycle, meaning that most trees along City streets should be pruned once every eight years. This length of cycle is generally considered adequate to balance maintenance costs and the benefits provided by proper pruning. (City of Mississauga, 2014.)

Park tree maintenance is generally carried out differently than on street trees. Best practices suggest annual inspections on trees in active parks with maintenance on an as-needed basis. However, this is likely unachievable in most jurisdictions due to resource constraints. An inspection cycle of five years is recommended, but most communities' use a seven to eight year cycle; however even this cycle can be difficult to achieve. For example, in Burlington, park trees are visually inspected approximately once every seven years, and maintenance is carried out on an as-needed basis.

In a municipality such as Haldimand, which contains both urban area and rural settlement areas, it is challenging to ensure that all street trees are maintained in a cyclical manner. Similarly-structured municipalities with cyclical pruning programs will typically implement the proactive cycle in their urban areas, while undertaking reactive request-based or as-needed maintenance in the rural areas.

Some high-risk trees are good candidates for conversion into a wildlife habitat tree. Suggestions include:
- Retaining trees with non-critical defects that improve wildlife habitat in low use area such as cemeteries and parks;
- Choose a tree with characteristics such as cavities that are suitable for wildlife habitat;
- Remove or reduce the size of defective scaffold branches;
- Shorten the trunk to minimize the chance that the tree will fail;
- Leave the cavity for wildlife to inhabit.

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Recommendation 5.1.1.2a

> ***Establish and implement a seven-year pruning cycle and a "grid" pruning program for street, park and cemetery trees to shift from a reactive to a proactive maintenance mode.***

Recommendation 5.1.1.2b

> ***Develop guidelines for tree maintenance and other practices to support the preservation of large canopied trees that can be consistently applied to County properties and projects.***

Recommendation 5.1.1.2c

> ***Train staff (particularly the Facilities and Parks Operations Division staff) in proper pruning and maintenance practices.***

5.2 Cabling and Bracing

Cabling and bracing is the practice of adding a support system to a tree to reduce the stress on weak branch unions. It is used on trees that have acute, V-shaped branch unions that form included bark, or to correct trees with poor architecture. Cabling and bracing does not repair a high-risk tree, but when done correctly by a specialized arborist, it can reduce the amount of stress on branches with poor structure, thus reducing the amount of risk and extend the life of the tree.

There are many considerations that must be addressed before a cabling and bracing system is installed in a tree. The tree may have a high value in a particular landscape, or it might be a historic or unique specimen. Before investing in a cabling and bracing system, the cost of installation and future maintenance must be balanced against the risk of failure and possible loss of aesthetic value during the tree's extended life. Other considerations when thinking about cabling and bracing are the soil and root situation, species, decay and costs related to future inspection and maintenance.

Cabling will add a level of security and risk reduction, and can help to affect the direction of failure if a branch should fail. When designed and installed properly, appropriate use of cabling and bracing will extend the life of a tree and reduce the risk to an acceptable level. If cabling and bracing is used to extend the life of a tree, it must be understood that such treatments are temporary.

Recommendation 5.2.

> ***Consideration should be given to cabling and bracing high value trees when they are identified.***

5.3 Public Education/Communication

Besides general communication efforts described in Chapter 7, local communications is required for maintenance work. When trees are being pruned or removed in their neighbourhood members of the public often show concern, and neighbourhood communications will reduce concerns and help with community education. In Brampton and Oakville, as an example, 'door-hangers' are used. Staff inspecting a location provide the resident with information on the tree, a diagnosis and the expected course of action. Customers are given a reference number specific to their concern and contact information in the event

they wish to followup on the status of any scheduled work. Each resident in the relevant blocks receives a notice of pruning activity in advance of the scheduled day. The notice is accompanied by a map to illustrate that their neighbourhood is pruned systematically every cycle. When people understand that pruning is conducted as routine maintenance, they will become less concerned during the activity. This regularity and advance notice helps to educate residents about tree care needs.

In Mississauga, if the City-owned tree adjacent to a home has been inspected and maintenance work is required, an inspection notice, outlining the work required, is at the home. Mississauga provides an on-line service where citizens can report a tree issue. Of course they can call in the problem as well.

Recommendation 5.3
> *In conjunction with grid pruning operations develop communications tools, such as door hangers, to advise the public of impending tree work.*

5.4 Tree Risk Management

Much of the information in this section is taken from *Pokorny, Jill. 2003. Urban Tree Risk Management: A Community Guide to Program Design and Implementation.*

Risk management is a well-established concept in the management of public spaces. Acceptable levels of risk have been recognized or defined for most basic infrastructure elements such as sidewalks, curbs, streets, playgrounds, and utilities. In many communities, these elements are assessed and managed according to acceptable levels of risk that are specified within written policies or enacted through management practices. Although not all pot-holes can be immediately filled in, not all heaving sidewalks immediately repaired, not all burned-out street light bulbs immediately replaced, a successful risk management program provides a community with a systematic approach to implement corrective actions within a reasonable time frame (Hauer and Johnson, 2003). An operational and effective risk management practice shows an insurer that your organization is committed to loss reduction or prevention.

An urban community consists of both gray infrastructure (buildings, streets, utilities) and green infrastructure - the urban forest and other natural features. Gray infrastructure has long been assessed and monitored for acceptable levels of risks. The concept of considering or evaluating risks in the context of location and condition is less applied with the green infrastructure.

It is impossible to maintain trees free of risk. Some level of risk must be accepted by the community to generate the benefits that trees provide. Developing and implementing a tree risk management program will increase public safety, reduce the potential woody debris loads generated by storms, and move a municipality towards a proactive urban forestry program. Implementing a tree risk work plan will help identify problems with trees, plan for the remediation of high-risk situations, and implement the recommended maintenance work before the trees fail and cause crisis situations.

Tree risk mitigation can extend the life of a tree that has significant risk factors. Practices such as crown reduction and cabling and bracing, if performed and managed appropriately, can greatly reduce the risk presented by aging trees while maintaining the environmental benefits they provide.

Tree defects often derive from injury or disease that seriously weakens part of the tree, predisposing the branch or tree to failure. Defects also arise from poor tree architecture or poor pruning practices that lead to weakness in branch attachments, rooting habits, trunk characteristics, and species with inherently brittle wood. Structurally sound and healthy trees may be considered high risk if they interfere with or threaten utilities, roadways, walkways, raise sidewalks, or obstruct motorist vision. Structural pruning on young trees to correct developing structural weaknesses and proactive maintenance will significantly reduce general risk associated with trees.

5.4.1 Management of Tree Risk

Community managers have the responsibility and maintain a safe and useful urban forest for their constituents. Urban foresters need the training and expertise to recognize varying levels of risk, and to manage the forest at an acceptable level of risk. Modern techniques and procedures can be used to assess trees and mitigate problems, helping to minimize the risk of damage to property and personal injury.

Tree risk management involves the process of inspecting and assessing trees for their potential to injure people or damage property. Hazard trees are defined as trees with structural defects that may cause the tree or tree part to fail, where such a failure may cause property damage or personal injury. Trees will vary, ranging from low- or moderate-risk (i.e. trees that are assessed not to have an immediate risk of failure) to high-risk (i.e. where trees are more likely to fail and cause property damage or personal injury). The threshold of risk acceptable to liable parties is dependent upon their policies and objectives. Trees that surpass the level of acceptable risk are hazards from a program viewpoint.

Arborists who perform tree risk assessments assign tree risk ratings based on factors like the potential for tree (or branch) failure, the size of the part that may fail, and the likelihood that a failure might harm people or property. The managers then choose an acceptable level of risk and manage problems down to that level.

The perception of safety or acceptable levels of risk is equally or sometimes more powerful than the reality of the condition of a tree and the situation that it is growing in. People without forestry or arboriculture background often make forestry decisions based on politics, emotions, perceptions of safety and other reasons. In order to make objective, science-based decisions on the safety of trees and the urban forest, individual trees and site conditions need to be evaluated by experienced professionals to assess the level of risk that they present.

5.4.2 Community Tree Risk Management: Program Planning and Design

Most of us have witnessed the destruction caused when a tree falls and strikes a physical structure or person. Without question, trees can become hazardous over time and come to pose significant risks to people and property. A key issue facing communities is how to manage the urban forest, both from an ecological standpoint of promoting resource health, and from a public safety standpoint; ensuring that reasonable care is being taken to manage the risks associated with trees. The best way for a community to confront this issue is to develop a tree risk management program. The program should focus on the prevention, identification and correction of hazardous tree defects, using a written, systematic procedure

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for inspecting and evaluating potentially-hazardous trees. Tree risk management programs should be designed to complement a community's overall street and park tree management goals, and be fully integrated with the tree planting, maintenance, and emergency response programs.

History documents that most trees fail during storm events as storms rage through the area, causing damage to trees and associated tree injuries and/or property damage. Severe storms can also hinder community public service and emergency response systems. As destructive as these storms are, valuable lessons can be learned from them. Post-storm surveys of damaged trees provide forensic evidence about tree failure patterns and structural defects that are commonly associated with tree failures. By knowing more about how and when trees fail, we can more accurately assess the degree of risk associated with specific tree defects, and make well founded tree risk management decisions.

Post-storm surveys strongly demonstrate the value of investing community resources to prevent structural defects through proper tree planting and pruning practices, and to inspect trees on a regular basis to correct hazardous tree defects before they cause tree failures. Aerial and ground examination of trees damaged by Hurricane Andrew, in Florida 1992, revealed that inappropriate species composition and improper planting and maintenance practices in urban and suburban areas resulted in extensive and unnecessary tree losses and associated property damage (Demsey 1994). Field observations following the January 1998 ice storms that struck northeastern United States and eastern Canada noted that branch breakage and overall tree damage was much less on trees that were well pruned and well maintained. Johnson (1999) found that 84 percent of the trees damaged during high wind storm events had pre-existing defects that resulted in tree and branch failures. They found that most of the pre-existing defects that contributed to tree or branch failure could have been prevented through proper tree planting and pruning practices, and could have been detected and corrected if the trees had been inspected for the presence of hazardous defects.

5.4.3 Tree Risk Management Program Planning and Design: A Ten Step Approach

(Pokorny and Albers 2003)
This approach is underway in Haldimand through the work associated with this Management Plan and references to appropriate sections included below.

5.4.3.1 What Do You Have?

Step 1. Assess the tree resource. *Found in Chapter 2 Tree Inventory of this plan with recommendations.*
Inventory information provides the baseline of the current condition of the tree population and identifies key public safety issues and tree maintenance needs. This inventory will help determine costs associated with maintenance needs; tree removal and disposal, pruning, planting, and value of the urban forest resource.

Step 2. Review current tree management practices. *Found in forest strategy and summarized throughout this plan.*

Step 3. Assess fiscal and human resources available to manage the tree resource. *Found in strategy and in sections of this plan.*

5.4.3.2 What Do You Want?

Step 4. **Identify program goals**. Applicable program goals from the Haldimand strategy are:

- To improve the resilience of the urban forest to current and anticipated stressors, including climate change, pests and diseases by implementing policies and management practices that optimize tree species diversity, structure and age classes, with appropriate monitoring. *Recommendations are found in this chapter.*

- To prioritize protection and maintenance of mature, healthy trees and preservation of older large-canopied species to the greatest extent possible. *Recommendations are found in this chapter.*

- To utilize human resources efficiently and effectively to address the tree-related activities. *Recommendations are found in Chapter 3 - Service Delivery Framework.*

The two guiding principles of any tree risk management program are:

- Increase public safety;
- Promote tree health and sustainability.

Both guiding principles can be achieved through a two-tiered program that focuses on the fundamental goals of 1) preventing hazardous tree defects through the implementation of proper arboricultural practices that promote tree health and structurally sound trees, and 2) correcting hazardous tree defects through the use of a systematic process to accurately detect and assess hazardous defects, and implement corrective actions within a reasonable time.

5.4.3.3 How Do You Get What You Want?

Step 5. Formulate a tree risk management plan.

A tree risk management plan enables a community to prevent, detect, assess, and correct structural defects in trees, before they endanger public safety or tree resource health. Just as nothing in life is risk-free, every landscape and tree situation involves risk. Management strategies should address program principles and fundamental goals, implement actions that address specific needs, and produce measurable results.

Consider actions to prevent hazardous defects. Sound arboricultural practices are the best defense against development of hazardous defects. Choose species that are suitable for the available planting sites, and implement proper planting techniques. See Chapter 6 of this plan for criteria for selecting nursery stock, species selection, and proper planting and pruning techniques. Once a tree is planted, a program of early and regular tree pruning will prevent the development of many structural defects, and reduce subsequent pruning, tree removal, and replanting costs.

Consider actions to correct hazardous defects. A tree risk management plan must provide the community with a systematic process to detect, assess, and correct hazardous defects before they cause tree failures.

Step 6. Prioritize inspection and corrective action needs.
There will never be unlimited resources to attend to every aspect of tree care and maintenance and there will always be many components of the forest that are equally worthy of attention, often with conflicting management requirements. Thus a practical approach should be adopted to optimize resources, utilizing limited budgets and personnel to conduct tree inspections and implement corrective actions over a period of time.

Communities should prioritize inspection and corrective action needs, identifying those that require immediate attention and those that may be delayed with minimal impact on public safety and tree health. Exclusion criteria could include specific location, tree size, low use areas. Tree inspection and corrective action needs are prioritized, based on a process that:
- divides the community into tree risk zones,
- establishes tree risk inspection methods and schedules, according to tree risk zones; and
- implements corrective actions in a reasonable and timely manner.

Appendix IV provides detail as described in Pokorny and Albers (2003).

Step 7. **Select a tree risk rating system.**
Determination of acceptable risk, outlining what the County considers an acceptable threshold for risk of tree failure. The International Society of Arboriculture and other agencies have developed assessment methods for tree risk. Many communities have adopted one of these or developed their own tree risk assessment procedures. An inventory database should include risk assessment data as well as basic tree inventory data and is then used to generate management recommendations.

Establish an implementation schedule for corrective actions. Immediate removal or corrective treatment of very high-risk trees must be the top priority of any urban forestry program. It is common for communities with no current tree inventory or tree risk inspections to have many high-risk trees. For most communities, limited budgets and personnel will require that corrective actions be phased in over a period of time. Clear guidelines are necessary on identifying high-risk trees, prioritizing corrective actions, and implementation within a reasonable time frame. Numeric tree risk rating systems provide a clear way to prioritize corrective treatments. Trees with the highest risk rating are treated first, and other corrective treatments are implemented later, according to decreasing ratings.

Step 8. Write a comprehensive tree risk management program policy.
- State the community's understanding of its responsibility to maintain the safety of public lands from potentially hazardous trees;
- Identify who will administer the tree risk management program and possess the authority to enforce tree risk reduction policies;

- Determination of acceptable risk, outlining what the County considers an acceptable threshold for risk of tree failure;
- Minimum levels of training and qualifications of risk assessors, outlining the expected credentials that tree risk assessors should possess;
- Frequency of assessment, outlining how often publicly-owned trees in different settings (e.g., trails, high-traffic streets, new communities) are to be inspected for risk;
- Management options, outlining what arboricultural treatments the County will consider for implementation to mitigate risk, such as pruning, cabling, bracing, or removal;
- Record-keeping protocols, to enable tracking of inspections and mitigation actions;
- Specify a process by which corrective actions will be implemented;
- Identify a process for handling corrective action appeals presented by affected citizens;
- Identify a process for handling violations of the tree risk management program policy.

Step 9. **Implement a tree risk management plan.**
- Hire or train staff;
- Implement risk inspections and corrective actions according to established methods and schedules;
- Document tree risk inspections, corrective actions, and tree failures.

5.4.3.4 Are You Getting What You Want?

Step 10. Evaluate program effectiveness.
For a tree risk management program, two expected outcomes would be 1) increased public safety and 2) improved urban forest health and sustainability. Once the major outcomes are identified, observable measures or indicators of success or failure must also be identified. Annual analysis of the updated tree inventory can provide an index to program effectiveness. For example, the average tree risk rating for all or part of the County could be used as part of an evaluation.

Recommendation 5.4.3.4a
> *An Urban Forest Risk Management Policy should be developed regarding tree inspections, and maintenance practices that identifies, prioritizes and resolves potentially hazardous situations associated with county trees and forests.*

Recommendation 5.4.3.4b
> *County trees on streets and developed areas of parks and cemeteries should be assessed on an average of seven to eight years regarding safety and maintenance issues, and the inventory updated to reflect current conditions.*

Recommendation 5.4.3.4c
> *A risk management policy for woodland trails should be developed. This would include signage at the entrances of County owned woodland trails that direct users to stay on the trails and enter at their own risk. Maintained woodland trails should be inspected every five years and*

> *after significant storm events to recommend tree pruning or removal of trees within falling distance of the trails.*

5.4.4 Emergency (Storm) Events

Mitigating damage to trees and managing woody debris are important components of an emergency plan. When catastrophic disasters, such as tornadoes, ice storms, hurricanes, and severe straight-line winds strike an area, thousands of cubic meters of debris are produced. Trees and vegetation can account for a significant amount of this debris. After storms, trees and woody debris often block streets, driveways and power restoration efforts or cause power outages and property damage (both personal and public). Beyond the task of collecting and disposing of woody debris, considerations include increased dangers from hanging limbs, uprooted trees and their hindrance to emergency response efforts. The impact of these tree-related considerations is not always quantifiable but can overwhelm public services and slow down the recovery process. (Urban Forestry Best Management Practices for Public Works Managers-4.)

Public safety can be increased and potential debris generated from storm events can be reduced if high-risk trees are remediated. Options include moving the target (e.g., raising power lines, removing structures), pruning the tree, or removing the tree. Removing the target does not prevent a tree from failing, it only reduces the risk. Typically, moving a target away from a tree that is likely to fail is a short-term solution and later pruning or removal may be necessary to reduce the risk to acceptable levels. The focus of post storm inspections should be the retention of as many trees as possible because the most failure prone component parts were likely to have failed during the storm. The system should also recognize the benefits of trees in varying conditions and seek to preserve a balance of these through appropriate management practices and maintenance systems.

The City of Kington Urban Plan has a simple Emergency Response Plan (undated). Its objective is "*to* be ready to deal with storms and infestations that affect the urban forest". The operational policies and practices are "to identify and establish roles and responsibilities prior to a storm or infestation for both minor and major events". There are organizational charts, call lists, emergency contacts, equipment lists, forestry contractor list with contracts ready, and getting help from the utility company. In Haldimand situations may involve trees blocking roads, falling on structures and utility wires and then includes post-emergency work including proper tree maintenance on damaged trees.

Recommendation 5.4.4
> ***Develop a directed emergency response plan within the broader Haldimand County Emergency Response Plan. This helps to ensure that risks are mitigated as required and that the necessary resources are allocated to the planning-through-recovery stages of a significant storm event.***

5.5 Invasive Insect, Disease and Plant Species

Invasive exotic insect pests pose a serious threat to the health of urban forests as no natural controls have developed to regulate these non-native species. Consequently, infestations commonly result in a substantial loss of canopy cover and associated ecosystem services, an increase in municipal maintenance costs, a loss of species diversity, and a shift to younger age class distribution.

The greatest current threat to eastern North America's forests is the emerald ash borer (EAB), which is likely to eliminate most of the ash population. Ash comprises an estimated nine percent of the tree canopy in the County. EAB was first identified officially in Haldimand in 2014 (although it is presumed to be present from 2007) and has been responsible for killing large numbers of trees. Management of the EAB is found in Chapter 8.

The Asian long-horned beetle *(Anoplophora glabripennis)* (ALHB) is another invasive beetle, native to eastern Asia. This exotic beetle attacks many Canadian hardwood species; in particular, maple species are a preferred host tree. However, the beetle also attacks horse chestnut, elm, birch, poplar, willow, mountain-ash) and hackberry. The ALHB's presence in Canada was first detected in 2003 in an industrial area on the Toronto – Vaughan boundary. The Canadian Food Inspection Agency (CFIA) launched an aggressive campaign to eradicate the ALHB the infestation which was declared eradicated in 2013. That same year a new infestation was found near the Toronto Airport that is undergoing the same eradication protocol. The fact that this beetle feeds on many species makes it a significant threat to forest health in Ontario given the wide distribution of deciduous forests.

An example of an insect that will likely move into Canada, and a good reason to have a monitoring plan, is the hemlock woolly adelgid (*Adelges tsugae*) (HWA). It was first described in western North America in 1919 and first reported in the eastern United States in 1951. HWA is kept under control in the west by native beetles, however natural control elements in eastern North America are lacking. HWA is now established through 19 eastern United States, including New York. Natural dispersal of HWA typically occurs slowly via wind, birds, deer and other forest dwelling animals. The risk of long distance dispersal primarily comes from the movement of infested nursery stock, logs and other unprocessed forest products (CFIA 2014).

Since 2012, there have been localized finds of HWA at two separate sites in Ontario, one in Etobicoke and the other in Niagara Falls. At both sites, the CFIA have conducted special surveys, designed to delimit the area in which HWA has been detected. At both sites, the infested material was removed and destroyed and the CFIA is conducting ongoing monitoring at these sites to verify eradication efforts.

North America and Ontario have a history of significant damage to trees from invasive pathogens. These include chestnut blight (*Cryphonectria parasitica*) which wiped out the American chestnut; Dutch elm disease (*Ophiostoma ulmi*) (DED) which was introduced in North America in the 1930's and has spread throughout most of the range of native elm species in North America. In the 1960's and 1970's DED wiped out a majority of the elms in Ontario. Before DED, white elm was arguably, the most prominent street tree in eastern North America and a significant part of lowland forests. Following the elm's demise they were often replaced in street tree plantings with Norway maple and green ash.

Other tree species are threatened from exotic pathogens. Beech has been ravaged by the beech bark disease (*Nectina coccinea* var, *faginata*). Butternut is attacked by butternut canker *(Ophiognomonia clavigignenti-juglandacearum)* and flowering dogwood is being wiped out by dogwood anthracnose fungus (*Discula destructive sp.*). The latter two species are on the endangered list of the Endangered Species Act, 2007.in Ontario directly because of the exotic fungi.

Invasive plant species are also a major stressor in urban forests. Invasive plant species can be described as species that are fast growing, prolific seeding and aggressively competitive with desirable native species. Often these species are also non-native. There are numerous invasive plants in southern Ontario. A few such as buckthorn, Norway maple, garlic mustard (*Alliaria petiolata*) and dog strangling vine (*Cynanchum rossicum)* are prevalent in the urban forest. In urban woodlands and forests, they can threaten local ecosystems by outcompeting and displacing indigenous plant communities. Management of invasive plant species typically requires dedicated resources over multiple years to be effective.

The challenge of identifying and controlling invasive pests has become more urgent for urban forest managers as increasing movement of people and commercial goods continue to bring new invasive species to North American forests. Trees in urban areas can be more susceptible to the effects of pests and pathogens than trees in natural settings due to stressful urban environments. Once introduced, eradication of most pest species is usually impractical or impossible, and even targeted control may be difficult.

Recommendation 5.5

> *Develop and implement a strategy to monitor forests for existing and potentially invasive and exotic species that can affect natural ecosystems and impact tree health and maintenance requirements. Where appropriate the County should coordinate efforts with agencies like the Canadian Food Inspection Agency, the Canadian Forest Service, the Ontario Ministry of Natural Resource and Forestry, Conservation Authorities and surrounding municipalities.*

5.6 Recommendations/Actions

Goal: Improve the resilience of the urban forest to current and anticipated stressors, including climate change, pests and diseases by implementing policies and management practices that optimize tree species diversity, structure and age classes, with appropriate monitoring.

Goal: Prioritize protection and maintenance of mature, healthy trees and preservation of older large-canopied species to the greatest extent possible.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
5.1.1.1. - Hire seasonal/contract technicians for a minimum two-year period to conduct tree maintenance and structural pruning on young trees.	Medium	2019-2020	31,100	Contract
5.1.1.2a - Establish and implement a seven-year pruning cycle and a "grid" pruning program for street, park and cemetery trees to shift from a reactive to a proactive maintenance mode.	High	2019 to 2021	916,000	Contract
5.1.1.2b- Develop guidelines for tree maintenance and other practices to support the preservation of	Medium	2019		Forest Manager

large canopied trees that can be consistently applied to County properties and projects.				
5.1.1.2c - Train staff (particularly the Facilities and Parks Operations Division) in proper pruning and maintenance practices.	Medium	2018 ongoing	5,000	Contract
5.2 - Consideration should be given to cabling and bracing high value trees when they are identified.	Medium	As needed		Contract
5.3 - In conjunction with grid pruning operations, develop communications tools such as door hangers, to advise the public of impending tree work.	High	2019		Forest Manager and Communications
5.4.3.4a - An Urban Forest Risk Management Policy should be developed regarding tree inspections, and maintenance practices that identifies, prioritizes and resolves potentially hazardous situations associated with County trees and forests.	High	2017	13,000	Contract
5.4.3.4b - County trees on streets and developed areas of parks and cemeteries should be assessed on an average of seven to eight years regarding safety and maintenance issues, and the inventory updated to reflect current conditions.	Medium	2017 and Next plan period		Forest Manager and staff
5.4.3.5c - A risk management policy for woodland trails should be developed. This would include signage at the entrances of County owned woodland trails that direct users to stay on the trails and enter at their own risk. Maintained woodland trails should be inspected every five years and after significant storm events to recommend tree pruning or removal of trees within falling distance of the trails.	Medium	2018		Forest Manager and staff
5.4.4 - Develop a directed emergency response plan within the broader Haldimand County Emergency Response Plan. This helps to ensure that risks are mitigated as required and that the necessary resources are allocated to the planning-through-recovery stages of a significant storm event.	Medium	2018		Staff team
5.5 - Develop and implement a strategy to monitor forests for existing and potentially invasive and exotic species that can affect natural ecosystems and impact tree health and maintenance requirements. Where appropriate the County should coordinate efforts with agencies like the Canadian Food Inspection Agency, the Canadian Forest Service, the Ontario Ministry of Natural Resource and Forestry, Conservation Authorities and surrounding municipalities**.**	Low	2022-2026		Contract

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6.0 Tree Removal, Replacement and Establishment Protocol and Guidelines

6.1 Tree Removal Guidelines

Removing a hazardous tree is the option of last resort and should be conducted only when other corrective actions cannot reduce the level of risk to an acceptable level at a reasonable cost. However, trees of all ages and conditions may be candidates for removal because of construction or development projects. The effects of removing a tree, including visual and emotional impacts to people who value a particular tree, can be substantial. Candidate trees for potential removal should be evaluated by an experienced certified arborist for condition and hazard according to current arboricultural standards. Tree removals can be linked to a tree replacement program that includes strategies to reestablish trees at suitable planting spots where they will grow well and suit the situation.

6.1.1 Why Trees Should be Removed

- The tree is all or mostly dead, or is in poor condition and is in severe decline. A hazard has been identified and removing the entire tree is the best option. Hazards include leaning trees, bole decay, large cankers on the main stem, weak forks and severe root damage.
- The tree is diseased with, or host to, a pest that may spread to adjacent trees in the urban forest.
- The tree may be interfering (i.e. competing) with other trees considered to be more valuable or more important in meeting long-term objectives.
- The tree is located in the path of infrastructure development (e.g. roadway).
- The tree is obstructing a view or interfering with pedestrian or vehicular traffic.

6.1.2 Removal Procedures

Where the Forest Manager recommends that a tree should be removed because of safety or other reasons, the work may be done by County staff where appropriate or by a contracted tree service where the volume of work or specialized skills and equipment is required. Contracted tree firms should be experienced, have qualified staff and appropriate equipment and insurance. When prescribing a removal, the Forest Manager should itemize special considerations that the removal crew must consider when conducting the removal.

These considerations include:
- Access for equipment, personnel and working space;
- Special site considerations – soil/site consideration; (e.g., compaction susceptibility)
- Stump removal; (street and active park areas)
- Safety considerations – structures, wires, utility locates;
- Special liability concerns.

Local policy and the location of the tree (e.g. a street tree or a tree in a passive recreation area) will dictate whether stump removal or grinding is appropriate. Stumps from street trees and active parks should be

removed by grinding. Stumps should be ground to a depth of grinding (e.g. 25 cm below grade), removing structural roots greater than 10 cm within 3 m of the trunk, and condition of the site following the grinding (e.g. the site will be leveled to grade, seeded with fescue, and covered with straw) should be specified.

Recommendation 6.1a
> *Develop and adopt standard practices for tree removal.*

Recommendations 6.1b
> *Remove trees as required based on inventory and risk management approach.*

6.1.3 Wood Waste Plan

Urban wood waste can include pruned branches, whole trees from street and park removals, stumps and used lumber from demolition and construction or renovation activities. While there may be some wood from construction and demolition, this section considers waste resulting from tree pruning or removals, and the removal of trees due to construction or clearing. While this plan only considers wood generated from maintaining county-owned trees, it should likely be considered within the broader waste management context that includes wood waste generated by the public. This waste will likely be higher during the next five years because of increased removals of trees killed by EAB.

6.1.3.1 Current Wood-Waste Management

The County produces wood-waste as a by-product of tree maintenance pruning and removal. Both Roads Operations and FAPO produce wood chips and round wood (i.e., trunks and large branches). Smaller branches are chipped on site, blown into a truck and transported to a holding yard. In parks and natural areas, chipped material is usually piled on-site for landscape use. Larger wood is often cut to manageable size with a chain saw and left for public use. For street trees, wood and/or chips are often left for the home owner and large pieces may be left at roadside for removal on a 'first-come first-serve' basis.

The County uses some chips in its programs. FAPO use or could use some of the chips as mulch placed on natural trails, off-leash dog parks or around newly planted trees and in open planting beds. Otherwise, material is moved to the Road's yards for free pickup. Schools and service groups have priority to pick up mulch material. Eventually the remaining material is moved to the Canborough Waste Management Facility where a contract tub grinder will be hired annually to produce mulch.

The tub grinder pulverizes wood into small pieces and perhaps ground to finer mulch depending on the terms of the contract. The mulch will be left onsite for the public or groups, or hauled to a commercial facility. Generally it is cheaper to have the public remove the chips than to have them hauled to another user. Chips could be used by school boards or other institutional users with perhaps, some cost recovery. Presently there is no effort to produce sawlogs for sale.

6.1.3.2 Potential Uses for Wood Waste

The majority of the waste wood comes from the removal of large open-grown deciduous street trees. Site conditions that affect the work include above ground utility lines, houses, cars, sidewalks and roads. Site conditions may dictate the cut length of the sections. These factors, combined with the diversity of the resource itself, result in stem and limb wood that is highly variable in length, diameter, species and quality in terms of the presence of cavities, decay or other defects that affect merchantability. Many of the log-sized wood is irregular in shape and some urban trees have imbedded metal, such as nails, staples, and other foreign objects that can damage sawmills.

Logs can be sawn into lumber if straight, large enough and free of metal or other foreign matter. Typically, only trees that are either dead, in a state of severe and irreversible decline, or are structurally unsound are removed. These trees have generally low value for commercial lumber. However with the anticipated number of ash tree removals there may be an opportunity to sell logs for lumber or other wood for fuelwood.

Potential markets for waste wood in Haldimand include chips for landscape mulch, compost material, animal bedding, soil conditioner, boiler or residential fuel, or wood pellets and fuelwood or lumber from round wood. Some cleaning or processing may be required to make waste wood suitable for some products. This may include cleaning to remove contaminants and foreign objects and in some cases debarking, grinding or chipping.

Commercial sawmills are generally very reluctant to accept logs from urban trees because of possible contaminants (e.g., wire and nails) and poor log quality, although some logs from woodland parks may be acceptable. Wood from recovered trees in the urban forest may be sawn by owners or small-scale or specialty mills to provide rough cut and dressed lumber for small construction/renovation projects, or woodworking. Some municipalities have developed programs to support local use of the wood (e.g., Toronto and Hamilton), but these are generally public relations or waste reduction activities and do not generate revenue. The increasing popularity of portable saw mills has made it easier to make lumber from urban logs, but generally provides little revenue.

6.1.3.3. Cost Recovery/Reduction Options

Where the wood or chips are left on site or dropped off for users, there are negligible disposal fees. Hauling wood and/or chips to a public facility incurs some costs which can escalate if processing (e.g., grinding) and hauling costs are subsequently incurred. Many municipalities allow the public to remove chips or wood from designated locations at facilities and require no further debris management. However, these practices should be reviewed by the County risk-management program to ensure that proper signage and monitoring is used to protect the County from liability while the public is at these locations.

6.1.3.3.1 On-Site Use by Residents and Delivery

Because wood removal and disposal are costs of urban tree management, practices that result in less wood to dispose of or that produce some revenue represent cost savings to the County. Current practices (both

County and contract crews) rely on wood use by the public where wood is left on site and it is salvaged by neighbors for firewood or other uses. Smaller branches are chipped and blown into trucks, then dropped off at private properties for their use or delivered to a public (County crews) or private (contract crews) storage facility. However, where contract arborist crews dispose of the chips they produce, those costs are likely included in their fees.

6.1.3.3.2 Wood Management at a County Facility

Wood brought to a County facility can be handled in different ways:
1. Chips and cut wood for public removal/use;
2. Sort logs so those with potential to be saw logs (for lumber), fuelwood or grinding are separated;
3. Market logs to local buyers;
4. Grind unmarketable logs and excess chips;
5. Haul/market ground wood to industrial (mulch or fuel) users.

Cost recovery/reduction options for waste wood include sawlogs (lumber), fuelwood, and chips for fuel, pellets or mulch. Oakville and Toronto have been able to market logs and fuelwood (mostly dead and dying ash) from urban woodlands to recover 15 percent or so of the harvest/removal costs. However this applies to urban woodlands rather than wood from trees growing in developed areas like residences and commercial areas.

Recommendation 6.1.3.3.2
> *Formalize a policy that describes procedures for disposal of wood waste from urban forest tree management. This would include:*
> - *Public salvage of wood/chips left at the work site;*
> - *Delivery of wood/chips to private owners and institutions;*
> - *Public removal of chips and wood from public facilities (including signage and monitoring);*
> - *Marketing of wood from County facilities;*
> - *Disposal of unmarketable/unsalvageable wood from County facilities.*

6.1.3.3.3 Wood Marketing

The County could market wood directly to buyers or partner with the Haldimand and Area Woodlot Owners Association (HAWOA) to market logs and wood as a fund raiser through auction or direct sale. Local portable saw mill operators could be contacted to determine if there is an interest in obtaining stem and large limb wood generated by regular operations. For example, wood working artisans commonly desire very small quantities of specific species. Often of interest is wood that has character flaws or irregularities such as burls. An annual "wood auction" could be organized by a partner and the wood sold as pieces or in bulk to end users. Firewood has a low value compared to lumber or veneer, but there is an existing market to large and small firewood dealers or individual users.

Recommendation 6.1.3.3.3

> ***Work with the HAWOA to market small or specialty wood and sawlogs.***

Some municipalities have successfully marketed waste wood from urban trees for reuse. However revenues are low and have the effect of reducing costs For example, in Toronto where there is the greatest amount of wood from urban trees, a 2011 'Offer to Purchase' waste wood yielded $70 in revenue, with a corresponding reduction in tub grinding expenditure of $4,200.

The City of Toronto's Economic Development and Culture Department has implemented an initiative, "Neighbourhood Wood," to encourage homeowners and commercial enterprise to salvage and re-use Toronto's valued local trees. A directory has been established to link homeowners and commercial enterprise to the companies that can provide services and make products from the urban wood when the need arises to remove a local tree.

Chatham-Kent was one of the first municipalities, east of Windsor, to see the results of the EAB in Ontario. In partnership with an architectural firm they incorporated salvaged local ash into the redesign of the Kingston Park Pavilion, which won a Wood Works Award for excellence in wood building in 2011. In Kingston Park, ash wood was given a second life through this innovative approach, instead of going to an Ontario landfill.

A number of websites provide some background on wood waste in general and some Toronto area solutions. See bibliography.

The wood waste generated by the County urban tree management program has very limited marketability and generally represents a cost to the operations. However, costs can be minimized by using many practices already employed (e.g., making wood/chips available to the community) and some innovative marketing. Logs and wood from county-owned forests and natural parks can be marketed to forest products companies.

6.2 Tree Replacement

Adapted from "Building the Urban forest" in Georgia Model Urban Forest Book. (2001)

6.2.1 Preserve Existing Trees and Forests.

Preservation of existing trees and canopy should be a higher priority than replacement. Replacing trees and maintaining forest cover in urban centers is challenging, especially for trees situated near roads, in parking lots, on boulevards and with the EAB situation. A tree replacement policy directs the number, sizes and species to be planted, to replace trees removed because of natural decline or mortality, for private or public construction projects, or other reasons. Appropriate planting sites for replacement trees can be directed to locations near the removal site, or according to a site selection process described in the section 6.3.

Tree replacement protocols can be written as policy, in a technical manual or in a by-law. The objective of a tree replacement protocol is to support the continued growth and development of the urban forest by

providing that where trees are removed, injured or damaged, or otherwise lost, and that there will be funds available for their removal, repair and replacement. This would apply to all trees on County property in Haldimand. There can be exceptions such as previously approved development or road widening.

Many municipalities including Oakville, Mississauga and Burlington have developed protocol for tree replacement. As an example, the following information is adapted from the "City of Hamilton Reforestation Policy – Municipally Owned Lands" (undated). See bibliography for web link to entire text.

Replacement requirements in a protocol for public trees should include:
- Require permission to remove trees (including from the County operations);
- Put responsibility for tree removal cost and replacement on the permit holder;
- Require anyone (permit or not) who damages or injures a tree to pay for repair or removal and replacement of each tree;
- Development and infrastructure improvement must have an approved budget for tree replacement
- All funding should be deposited into a designated account or fund (see chapter 7). Where replacement is not feasible cash-in-lieu (to be put into a designated account or fund that supports tree planting) is acceptable;
- Cost for tree removal, carried out by the County or a contractor for the County, for a third party should take into account staff wages, equipment costs, disposal, contract and administration costs;
- The replacement valuation for healthy trees of a significant value (historical, heritage, structural, age etc.), should be evaluated in accordance with the ISA Standards for tree replacement value.

Decisions must be made to locate planting spots for replacement trees. In new developments, current policy requires developers to plant required trees on private lands to reduce county tree maintenance costs. This can result in poor planting and maintenance, with little assurance that these new trees will contribute to the urban forest in the long run.

If developers can deposit funds with the County to cover all aspects of tree planting, the process can be beneficial for all parties, as developers are relieved of responsibility for tree maintenance and replacement and can therefore reduce costs, while staff has more control over factors such as stock and planting quality, species selection, and maintenance. (Cambridge, 2015)This fund is explained further in Chapter 7.

Ontario municipalities use a variety of replacement strategies. At a minimum, the total number of replacement trees should correspond to the original number of trees removed from a particular location. However, a small replacement tree, if it survives, does not provide the similar benefits as a mature tree for many years. Many municipalities use a diameter replacement policy, where the diameter at breast height of the tree to be removed is measured and the total diameter of the younger and smaller trees to be replanted must add up to the original tree's diameter. In Cambridge replacing ash trees is recommended at a 1:1 ratio or more; and higher for parks. Hamilton and Burlington require replacement of trees equal in total diameter to the damaged or removed trees.

In Markham (2009), trees between 20 and 40 cm in diameter must be replaced at a ratio of 2:1. Trees over 40 cm will have an individual evaluation by an ISA certified Arborist in accordance with the Council of Tree and Landscape Appraisers (CTLA) Guide for Plant Appraisal (2000).

Recommendation 6.2

> *Replace trees that are removed from streets, with a new tree (6 to 10 cm caliper) for every 20-cm of diameter in trees that are removed. Replace trees from parks and cemeteries at a 2:1 ratio. Replacement trees should be of appropriate native species and non-invasive exotic species and planted in locations determined in the inventory.*

6.3 Tree Establishment Programs

Tree establishment to replace trees lost is a high priority in Haldimand. As a result of mortality from the EAB and the demise of other high risk older trees, some streets and parks will have a less than needed. Suitable sites for tree planting can be identified during the course of inventory and forestry operations and included in the inventory to guide tree establishment planning.

Trees can be established through several different programs, including replacement of removed trees, request-based planting, filling of available spaces on County lands, tree establishment in new developments on private property, or naturalization/restoration plantings. Other alternatives include: creating forested areas in parks and along trails and pathways, naturalizing ravines and watercourses; trees in planters; and planting trees in schoolyards, community centers and right of ways. Areas identified for naturalization in Conservation Authority watershed plans and those most heavily affected by EAB caused tree mortality should also be prioritized.

Boulevard tree planting can be accomplished by County staff or by hiring contractors. In some cases volunteers could be involved. Volunteers or neighbours can best be involved through maintenance such as watering or mulching. However fertilization and pruning should be done by qualified staff. Trying to keep boulevards free of above and below-ground utilities would also help create better tree planting opportunities.

Recommendation 6.3

> *Investigate alternative planting locations that will aid in increasing canopy cover.*

6.3.1 Right Tree, Right Place.

The principle of "right tree, right place" emphasizes matching different trees to different site conditions, considering soil/site issues, and physical limitations like wires and other hard infrastructure limitations. It is critical step in the successful management of the urban forest. The right tree in the right location is as much about tree hardiness as it is about tree size. If an urban forester can match tough tree species to harsh sites and more sensitive tree species to higher quality sites, a community can utilize a wider variety of species in their urban forest and create a more stable, sustainable tree population.

Successful tree planting requires planning. Urbanized soils are often altered significantly from their native condition. See Box for examples of soil properties that the urban forester must deal with. Professional expertise is needed to analyze growing conditions and prepare planting plans and specifications, especially for larger projects or difficult sites. It starts with an analysis of potential planting sites to develop an understanding of growing conditions. Planting requirements will vary with site conditions such as compaction, de-icing salt, traffic and hard surfaces. A list of trees that can be planted is matched with a group of plantable spots (e.g., 5) based on soil, height and hardscape limitations. Groups of different species are planted nearby to maintain diversity.

Proper tree spacing is an important step in the design process, but is always a compromise between short-term and long-term goals. Trees need to be able to develop healthy, stable crowns and root systems to provide canopy coverage in a reasonable period of time. A spacing of 10-15 meters on center for new plantings is reasonable, depending on tree size. Spacing of large-stature trees should move towards 16-20 meters as the trees mature. The increased spacing over time can be accommodated by natural mortality or thinning.

Recommendation 6.3.1

> *Adopt tree planting guidelines based on recommended arboricultural practices such as ISA standards regarding tree planting and tree planting technical details.*

6.3.1.1 Urban Site Index

Potential chemical, physical, and biological soil properties encountered in urban situations.

Chemical Changes
- Increased soil pH
- Reduced nutrient recycling
- Increased soil pollutants (heavy metals, de-icing salts)

Physical Changes
- More shallow soil profile
- Reduced organic matter content
- Increased concentration of buried debris (asphalt, concrete, etc.)
- Reduced percolation rate (soil drainage)
- Reduced oxygen concentration due to soil compaction

Biological Changes
- Increased competition by turf grasses, such as Kentucky bluegrass
- Reduced numbers of symbiotic microorganisms (mycorrhizal fungi, bacteria, and actinomycetes)
- Increased numbers of opportunistic pathogens and insect pests

Pokorny, (2003).

The Urban Site Index (USI) was developed in 2009 in Ohio in response to critical infestations by EAB. At the time, EAB was moving through Ohio, killing ash as it went. Ash trees were a primary street tree in many communities and the USI was developed as an urban forest restoration tool to help smaller communities recover from the devastation left in the wake of EAB. The following information on USI was adapted from two draft manuscripts by the Ohio Department of Natural Resources. (Siewert, A. and S. Miller, 2009a and 2009b). See Appendix V for specific details. The USI uses assessments of street characteristics and soil characteristics to assess planting site quality and matches that with tree characteristics (e.g., mature size, tolerance to salt or compaction). The process then guides the user to identify appropriate trees for the locations and develop a planting plan for the community.

The USI was evaluated in Toronto and it was concluded that it was time efficient and easy to use. Because it was easy to use, low in cost and generated a strong relationship between site quality and tree condition, it could be adapted into Toronto's planting protocol. (Dramova, 2012). The USI would be an

excellent process to use to assess Haldimand communities and plan tree planting. Implementation of the USI process in concert with the development of a tree inventory for the County would help to reduce costs and improve the success of replanting efforts.

Recommendation 6.3.1.1

> *In conjunction with a tree inventory, the County should use the Urban Site Index process to guide new plantings in along urban streets, and in County parks and cemeteries.*

6.3.2 Rooting Space/Soil Volume and Tree Planting.

Soil volume available for root growth is an important factor in long-term health and growth of urban trees. Lack of soil is a major impediment to long-lived healthy trees on boulevards and in parking lots. Street trees often have a limited soil volume available because of hardscapes and urban use (e.g., roads, sidewalks and their supporting base, and compaction by foot or vehicle traffic). In downtown areas, street trees are sometimes planted in large containers above ground.

Survival and growth of newly-planted trees will increase with improved rooting space. Some municipalities have established requirements for soil volumes on street plantings. In Thunder Bay (2011), recommended soil volumes have been established for tree planting. Recommendations for Soil Volume for Urban Tree Planting Usable soil volumes can be calculated using several different models (Appendix VI), but most provide the following guidelines:

- Between 5 and 15 m^3 for a small tree;
- Between 20 and 40 m^3 for a medium sized tree;
- Between 50 and 80 m^3 for a large tree.

How much soil is needed?

Research indicates that minimum soil volume for optimal tree growth is 0.06m^3 (2 ft^3) for every 0.1m^2 (1 ft^2) of future crown projection area, and greater soil volumes are to be encouraged wherever possible. Few municipalities have, to date, included minimum soil volume as a requirement for new development or street tree plantings.

The Town of Markham (2009) requires 30 m^3 of soil volume for new boulevard tree plantings. This volume is the minimum recommended for long-term tree health. The Town of Oakville developed "Tree Habitat Design Guidelines for Oakville" based on the work of Lindsey and Bassuk (1991). It was determined that large-stature trees require 98 m^3 of soil volume, medium trees require 44 m^3, and small trees require 16 m^3. The Oakville Urban Forest Management Plan recommends that these be adopted as minimum engineering guidelines; however, their implementation has not been widespread to date. The recent North Oakville UFMP requires 15 m^3, 30 m^3 and 45 m^3 for small, medium and large-sized trees, respectively. (Town of Milton, 2014)

Requiring minimum space for tree-planting spots —associated with curbs, sidewalks, boulevards, ditches and buildings — helps prevent future conflict with other municipal infrastructure, and tree-health problems. Boulevard width and overhead clearance for lights and utilities must be taken into account. Town of Milton Urban Forestry Management Strategy (2014) has a table of standards for a few southern Ontario municipalities.

For new plantings in established areas, it may not be possible to substantially increase soil volume for trees. However, during retrofit projects or new developments, enhanced rooting environment techniques such as soil cells or continuous trenches should be considered in order to provide adequate soil volumes. A review of engineering standards and development guidelines should also consider implementing increased minimum soil volume requirements.

Recommendation 6.3.2a

> *Soil volume specifications should be adopted for use in downtown areas and new developments.*

Recommendation 6.3.2b

> *Develop and implement policies to support improved tree habitat by retaining native topsoil, or other means (e.g., cultivation or soil amendments) on-site post development to improve the quality of tree planting sites.*

6.3.3 Select Trees for Diversity and Suitability.

The results of the sample inventory in the County indicated there are an overabundance of some species and an overall lack of species diversity. There are a number of very suitable species that are in low numbers on County-owned land. Use of native species over non-native species is desirable. Native means naturally occurring (indigenous) in Ontario. However, there are numerous non-natives that do very well in the urban environment, that are not invasive, and have few insect and disease problems.

The selection of appropriate tree species is based on many factors including: the space (height and area for the tree) and characteristics of the tree, the ability of the tree to adapt to the growing conditions of the planting site, and the availability of the size and quantity of trees needed for the installation. Large-stature trees should make up the majority of the planting where space is available. Small-stature trees should be used where there is limited space for crown or root development, as accents or to maintain diversity. Species diversity and use of native plantings are important but poor site conditions will limit tree choice to tougher species and some non-native trees. Professionals with local experience should advise or make tree selections.

As it is important to get the right tree gets planted in the right places, the planting stock should be high quality and appropriate size. Poor initial tree health or structure causes problems into the future, reducing life expectancy and causing maintenance problems several decades after planting. Bad grafts, girdling roots, or poorly developed root systems and/or codominant stem leaders can contribute to future problems and tree failure. Each tree should be inspected by a trained professional prior to purchase. In addition to basic tree quality, other issues related to root ball package types such as when and how the tree is lifted, stored, and transported must be specified to ensure that the resulting tree is ready to develop into the mature specimen intended.

Recommendation 6.3.3a

> *Develop an Urban Forest Renewal Plan that guides tree planting and maintenance to encourage diversity of tree species and age classes in each community.*

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Recommendation 6.3.3b

> *Consult and cooperate with local nurseries, arborists, landscapers, etc. (urban forestry services) to embrace County urban forest goals and objectives. Establish a nursery growing contract with more than one grower to supply trees for County plantings and trees used in public planting initiatives. Work with volunteer groups to the same end.*

6.3.4 Municipal Tree Planting Programs - Ontario Examples

In Hamilton the "Street Tree Planting Program and initiatives shall attempt to establish a robust and flourishing infrastructure of street trees that will provide maximum benefits to the community with minimal costs, and conflicts to abutting land uses, traffic circulation (pedestrian and vehicular) and regular maintenance programs. Planting works may be initiated by property owner request or by staff, and will comply with the Design and Layout requirements". Planting Layout regulations have provisions and requirements for boulevard width, curb, sidewalk and driveway setbacks, ditch and building setbacks, overhead clearances, utility clearances, tree spacing, and hard surface tree plantings.

Also in Hamilton, online information and brochures help residents pre-select from about 50 desirable species and provide information to help City staff decide whether planting is appropriate. Forestry and Horticulture Staff will undertake to plant trees at residential, commercial as well as City owned properties across the greater Hamilton area. This fully funded program allows for the installation of new trees and replacement trees on the City owned portion of a property. See bibliography for websites.

The City of London (2015) has The Boulevard Tree Planting Program. It can be divided into 3 separate programs, each with its own procedures and practices. They are : New Subdivision program, Infill program and the Downtown projects program The Infill program can be divided into 3 areas: Replacement of trees, Request for new trees, and Pro-active infill of trees.

A number of municipalities have available web-based lists of tree species either available or suitable for planting. Appendix III has examples of many of these resources describe tree characteristics including size, growth rate, tolerances and value.

6.3.5 Planting in New Developments

Trees are required components of landscaping in virtually all new developments across Ontario and in many redevelopment scenarios... Street trees in new developments are most often installed by the developer and at the developer's expense on the public rights-of-way. Tree planting plans must be submitted for municipalities review and approval. There is typically a letter of credit to ensure that the approved plantings are provided and are in acceptable condition upon assumption of the plant materials. The mechanisms through which trees are planted vary greatly, as do means to compensate for restricted lots where trees are required but cannot be planted on the property due to site constraints. (Urban Forest Innovations and Beacon Environmental, 2014).

Current planting policies in new developments are to plant required trees on private lots/lands rather than the road allowance, to reduce county tree maintenance costs. However, this can result in limited planting success because of poor planning, planting and maintenance, with little assurance that these new trees will be retained in the long run.

In Haldimand trees are planted on private property along road allowances in new subdivisions. The Haldimand County Design Guidelines require a landscape plan and specifications prepared by a landscape architect on behalf of the developer. Trees are planted on private land near the public boulevards and are the responsibility of the landowner.

In Burlington, Ajax and Milton, a developer submits a planting plan which the municipality reviews and accepts. The trees are planted by the developer on public right of ways and tended for several years. After the appropriate time, the plantings are inspected and adopted by the municipality.

In Hamilton, London, Oakville, St Catharines and Windsor, the developer submits a plan which the municipality reviews. However the city collects a fee from the developer which is used to acquire, plant and tend the trees. This provides the municipality with direct control of species, size, seed source, plant quality, planting and watering. Municipalities have often adopted the latter approach because of poor or widely varying success with plantings by the proponent.

Recommendation 6.3.5

> *In new developments, a 'tree fee' be collected from the developer and that the species, location, planting and maintenance be completed by the County to ensure successful growth.*

6.3.6 Planting in Hardscapes

Trees must have as much room to grow as possible in order to sustain their health and growth potential, and consequently provide the most benefits. Trees compete for available space within the boulevard. This space is crowded with:

- Infrastructure to accommodate pedestrian and vehicular traffic;
- Conflicts with utilities above and below ground such as municipal gas, water and hydro lines.

These factors restrict the available space for crown and root development to support leaf area and root growth balance.

Much research has been done to improve planting methods and opportunities in difficult urban areas. Ensuring there is adequate water but enough drainage are key elements to planting in hardscape areas. Manufactured root paths, using continuous soil zones or soil vaults, installing structural soils or building suspended pavement on soil cells are all means to have trees grow and thrive in intensely developed urban areas. The City of Toronto(2013) produced the "Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual", which is perhaps the most extensive compendium of practical solutions to provide enhanced rooting environments, increased soil volumes and improved soil quality for trees in urban settings.

Recommendation 6.3.6

> *Investigate means such as soil cells, pavement bridges and open planters to grow healthy trees in downtown areas.*

6.4 Tree Planting and Maintenance During Establishment

Among the greatest challenge associated with any tree planting programs is to ensure tree survival. Follow-up inspection, post-planting care, and performance tracking must be considered critical components of any large-scale planting program. There are many good examples of planting specifications for street tree planting. See references in bibliography. It is important that the planting stock meets required criteria and that it is planted correctly. Whether planting is conducted by staff, contractors, or volunteers stock and planting should be audited by qualified County representatives (staff or consultant).

Trees that are properly maintained in the critical early growth years improve the overall appearance of the neighbourhood and significantly help reduce replacement costs. A healthy urban forest maintains benefits and services over the long term and is managed to maximize return on investment. Each site will have specific maintenance requirements associated with the use, design and external influences.

Maintenance during establishment shall be ongoing throughout the guarantee period and is the responsibility of the Contractor and Landscape Architect under supervision and inspection of the Developer. Maintenance of newly planted trees should focus on producing healthy plant growth toward desired mature form and increased size. The Markham Streetscape Manual (2009) provides the following guidelines.

- **Inspections** shall be undertaken by the Developer's Landscape Architect at least once per month during the growing season from June 1 to October 31.
- **Records** should be filed using a standardized format including the date of inspection, inspector's name, tree location, size, species and condition, action required and urgency of action. Records should include photos, drawings, defect descriptions, utilities, target location and description.
- **Watering** shall reflect soil conditions, plant requirements and microclimate, and supplement natural rainfall. New plantings will require more frequent watering and should be monitored regularly throughout the growing season for signs of drought and overwatering. During the establishment period it is recommended that new plants are watered (according to conditions) at least every seven (7) to ten (10) days between May and August 30, and at least every fourteen (14) to twenty-one (21) days between September 1 and November 15. Watering shall be such that the water penetrates the full depth of the growing medium. Frequency of watering shall be increased when plant materials are showing signs of drought stress. Scheduled applications of water shall be skipped only when rainfall has penetrated the soil fully as required.
- **Fertilizing** should only be done to supplement nutrient deficiencies determined by soil tests, observation of leaf growth, and tissue testing. Trees shall be fertilized only as required to correct symptoms of nutrient deficiency, except where otherwise recommended on the basis of soil or tissue test results.

- **Mulching** shall be maintained to reduce weed growth, improve water retention in soil, moderate soil temperature, and improve the appearance of the planting areas. Maintenance requirements may include litter removal, replacing displaced mulch, and addition of mulch to maintain specified settled depth.
- **Weed Control:** All areas shall have all weeds removed at least once per month during the growing season by hoeing, cultivation to a maximum depth of 100 mm, (varying the depth to prevent a soil pan), hand pulling or, if absolutely necessary by the use of herbicides. Ground covers and shallow rooted plant material should have the weeds manually removed.
- **Pruning:** should be done by an ISA certified Arborist at the appropriate time according to individual species requirements. Pruning should be limited to cuts that are necessary to remove dead, damaged, diseased, crossing and rubbing branches, to direct growth and correct structural weakness, and for sucker removal**.** Proper pruning during establishment is critical to strong and safe tree growth.
- **Support Systems:** for trees should be inspected regularly to ensure that the ties are not damaging the trunk. Stakes, guy wires and ties shall be maintained for one full growing season. Ties shall be checked at least every three months to ensure that they are not rubbing against the bark, and shall be loosened, repaired or replaced as necessary. After one full growing season, the Contractor shall remove all staking and associated ties. Trees shall be inspected to ensure that they are secure in the ground. Trees that cannot sufficiently support themselves without stakes after one full growing season shall be checked to confirm adequate soil consolidation around the root ball and be re-staked for an additional growing season. Stabilization material shall be removed no later than the end of the guarantee period.
- **Tree guards:** Tree guards can protect trees from damage by rodents/animals, weed eaters, lawn mowers and sun scalding. They should be installed at planting, or with early signs of damage.
- **Pest and Disease Control:** All new plantings should be inspected for pests and diseases at least once a month throughout the growing season from May to October. The principles and methods of Integrated Pest Management (IPM) and Plant Health Care (PHC) should be applied in controlling pests and diseases.

Recommendation 6.4

Adopt technical planting and maintenance standards for new planting such as those found in the Markham Streetscape Manual, 2009.

6.5 Recommendations/Action

Chapter 6

Goal: To undertake an inventory of County-owned urban and roadside trees and forests to identify tree species, age, condition and recommendations for maintenance, removal and replacement.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
6.1a - Develop and adopt standard practices for tree removal based on a risk management approach.	High	2017		Forest Manager
6.1b - Remove trees as required based on inventory and risk management approach.	High	2017 – 2021	477,750	Contract
6.1.3.3.2 - Formalize a policy that describes procedures for disposal of wood waste from urban forest tree management. This would include: • Public salvage of wood/chips left at the work site • Delivery of wood/chips to private owners and institutions. • Public removal of chips and wood from public facilities (including signage and monitoring) • Marketing of wood from County facility • Disposal of unmarketable/unsalvageable wood from County facilities.	High	2018		Waste Management
6.1.3.3.3 - Work with the HAWOA to market small or specialty wood and sawlogs.	Medium	2017		Forest Manager

Goal: To transition towards proactive tree establishment and replacement whereby all potential plantable spots on the County lands are explored and apply "right tree, right place" principles, except where policy requires that new trees be planted on adjacent private property development.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
6.2 - Replace trees that are removed from streets, with a new tree (6 to 10 cm caliper) for every 20- cm of diameter in trees that are removed. Replace trees from parks and cemeteries at a 2:1 ratio. Replacement trees should be of appropriate native species and non-invasive exotic species and planted in locations determined in the inventory.	High	2017-2021	494,075	Contract/ Volunteers with Forest Manager
6.3. - Investigate alternative planting locations that will aid in increasing canopy cover.	Low	2019		Forest Manager
6.3.1 - Adopt tree planting guidelines based on recommended arboricultural practices such as ISA	High	2018		Forest Manager

standards regarding tree planting and tree planting technical details.				
6.3.1.1 - In conjunction with a tree inventory, the County should use the Urban Site Index process to guide new plantings in along urban streets, and in County parks and cemeteries.	High	2018	2,000	Contract
6.3.2a - Soil volume specifications should be adopted for use in downtown areas and new developments.	High	2019		Forest Manager
6.3.2b - Develop and implement policies to support improved tree habitat by retaining native topsoil, or other means (e.g., cultivation or soil amendments) on-site post development to improve the quality of tree planting sites.	Medium	2019		Forest Manager
6.3.3a - Develop an Urban Forest Renewal Plan that guides tree planting and maintenance to encourage diversity of tree species and age classes in each community.	High	2018		Forest Manager
6.3.3b - Consult and cooperate with local nurseries, arborists, landscapers, etc. (urban forestry services) to embrace County urban forest goals and objectives. Establish a nursery growing contract with more than one grower to supply trees for County plantings and trees used in public planting initiatives. Work with volunteer groups to the same end.	High	2018 and ongoing		Forest Manager
6.3.5 - In new developments, a 'tree fee' be collected from the developer and that the species, location, planting and maintenance be completed by the County to ensure successful growth.	High	2018		Forest Manager
6.4 - Adopt technical planting and maintenance standards for new planting such as those found in the Markham Streetscape Manual, 2009.	High	2018		Forest Manager

Goal: To use new technologies in selected areas for integration of trees in hardscapes such as downtown centres and parking lots.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
6.3.6 –Investigate means such as soil cells, pavement bridges and open planters to grow healthy trees in downtown areas.	Low	As opportunities arise		Forest Manager

7.0 Education and Promotion, Stewardship, Partnerships and Funding Opportunities

7.1 Education and Promotion

7.1.1 Communication Plan

A robust communication plan is important to recruit volunteers, announce events, educate the public or celebrate achievements. It can include development and circulation of flyers, publishing inserts or press releases for the local newspaper, electronic communications, or door hangers to inform about tree planting, pruning or maintenance activities. The plan should identify key messages and the best delivery methods. In addition to providing information, the community may also need incentives, support and encouragement to increase their engagement as stewards of the urban forest.

An effective plan can make communication efforts more efficient, effective, and lasting and make it possible to target your communication accurately. It gives a structure to determine who needs to be reached and how. The plan should identify key messages and how best to deliver them. Engaging the community requires not only delivering information, but providing incentives, support and encouragement to become engaged as stewards of the urban forest.

The City of Kingston's Urban Forest Plan (2011) has an example communications plan. The City of Guelph Framework for Strategic Urban Forest Management Plan (2007) has a more comprehensive communications plan.

Recommendation 7.1.1

> *Develop and implement a comprehensive communication strategy to facilitate public understanding of urban forest management. Ensure that the strategy is coordinated by Communications staff and all County departments participate in its development so that initiatives are coordinated and can be rolled out smoothly in the appropriate season. Ensure that new policies and guidelines are included.*

7.1.2 Website

Websites are commonly used by municipalities to communicate information at many levels. They commonly reduce the number of calls to staff and can be used as a way to immediately refer the public to information on policy and programs. Websites are a primary and cost-effective tool to educate, promote and inform citizens about County forestry and urban forestry programs and to support better management of private trees in urban areas. In residential areas, there are more privately owned trees than public trees. Better electronic access to tree-care information for the County residents helps them find up-to-date information on tree selection, tree care and tree planting programs offered by the County and other agencies

Website information can include:
- the benefits of trees;
- links to tree by-laws (protection, preservation, permits, penalties);
- planting requests and species availability;
- species selection, planting, aftercare and long term maintenance;
- responding to invasive species;
- pruning and removal requests;
- process and response time for public tree maintenance;
- who to contact regarding tree ownership;
- County sponsored and endorsed community programs and events;
- links to other organizations;
- EAB and other tree health information;
- incentives and support.

This information will enable all members of the community to be informed and up to date on all aspects of the County's forest program. Most Ontario municipalities with some urban forest program have a web presence. One example is the Mississauga website (Bibliography).

Recommendation 7.1.2a

Develop a simple forestry website that can be expanded to provide public access to information about Haldimand's forest. In the longer term build a more comprehensive website to focus on customer service, with seasonally appropriate information about the urban forest, provide information about upcoming forestry events and provide updates related to forest strategy goals.

Recommendation 7.1.2b

Increase public awareness about threats to the urban forest, best forest management practices, the forest ecosystem and tree conservation.

7.1.3 Volunteer Activities Related to the Urban Forest

Involvement in community activities is important to both citizens and the community. Reaching out to community organizations, schools and businesses has potential to build community and the urban forest. There are numerous ways that volunteers can be engaged including:
- Tree planting;
- Monitoring forest health;
- Inventory;
- Pruning, watering and mulching small trees;
- Committee work.

Volunteer activities provide opportunities for students to gain "community hours" and can help inspire them towards careers in natural resources and related areas. While task-oriented volunteer activities help the community work with the County and staff, regular guided educational tours, can involve volunteers

and help the community and tourists learn more about their town and area. Special school activities including tree or other inventory, and urban forest walkabouts can be conducted.

It is important that volunteers be protected from liability through municipal insurance policies and with proper documentation and agreements.

Recommendation 7.1.3

> *Explore options for providing support and coordination of ongoing and potential volunteer activities related to Haldimand's forest.*

7.1.4 Inter-Department Coordination

It is just as important to educate and promote the County's forestry programs to all staff, through Staff information systems, training and regular updates. This improves staff knowledge of trees and the forest and working with colleagues in other departments that may have personal or job interests in tree and forest management.

The creation of a Forest Working Group interdepartmental steering committee that may include community representation is recommended in Chapter 3.

For urban forestry program staff, training is diverse given the nature of the resource and the working conditions (American Public Works Association, undated). Typically, all employees in forest related activities should be aware of and receive some training in:
• Tree identification and basic tree physiology;
• ANSI A300 pruning, maintenance, and protection standards;
• ANSI Z133.1 safety requirements;
• ANSI Z60.1 standards for nursery stock;
• Job site setup, flagging, and safety;
• First Aid, CPR;
• OHSA compliance;
• Electrical Hazards Awareness Program;
• ISA Certified Tree Worker and Certified Arborist Training.

A comprehensive, ongoing, and consistent training program is essential in keeping staff safe, efficient in their work, and motivated about learning new concepts, with similar benefits to the public.

Recommendation 7.1.4

> *Explore mechanisms to improve inter-departmental coordination regarding proper protection, maintenance and replacement of the County's green infrastructure (i.e. its trees) and inform staff about tree protection guidelines, policies and best practices.*

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7.2 Stewardship

A stewardship approach helps to sustain the quality and quantity of urban forests in Haldimand and requires ongoing involvement across the community. Urban forest stewardship needs to be fostered by engaging residents, businesses, builders and homeowners to plant trees and to care for their growth and development. Public education needs to focus on why trees are needed, where, when, and how they are planted, established and tended.

7.2.1 Current Programs

Specific details on the Haldimand *Community Partnership Program* (CPP) and the Haldimand *Rural Water Quality Program* (HRWQP) are outlined in Section 7.2.4.

7.2.2 Community Engagement Activities

A multi-pronged strategic approach for promoting Haldimand's Forest Strategy and Management Plan should highlight its objectives, initiatives, key concepts and community benefits. Different segments of the community have differing priorities and motivations. Removing the barriers to action and recognizing positive efforts are all important strategies for earning and maintaining public support. Examples of working cooperatively with the community to provide ownership and a sense of stewardship for the urban forest can be promoted in the following manner:

- Neighbourhood fundraising for tree planting and maintenance programs;
- Sponsorship of urban forest initiatives by the business/commercial sector;
- Conduct public tree care workshops;
- Public participation in neighbourhood tree inventories; (i.e. Neighbourwoods inventory system)
- Incentives for tree planting and stewardship in schoolyards and public parks involving school or youth groups;
- Recognition of volunteer efforts by establishing community awards to recognize properties that have achieved success in conserving, protecting and/or restoring the urban forest;
- Integrate educational information about the benefits of the urban forest, issues (e.g. invasive species), threats, and related projects into public programs;
- Provide incentives that encourage homeowners to plant trees, preserve existing trees and implement best urban forest management practices in tree care;
- Create planting incentive programs (e.g. trees from the District nursery or discounts on trees at local nurseries);
- Utilize the benefits of social media, print media, schools, recreation programs, Community Associations and other educational institutions.

Create an online atlas of volunteer activities:
- Planting trees and providing maintenance for the post-planting period;
- Teaching citizens proper tree planting, watering and maintenance skills;
- Assisting in the removal of invasive species; and
- Maintaining an up-to-date list of volunteer opportunities related to urban forest programs.

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 Opportunities can be identified to plant and maintain street trees on municipal road rights-of-way in area neighbourhoods without sidewalks and street curbs. In these neighbourhoods, public outreach programs, homeowner stewardship, and volunteer efforts would be a mainstay. In newer neighbourhoods, residents can be educated on the benefits of the urban forest and encouraged to plant trees on their properties by local urban forest volunteers and environmental groups working in cooperation with County staff.

To increase community awareness of the benefits of trees, the County can encourage the community's involvement, and create a shared sense of responsibility for the stewardship of the urban forest. Progress towards the goals can be reached through education and stewardship programs to County Council and staff, construction companies, homeowners, developers, woodlot owners, the business community, children and youth, to become more knowledgeable about the urban forest

Recommendation 7.2.
> *Consult and cooperate with citizens at the community/neighbourhood level to embrace County urban forest goals. Develop community/neighbourhood tree plans within the context of the larger plan.*

7.3 Partnerships

During the development of the Forest Strategy and Management Plan, the County reached out to many current and potential organizations. It is important to nurture existing community partnerships and promote new ones. Community partners can be encouraged to remain or become engaged in urban forest stewardship through outreach and educational programs regarding the environmental, economic and social benefits of the urban forest.

Potential partner organizations or companies should be made aware of the Forest Strategy and Management Plan. Often companies support green initiatives to improve their image. Large private property owners can be encouraged to support outreach programs directing them to plant more trees on their properties, or targeted to sponsor tree planting in a park or other public location.

Partnerships with tree nurseries and garden centers can be especially fruitful and should be encouraged to stock more native trees. Garden centres can influence what tree species people buy and should encourage planting species and varieties recommended in the Plan. Nurseries can be encouraged to stock a greater diversity of species, particularly native species. Arrangements involving a few nurseries can help with increasing tree diversity and lowering costs.

Tree/seedling subsidies or giveaways are a good way to stimulate interest especially in newer neighbourhoods. This idea can take many forms, but in general refers to a County-led program to provide seedlings or whips to citizens at a little or low cost. Corporate sponsors can play a role and existing nurseries and garden centers can function as the delivery method for such a program.

Recommendation 7.3a

> *Consult and cooperate with large private landholders and business owners to embrace County urban forest goals and objectives and particularly to increase tree cover and improve tree health and tree care in commercial and industrial zones.*

Recommendation 7.3b

> *Encourage the development community to actively steward the urban forest. Revise brochures and other communications for the development community to explain their roles in protecting and the urban forest by using best development and construction practices. Outline the importance of the urban forest.*

Recommendation 7.3c

> *Engage local Service Clubs in tree planting and reforestation projects.*

7.4 Funding Opportunities

Additional fiscal resources may be necessary to implement many of the recommendations in this Plan. A few potential ways to increase funding or reduce costs for urban forest management activities are:

- Allocate current or increased budgets for forest management activities, within the departmental budget (supported by approved management programs and increased public support due to an increased awareness and appreciation of forest benefits);
- Increase the participation of volunteers, coop-students and interns;
- Apply for external funding for recreational, environmental and educational sources for special activities and events;
- Partner with governmental agencies, conservation authorities, educational and research institutions, and other publicly-funded groups;
- Partner with private-sector organizations such as companies and service clubs.
- Assess and charge appropriate service fees;
- Effectively use the existing budget based on management monitoring and evaluation;
- Establish a Forest Recovery Fund (see below) with non-tax funding (e.g., funds from development agreements, settlements, donations etc.).

7.4.1 Internal Funding Opportunities

The **Community Partnership Program** (CPP) is a County program that helps the County partner with community groups to develop and enhance community assets on property owned by Haldimand County. One component of the program is the Community Beautification Fund. Tree planting is one component that includes community signage, and streetscape and park improvements. The program is allocated $60,000 annually to fund beautification projects proposed by community beautification projects. The funding recognizes the importance of beautification to the vitality of any community, as well as the sense of pride and quality of life it fosters for residents and visitors to the County.

The program showcases community and supports business attraction and retention, leading to new tourism and economic development opportunities. Groups may apply for beautification funding of up to

50 percent of the total cost of the proposed project to a maximum of $4,000 per year per organization. Through the Community Beautification program the County has provided grant funding related to tree planting to four organizations (six grants over 10 years for a total funding value of $21,966). These projects included the replacement of trees planted during streetscaping, planting of trees in a soccer park for shade, native tree plantings and tree distribution for roadside beautification.

The *Haldimand Rural Water Quality Program* (HRWQP) is an initiative of Haldimand County and its partners to improve water quality in the County. This voluntary program provides technical assistance and funding to private landowners for tree planting and natural restoration - stream buffers, fragile land retirement, and field windbreaks among other projects to protect and improve water quality. The program is delivered by the three local Conservation Authorities, the Grand River Conservation Authority, the Long Point Region Conservation Authority and the Niagara Peninsula Conservation Authority. The HRWQP also provides funding for Living Snow Fences as defined by Haldimand Roads Operations. The benefits of improved water quality include a safe secure water supply, a healthy aquatic ecosystem, increased recreational opportunities, sustainable agricultural operations and a vibrant economy.

The **Forest Recovery Fund** receives money from County-owned harvest operations and prosecutions undertaken as a result of by-law infractions on private land. The current balance is about $30,000 which is targeted for reforestation. County-owned forests are managed under contract to forestry staff from Norfolk County. It may be possible to support urban forestry initiatives through this or another internal account. By attaching a name to the pool of revenues, it provides a marketable name for potential donors to contribute to, as well as including monies from various additional sources. Property owners participate by paying for a portion of the cost and have a tree planted the following season. This program provides a cost-shared option for accelerated tree planting, and includes a public outreach component that encourages stewardship of the new trees and other boulevard trees.

Damage Compensation

This is a legitimate and often under-pursued source of funds. When an automobile damages a public tree or when construction equipment destroys a group of public trees, the County could seek compensation for the landscape value of that tree(s). The County can rightly seek compensation for the total damages, including: the value of the tree(s); the cost of repair or clean-up; and the cost of the administrative time used during the resolution of the situation. The receipt of $500 from a minor car accident to $5,000 for a major damage claim can add up over time. Generally, the compensation is collected from the insurance company of the person responsible for the damage or directly from the person or company that caused the damage to public trees.

Permit and Plan Review and Inspection Fees

Most municipalities require permit fees to support the administrative and staff time needed for proper and professional plan review and site inspection tasks. In light of the County's goal to protect and enhance the urban forest, charges for the time and arboricultural expertise needed to approve permit applications, review plans, and make site inspections could support the salary or expenses of full or part-time urban forestry positions. The County may need to perform a job analysis to determine the time spent performing review and inspection tasks, and could investigate what other cities in the region, or of a similar size, are charging for such a task.

Developers' Fees

Developers could be required to pay a set amount to support Haldimand's overall urban forestry program. This would be in lieu of or in addition to new tree-related plan and inspection fees, and previously mentioned currently required expenses for tree preservation compliance, landscape installation, and other zoning/subdivision regulation activities, In effect, it would be a cost of doing business within the County limits. The fee could be a percentage of the total project cost, based on the number of housing units built, or based on the area of land being developed. It is suggested that this fee would be paid and deposited in the Urban Forestry Fund before the project is approved.

Utility Company Fees

Utility companies perform new construction, maintenance, and repair work on an annual basis in the County. This work may affect the aboveground and belowground portions of public trees. It is prudent and reasonable to assess a fee to such utility companies when their work affects municipal trees. Utility companies with aerial facilities might be required to provide the County with an anticipated annual work plan and maps with an appropriate fee attached to a blanket, County-wide annual permit to provide for inspection and monitoring. Additionally, any compensation for documented damage to public trees during utility work would be collected separately on a case-by-case basis, and the utility company should be responsible for the costs for any remediation necessary (e.g., pruning, fertilization, or temporary irrigation) above and beyond the fees and compensatory payment. The same conditions would apply for companies installing or maintaining underground utilities.

Private Donations and Corporate Sponsorships

Advocacy groups in Haldimand could solicit citizens for private donations to support tree planting, tree care, and public education activities. Again, attaching a name to the program would help market the Forest Recovery Fund. A major source of donations could be from businesses and corporations who wish to sponsor non-profit, environmental activities. All potential contributors may be tax-deductible when they file their federal income tax return.

Memorial and Honor Trees

Haldimand does not have a Commemorative Tree and Bench Program. Citizens at times of loss and at times of celebration often choose to plant a tree to remember special people or mark a special achievement or event such as a birth. This type of program can generate good public relations for the urban forestry program. Such a program should set a level of funding that will purchase and plant a tree of a certain size, as well as collect funds to pay for maintenance for three years. Examples include:

- Oakville: $2,163 includes plaque and maintenance for 5 years;
- Edmonton: $1,600 donation includes tree and plaque;
- Mississauga: $1,071 for a tree, $289 for the plaque, maintained as other parks trees.

Firewood, Mulch, and Wood Sales

The wood waste from tree maintenance and removals may be a source of funds for the Forest Recovery Fund particularly with all the trees removed as a result of the EAB. Some municipalities have been successful in selling split and un-split firewood, hardwood timber, and rough wood chips to the general public and commercial businesses. Rather than pay for removal and disposal, municipalities sell these

excess wood products. When a significant or historic public tree must be removed; the logs and useable wood can be given to local craftsmen who then create furniture, sculpture, and other collectibles from the wood. These can be sold and all or portions of the proceeds would be returned to the County or partner organization. See Chapter 6.1.3.

Recommendation 7.4.1a

> ***Establish a Forest Recovery Fund to support forestry initiatives. Funds could be received through initiatives such as damage compensation, permit and plan review and inspection fees, development fees, utility company fees, private donations and corporate sponsorships, memorial and honor trees, and firewood, mulch, and wood sales.***

Recommendation 7.4.1b

> ***Improve promotion of the Community Beautification Fund and participation of citizen and business groups. Annually transfer unused funds into the Forest Recovery Fund to improving communications, workshops, subsidies for trees on private properties, and young tree maintenance.***

7.4.2 External Funding Opportunities

The following organizations provide funding in Ontario or across Canada.

Conservation Authorities
The Conservation Authorities work with landowners to access the Forests Ontario, 50 Million Tree Program funding as well as their own tree planting programs. The LPRCA also has tree planting programs funded through Ontario Power Generation, their own Erosion Control Incentive Program, and Trees for Roads Program. The Niagara Peninsula Conservation Authority provides support and funding for habitat restoration including buffer strips, shelterbelts and windbreaks, floodplain & fragile land retirement, reforestation of sensitive lands & connecting fragmented woodlands.

Forests Ontario
http://www.forestsontario.ca/planting/programs/50-million-tree-program/
The program is designed to significantly reduce landowner's costs of large-scale tree planting and thereby increase the number of trees planted.

Toyota Evergreen Learning Grounds School Ground Greening Grants
http://www.evergreen.ca/get-involved/funding-opportunities/
Evergreen is one of Canada's leading funders of community and school greening projects. The Toyota Evergreen Learning Grounds program helps schools create outdoor classrooms and food gardens to provide students with a healthy place to play, learn and develop a genuine respect for nature. Since the program began in 2000, it has provided funds to over 3,000 schools from coast to coast, providing countless opportunities for students to engage with nature on their school grounds. Grants are available up to $3,500 for public schools and daycares located on school Board/District property.

Tree Canada

https://treecanada.ca/en/programs/

1) Greening Canada's School Grounds

Tree Canada will contribute up to $3,000 towards the implementation of the project, depending on the available funding from the sponsor.

2) CN EcoConnexions From the Ground Up

https://treecanada.ca/en/programs/cn-ecoconnexions-ground/

CN with Tree Canada program to support greening of municipal and First Nations properties across Canada, especially areas in close proximity to its rail lines. Proposals must demonstrate the intent to enhance local environmental/social health and wellbeing by planting vegetation in community open spaces, along railway tracks, in schools, in brownfields or in parks. Grants up to $25,000 are available.

3) Edible trees

https://treecanada.ca/en/programs/edible-trees/

Tree Canada will consider projects that increase equitable access to healthy food, empower neighbours to share in the harvest and care of city-grown food resources, provide access to the trees and their fruit, include creative plans for the produce grown, protect and preserves the Canadian environment, and assist residents in understanding and participating in environmental activities in local communities. Funding is available, but not limited to, community gardening groups, community housing projects, schools, parks and arboretums but not private property. The program offers funding of up to $4,000 and other resources for community-based projects.

Ontario Trillium Foundation   Community Grants Program

http://otf.ca/

The Ontario Trillium Foundation provides grants to non-profit or charitable organization for proposals that build healthy and vibrant communities in Ontario. The decision to fund all or part of a request depends on how well an application fits with the Foundation's action areas, their desired outcomes, the local areas of granting focus, the assessment criteria as well as the overall demand and granting budget in the catchment area. Current priorities include support for "green people" protecting and restoring ecosystems. Grant investments of up to $375,000 over five years. This can include up to $75,000 per year for operating or project expenses and up to $150,000 over one or more years for capital initiatives such as equipment purchases.

Recommendation 7.4.2

> *Explore external sources to identify funding opportunities to support tree planting.*

7.5 Recommendations/Actions

Chapter 7

Goal: To build awareness and engagement among County staff and the community, regarding the importance and value of the urban forest and the County's efforts to sustain this resource.

WILLIAMS & ASSOCIATES
Forestry Consulting Ltd.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
7.1.1 - Develop and implement a comprehensive communication strategy to facilitate public understanding of urban forest management. Ensure that the strategy is coordinated by Communications staff and all County departments participate in its development so that initiatives are coordinated and can be rolled out smoothly in the appropriate season. Ensure that new policies and guidelines are included.	High	2021		Communication staff and Forest Manager
7.1.2a - Develop a simple forestry website that can be expanded to provide public access to information about Haldimand's forest. In the longer term build a more comprehensive website to focus on customer service, with seasonally appropriate information about the urban forest, provide information about upcoming forestry events and provide updates related to forest strategy goals.	High	2018		Communication staff and Forest Manager
7.1.2b - Increase public awareness about threats to the urban forest, best forest management practices, the forest ecosystem and tree conservation.	Medium	2017 and ongoing		Communication staff and Forest Manager
7.1.3 - Explore options for providing support and coordination of ongoing and potential volunteer activities related to Haldimand's forest.	Medium	2018		Forest Manager
7.1.4 - Explore mechanisms to improve inter-departmental coordination regarding proper protection, maintenance and replacement of the County's green infrastructure (i.e. its trees) and inform staff about tree protection guidelines, policies and best practices.	High	2018		Forest Manager

Goal: To expand stewardship initiatives, and develop more partnerships that support the urban forest with initiatives such as tree planting and maintenance.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
7.2 - Consult and cooperate with citizens at the community/neighbourhood level to embrace County urban forest goals. Develop community/neighborhood tree plans within the context of the larger plan.	High	2022-2026		Forest Manager
7.3a - Consult and cooperate with large private landholders and business owners to embrace County urban forest goals and objectives and particularly to increase tree cover and improve tree health and tree care in commercial and industrial zones.	Medium	2022-2026		Forest Manager

7.3b - Encourage the development community to actively steward the urban forest. Revise brochures and other communications for the development community to explain their roles in protecting and the urban forest by using best development and construction practices. Outline the importance of the urban forest.	Medium	2022-2026		Forest Manager
7.3c - Engage local Service Clubs in tree planting and reforestation projects.	Medium	2018		Forest Manager
7.4.1a - Establish a Forest Recovery Fund to support forestry initiatives. Funds could be received through initiatives such as damage compensation, permit and plan review and inspection fees, development fees, utility company fees, private donations and corporate sponsorships, memorial and honour trees, and firewood, mulch, and wood sales.	Medium	2017		Finance Division
7.4.1b - Improve promotion of the Community Beautification Fund and participation of citizen and business groups. Annually transfer unused funds into the Forest Recovery Fund to improving communications, workshops, subsidies for trees on private properties, and young tree maintenance.	Medium	2018		CDP and Finance
7.4.2 - Explore external sources to identify funding opportunities to support tree planting.	Medium	2019		Forest Manager

8.0 Emerald Ash Borer Management Plan

8.1 Background

The greatest current threat to eastern North America's urban forests is the emerald ash borer (EAB), which has the potential to eliminate the entire ash tree population. As EAB moves out from introduction points, it is expected that 99 percent of ash trees in urban and rural areas will be killed, similar to how Dutch elm disease affected white elm.

EAB is an insect that was introduced from Asia to Michigan in the late 1990's and first found in Canada in the Windsor area in 2002. It attacks all species of the ash genus and kills healthy trees by tunneling underneath the bark, girdling the tree. At high populations, EAB can kill a healthy tree within two or three growing seasons. Its rapid spread is accelerated by people moving firewood, logs and nursery stock from infested areas to "new" areas.

Based on the sample inventory ash comprises an estimated nine percent of the urban forest in the County. Ash is a common forest species and frequently planted on parkways, boulevards, landscapes and parks throughout the country. The loss of this species will cause significant economic and environmental distress. As EAB has spread much faster than anticipated, it has caught many communities unprepared.

EAB was first found in Haldimand 2014 (although it is presumed to be present from 2007) and has been responsible for killing large numbers of trees. Ash removals are ongoing throughout the County. It is projected that almost all ash will be lost to the EAB over the next few years. Because of this high level of threat, a separate focus has been placed on managing the ash trees as they are being killed by EAB and extra resources are needed to ensure trees are removed in a timely manner.

The Canadian Food Inspection Agency (CFIA) has amalgamated areas under ash movement restriction (i.e., quarantine) so that ash trees, logs and products can move throughout southern Ontario. This means that nursery stock, logs and firewood of all ash species can move without restriction in the area.

Mortality is currently obvious in urban and rural areas throughout Haldimand. There is an untold number of ash on rural roads, along rural property lines and in the County-owned forests. While controlled harvests of ash may be conducted, this is most feasible in woodlands with ash greater than 20 percent of the stand overstory or in conjunction with other planned management activities. Harvests and thinnings in woodlands can provide some revenue to help offset the costs of removing potential hazard trees along trails and reduce safety and aesthetic concerns with the expected tree mortality throughout the forest. Ash on streets are the biggest concern and the highest cost for removal. Parks and cemeteries are of less concern and removal is less expensive.

Figure 8.1 shows the relationship between years after first EAB infestation and mortality. It indicates that about nine years after first infestation treatment options are greatly reduced. In urban areas, EAB-induced ash mortality is well underway. However, there are still individual trees that are healthy. It is possible to treat some strategic healthy ash trees to try and retain them, or proceed with the removal and replacement strategy. Treatment and retention of a few valuable trees would not significantly affect the cost or the amount of

Figure 8.1. Comparison of ash mortality compared to management options.
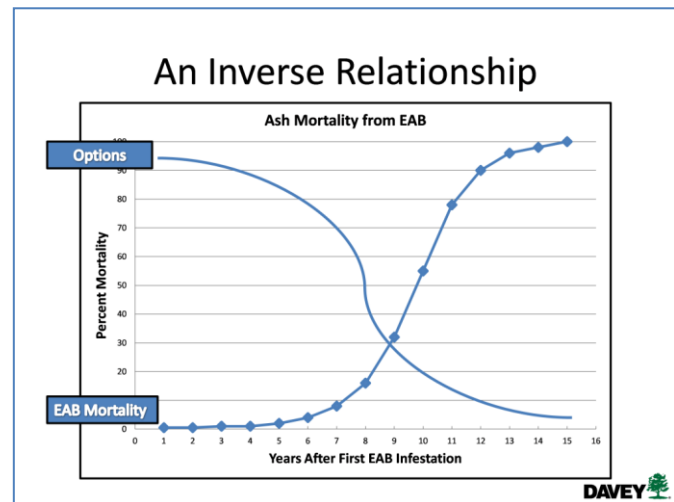
work required for removal and replacement of dead or dying ash from County property.

8.2 EAB Control Methods

While EAB can be controlled on individual trees by injection, control in forest situations is not feasible. In the initial stages, reducing the spread of EAB through wood movement restrictions and public education is very important. In forests, cultural pest control methods such as thinning or harvest can be used to limit EAB population growth (by reducing the amount of ash they feed on) or to reduce the impact of ash mortality on the forest. This strategy can also be used to reduce potential hazards in public use areas.

8.2.1 Insecticides

Insecticides can be used protect ash from EAB, and is particularly suited to important individual trees or groups of trees along streets or in parks. Protection of trees with injected insecticides is an ongoing cost but is necessary to keep important landscape trees so they can continue to provide important aesthetic and environmental benefits. TreeAzin (azadirachtin) is an organic pesticide developed by the Canadian Forest Service that is the most commonly used by municipalities. Three other products are available for use in Canada against EAB, including AceCap 97 (acephate), and two imidacloprid (a neo nicotinoid) formulations; Confidor 200 SL and IMA-jet. These three treatments are registered only for use in conjunction with government-led treatment programs (i.e., implemented by municipal or regional governments), their effectiveness varies, and all have higher mammalian toxicity. Certain high-value trees may be considered for treatment as part of an urban forest plan.

8.2.2 Natural Control

Natural enemies such as insect parasites, predators and pathogens have played an important role in many integrated pest management strategies. EAB, like many introduced insect pests, has an array of natural enemies in its native range, but few exist in North America. Native predators include woodpeckers and insects. While they kill a percentage of the beetles, it is not enough to slow ash mortality. The goal is for

natural enemies to kill enough life stages of EAB so that the population growth of the beetle is substantially reduced. This would not eliminate EAB, but may help limit populations in the future, allowing the ash population to recover to some extent.

8.2.3 Biological Control

In the past few years the Canadian Forest Service has released biocontrol agents in the form of parasitoid wasps (*Tetrastichus planipennisi and Oobius agrili*) from China. They have been released into a number of woodlots in southwestern Ontario and more recently into the Ottawa and Montreal area. These parasitoids kills EAB larvae or eggs and were approved for release in Canada because they are very specific to EAB. While this holds potential to control EAB in the future, it will not be able to provide significant control of EAB during the initial waves of ash mortality.

8.3 EAB Plan Goals and Objectives

The Forest Strategy identifies two mains goals for the EAB plan. They are:
- To improve the resilience of the urban forest to current and anticipated stressors, including climate change, pests and diseases by implementing policies and management practices that optimize tree species diversity, structure and age classes, with appropriate monitoring;
- To transition towards proactive tree establishment and replacement whereby all potential plantable spots on the County lands are explored and apply "right tree, right place" principles, except where policy requires that new trees be planted on adjacent private property development.

More specific objectives for EAB Management are to:
- Minimize costs associated with EAB;
- Mitigate liability and reduce public risk from dead trees;
- Minimize economic and environmental impact;
- Increase tree species diversity.

8.4 EAB Management Plan Components

8.4.1 Urban Tree Inventory

A primary goal of the Management Plan is to identify and prioritize trees and that require removal or maintenance work as well as to identify potential planting spots for replacement or new plantings. Knowledge of the location, size and condition of ash trees is crucial to the effective management of an EAB infestation. The sample inventory completed in 2016 provides only an estimate. The inventory showed that there is only three percent ash along sampled streets, most of which were larger trees. Assuming 6,000 street trees in the five urban areas, this suggests that there are about 200 ash on streets. The sample inventory found that 22 percent of trees in parks were ash (102 trees); although this number is quickly being reduced as the County removes dead and declining trees. However, only a small percent of park area was surveyed so the total number of ash in parks is hard to estimate from the data. For example, Lions Park in Dunnville had over 300 ash recently removed. Ash were only 4.2 % (22 trees) of the sampled trees in cemeteries. Because 45 percent of cemeteries were sampled, it is estimated that 50 to 60

ash trees might be in County-managed cemeteries. Some of the nicest and healthiest specimens were found in cemeteries.
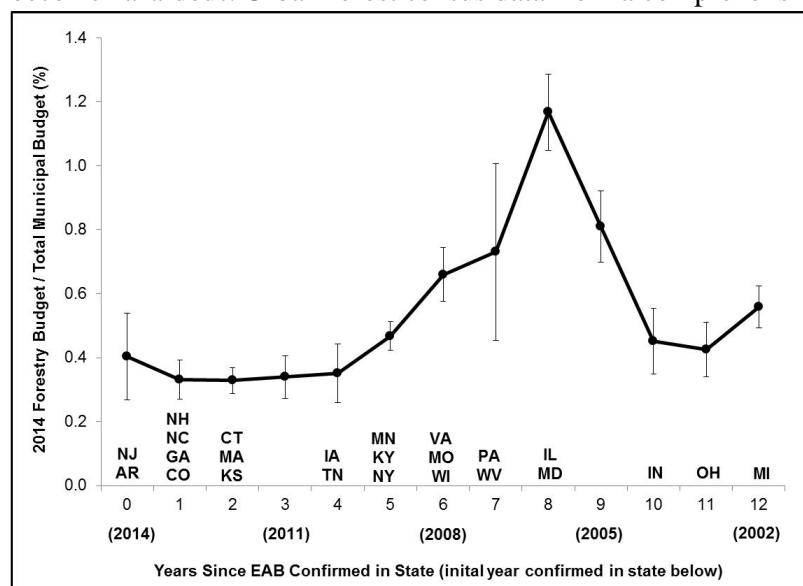
8.4.2 Detection and Monitoring

No inventory surveys for EAB (except for sample inventory) or branch sampling has been conducted in Haldimand County. Because EAB and EAB-induced ash mortality is found throughout Haldimand, no branch sampling surveys are recommended at this later stage of the infestation.

Recommendation 8.4.2
Conduct a windshield inventory to locate and determine general size and condition of ash trees throughout roads, parks and cemeteries.

8.4.3 Complete Ash Removals

Removal of dead and dying ash will be a priority for the next few years as more ash succumb to EAB and become hazardous. Urban forest census data from a comprehensive American survey shows how municipal budgets are affected by the EAB infestation (Hauer and Peterson 2017). After the initial 0 to 4 years, the percent forestry budget will approximately triple by the peak year in the 5 to 8 year post EAB confirmation in a state time period (Figure 8.2). Spending on tree and stump removal increased at the expense of tree pruning.

Figure 8.2. Temporal effect of emerald ash borer ash borer on municipal forestry budgets as a percentage of the total municipal budget. (n=366). Adapted from Hauer and Peterson 2016

Recommendation 8.4.3
> *Continue ash removals between 2017 and 2019. Priority is to remove dead and dying larger trees on the streets, high-use park trail and cemeteries followed by medium risk and smaller size tree on streets, parks, high-use park trails and cemeteries, and woodland trails.*

8.4.4 Identify Prominent, Healthy Trees for Treatment

Using staff knowledge, the public and the inventory; candidate trees can be identified for treatment and retention. Those identified for treatment can be scheduled for treatment in 2017. Those not treated should be prioritized on the removal list. Mature ash in prominent locations that are still healthy should be considered for retention because of their important contributions to scenery and nature of the community, and environmental benefits they provide.

Mature, large-stature trees provide exponentially greater benefits than small or newly-planted trees and are worth the investment in maintenance or treatment to keep them as part of the green infrastructure. The cost to treat a 40-cm ash tree (diameter at 1.37 m above ground) would normally be between $175 and $200 every other year. So it should be possible to retain 25 mature ash for a $2,500 per year cost. Signage can be developed to identify treated trees and their benefits to the public.

Candidate trees should meet the following criteria:
- Prominent location (e.g., (front of important building, prominent in park or cemetery);
- Good or excellent crown, stem and root condition;
- Minimal canopy decline (≤15% foliage loss);
- ≥25 cm diameter breast height;
- Acceptable location (not encroaching on structures or other trees).

Recommendation 8.4.4

> *Identify and treat candidate prominent healthy trees for treatment. Signage should be developed to identify treated trees and their benefits to the public.*

8.4.5 Implement an Ash Tree Replacement Plan

Tree replacement guidelines and recommendations are discussed in detail and recommendations provided in Chapter 6. However, some aspects are discussed below as they relate to recovering from the loss of ash trees from the community.

It is suggested that the County replace ash and other trees that are removed from streets, parks and cemeteries with a new tree (6 to 10 cm diameter) for every 20 cm of diameter in trees that are removed because of health problems (i.e., death or disease), safety concerns (i.e., structural soundness), construction (i.e., construction or development projects), or other reasons. Planting spots for replacement trees can be identified through the inventory process and consideration be given to staff or public suggestion. The Urban Site Index process can be used rate planting spots for site quality, infrastructure limitations and tree species growth and site preferences. See chapter 6.3.1.1.

Recommendation 8.4.5.

> *Replace ash trees that are removed from streets, with a new tree (6 to 10 cm caliper) for every 20- cm of diameter in trees that are removed. Replace ash trees from parks and cemeteries at a 2:1 ratio. Replacement trees should be of appropriate native species and non-invasive exotic species and planted in locations determined in the inventory.*

8.4.6 Wood Disposal and Utilization

Wood management is discussed in detail in Chapter 6.1.3; some specifics associated with ash are discussed below. As mentioned above, the CFIA does not regulate ash wood or other products within southern Ontario, eliminating concerns over moving ash wood within the region. As ash and other trees are removed, much of the wood and chips produced are used directly by the community, bypassing the waste management infrastructure. However, because of the increased volume of wood debris created by EAB, some short-term changes to waste-wood management are discussed and recommendations made in Chapter 6. These include delivering chips to institutional users in the County, providing specified, controlled public access to county wood and chip storage areas, and various methods of selling marketable products. These practices will help to minimize costs associated with the wood waste and keep the bulk of the material in the community.

8.4.7 Management of Ash on Private Land

Woodland owners can apply through the Forest Conservation By-law for a permit under a "salvage cut" which allows them to remove only ash trees. Privately owned ash trees are the responsibility of the property owner. Many municipalities provide information on their website for their citizens and the latest updates on EAB. For every ash tree on County land, there are three or four on nearby private lands. An EAB/Ash section of the web site with links to information management resources on the internet would serve to support landowners with ash tree problems. The County also accepts wood waste through current at facilities following existing guidelines, and may make space available for wood or chip collection. These issues were discussed in Chapter 6.1.3.

8.5 Communications

The public and staff will require information on EAB and ash management as questions come about EAB, tree mortality, tree management and tree replacement. The communications plan would be similar to that used for tree management and other municipal programs. The public would contact Service Haldimand or phone staff directly, staff would use their internal communication structure. A recommended tree/forest communications structure is proposed in Chapter 7 and applicable recommendations are below.

8.5.1 Identify an EAB Coordinator

Typically a communications staff member and/or the Forest Manager will be responsible for the communications, coordination and activities among staff and the public. Current updates on the latest EAB finds, treatment research and new information on EAB can be found at "Emerald Ash Borer is here, what I do? Tools for forest managers and landowners" invasiveinsects.ca and Emerald Ash Borer Information Network emeraldashborer.info. These sites link to local, state/provincial and federal information sources.

8.5.2 Inform the Tree Working Group/Advisory Board – and Decision Makers

Bring community leadership up to speed on the issue. Items to discuss may include: preparedness plan, funding, treatment strategies, by-law revision, enforcement, tree removal and treatment contracts, staffing, attrition, species to re-plant, surveying etc.

8.5.3 Inform the Public

Typical approaches to informing the public are written newsletter articles, addition of a link to the municipal website, public service announcements for local cable network, hosting educational workshops, connection with local neighborhood groups, etc. (multi-media) are.

Budget
Budget information is supplied in Chapter 9.

Recommendation 8.5a

> *Identify an EAB Coordinator who will be responsible for the communications, coordination and activities among staff and the public.*

Recommendation 8.5b.

> *Create an EAB/Ash section on the web site with links to information management resources on the internet to support landowner with ash trees on their property.*

Recommendations/Actions

Goal: To improve the resilience of the urban forest to current and anticipated stressors, including climate change, pests and diseases by implementing policies and management practices that optimize tree species diversity, structure and age classes, with appropriate monitoring.

Recommendation	Priority	Time Frame	Cost 2017-2021	Source
8.4.2 - Conduct a windshield inventory to locate and determine general size and condition of ash trees throughout roads, parks and cemeteries.	High	2017	6,000	Contract
8.4.3 - Continue ash removals between 2017 and 2019. Priority is to remove dead and dying larger trees on the streets, high-use park trail and cemeteries followed by medium risk and smaller size tree on streets, parks, high-use park trails and cemeteries, and woodland trails. Roads Operations will do low risk trees and most trees on rural roads.	High	2017-2019	613,500	Contract and Roads Operations
8.4.4 - Identify and treat candidate prominent healthy trees for treatment. Signage should be developed to identify treated trees and their benefits to the public.	High	2017-2021	18,500	Contract

8.4.5a - Replace ash trees that are removed from streets, with a new tree (6 to 10 cm caliper) for every 20- cm of diameter in trees that are removed. Replace ash trees from parks and cemeteries at a 2:1 ratio. Replacement trees should be of appropriate native species and non-invasive exotic species and planted in locations determined in the inventory.	High	2017-2021	Costs included in 6.2	Contract/ volunteers with Forest Manager
8.5a. - Identify an EAB Coordinator who will be responsible for the communications, coordination and activities among staff and the public.	High	2017		Communica-tions staff and Forest Manager
8.5b - Create an EAB/Ash section on the web site with links to information management resources on the internet to support landowner with ash trees on their property.	High	2017		Communica-tions staff and Forest Manager

9. Estimated Budgets for Haldimand Forest Management Plan

Table 9.1 shows the charts of costs for management and removal operations from 2013 to 2016. Although the data is not complete it shows an increase over the years. This is partially due to removing dead and dying ash but also due to a sizable backlog of high risk trees. The Roads Operations Division has seen an increase in tree management activity. In 2014, 253 work orders were created. This is an increase from 2013 which saw 230 work orders, which was a substantial increase from the 68 reported work orders in 2012. The FAPO Division has also experienced increased tree maintenance and removal costs in various parks and cemeteries. In 2014, $15,840 was spent by FAPO on contractors for tree maintenance and removal in parks and cemeteries; this is a sizeable increase from the $4,752 spent in 2010. As a result of Emerald Ash Borer infestation there is a one-time capital budget of $250,000 for ash tree removal and storm water management in Dunnville Lions Park and another $100,000 for replanting for 2016-17. As shown in Table 9.1 this project was under budget.

Table 9.1. Chart of costs related to the urban forest and tree removal 2013 to 2016. From Table 3.3 of Haldimand Forest Strategy.

Project	Costs				
	2013	2014	2015	2016 YTD	2016 Budget
	$	$	$	$	$
Roads Operations - removals:					
Internal resources (staff & equipment) 1	252,729	133,390	213,866	215,330	not segregated
Tree Service contract 2	91,284	91,874	123,059	97,912	105,710
Facilities and Parks Operations:					
Administration Facilities	1,131	-	1,913	458	not segregated
Cemeteries	2,936	6,400	21,750	3,150	not segregated
Parks	4,142	9,441	9,575	10,563	not segregated
Arborist contract (Norfolk)	25,825	26,109	27,083	-	27,240
Tree management strategy (contract)					30,000
Capital Program:					
Cemeteries		17,100			
Parks				52,745	400,000
Roads	16,678			78,725	234,200
Total	**394,725**	**284,313**	**397,246**	**458,882**	**797,150**

[1] There were 68 Roads Operations work orders in 2012; 230 in 2013, 253 in 2014 and 220 in 2015.

[2] The Roads tree service contract manages approximately 124 trees per year.

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Urban forestry program budgets are typically presented on an annual basis for a period of five to ten years. The budget estimate developed for this project is provided in Table 9.2, and outlines the costs for 2017 and 2018 with projections to 2021, including completing the inventory, and tree maintenance and removal (including EAB) and tree replacement. Cost estimates are based on information from the sample inventory, current costs of contract work in Haldimand, other municipalities, and the author's professional experience addressing the highest priority removal and maintenance recommendations first to reduce potential high-risk situations for the public and associated liabilities. Budgets for the recommended pruning and planting cycles were phased in over time as the costs for reducing the maintenance/removal backlog are cleared up.

The current budget estimate was compiled by estimating expenditures from the various departments conducting tree maintenance work, mostly Parks and Roads. Estimates for the first three years are generally higher than current because they include ash removal efforts that are currently underway and completing the tree inventory for the County. Each year also include the cost estimates for a recommended Forest Manager position, which may be a new position or be created through contractual arrangement.

The budgets estimate (Table 9.2) generally exceeds current levels because the plan recommends more comprehensive activities than currently practiced. This consideration recognizes that the urban forest is green infrastructure that requires maintenance and renewal rather than ad hoc-responses to problems. Green infrastructure requires management and renewal, the same as grey/hard infrastructure.

Many recommendations in this plan require higher budgets than current, but are expected to reduce costs and improve forest health and public safety in the long term. Revenue sources from tree removals are very limited and where available serve to be a cost recovery that reduces total costs. Numerous potential sources are discussed in Chapter 7.4 - Funding Opportunities.

Estimates for costs and revenues for implementing this Plan were generated, including:
- Developing a 5-year operating budget (2017-2021) for inventory, tree removal (including EAB), tree replacement, and other recommendations.

Specifically:
- Establish a maintenance plan with timelines and estimated costing within the 2017 existing operating budget and projected for 2018;
- Estimated budgets for recommended removal strategy for 2018 to 2021 in order of urban centre downtowns, parks, cemeteries and roads;
- Estimated budgets for tree removals for 2016 within existing operating budget and projected budget for 2017 with timelines and estimated costing (expenditures and revenue potential) that address EAB first, then risk/liability mitigation;
- Budget for a replanting strategy, describing participants, species, location, timelines and costing for 2017 and 2018 in order of urban centre downtowns, parks, cemeteries and roads;

- Estimated costs for recommended policy development and procedures that includes completing the forest inventory, tree maintenance, EAB mitigation with timelines extending out over the next 5 years; and
- Exploring and identifying revenues sources with respect to tree removal practices and replacement.

Table 9.2 Cost estimates for tree related activities for 2017 to 2021.

Activity	2017 Cost/tree ($)	2017 # of trees	2017 Total cost ($)	2018 Cost/tree ($)	2018 # of trees	2018 Total cost ($)	2019 est. Cost/tree ($)	2019 est. # of trees	2019 est. Total cost ($)	2020 est. Cost/tree ($)	2020 est. # of trees	2020 est. Total cost ($)	2021 est. Cost/tree ($)	2021 est. # of trees	2021 est. Total cost ($)	Five year cost
Ash tree removal and stump grinding - Contractor	650	100	65,000	680	100	68,000	715	100	71,500							204,500
Ash tree removal/stump - County RO	650	200	130,000	680	200	136,000	715	200	143,000							409,000
[1]Ash tree treatment - Contractor	220	25	7,500				220	25	5,500				220	25	5,500	18,500
[2]Pruning - Contractor	250	100	25,000	260	100	26,000	275	1,000	275,000	290	1,000	290,000	300	1,000	300,000	916,000
Structural pruning (<15 cm trees) -Contractor							60	200	12,000	63	200	12,600	65	100	6,500	31,100
[3]Inventory - Contractor	5.5	8,000	44,000	5.5	7,000	38,500										82,500
[4]Inventory update - County	5.0	675	3,375	3.5	905	3,168	3.5	1,925	6,738	3.5	1,650	5,775	3.5	1,575	5,513	24,568
[4a]Windshield Survey for ash(rural) - Contractor			6,000													6,000
[5]Assessment & removal/maintenance of high risk trees - Contractor	500	200	100,000	525	200	105,000	550	100	55,000	575	50	28,750	600	50	30,000	318,750
Stump grinding and cleanup	250	200	50,000	260	200	52,000	275	100	27,500	290	50	14,500	300	50	15,000	159,000
[6]Tree planting	300	50	15,000	315	240	75,600	330	240	79,200	345	340	117,300	365	340	124,100	411,200
Tree Planting Beautification - County	300		0	315	65	20,475	330	60	19,800	345	60	20,700	365	60	21,900	82,875
[7]Forest Manager (FM)			110,000			110,000			110,000			110,000			110,000	550,000
[8]FM operating			20,000			20,000			21,000			21,000			22,000	104,000
[9]Training and Policy development- Contractor			13,000			7,000			15,000							35,000
Total			**588,875**			**661,743**			**841,238**			**620,625**			**640,513**	**3,352,993**

Notes: Most activities are dependent on inventory results. Estimates are mostly based on contractor rates. Costs are increased appoximately 5% per year rounded.

[1]Ash tree treatment refers to insecticide application to retain some ash trees for the long term. Based on 40 cm tree and $5.50 per cm of diameter. Includes $2,000 for identification and assessment.

[2]Pruning assumed mostly larger high-risk trees in 2017 and 2018.
  Pruning rates based on a 3-person crew doing 10 large trees/day and doing >50 cm dhb trees.

[3]Assumes inventory for street trees complete in 2017. Inventory for parks, rural roads and other facilites in 2018.

[4]Inventory updates based on removals, maintenance and new plantings. Extra in 2017 to update 2016 inventory.

[4a]Windshield Inventory. Survey of rural roads to identify extent of ash inventory.

[5]Tree removal, stump grinding and tree planting based on separate operations. Planting is less expensive if done in same operation. Price of tree not included.

[6]Tree planting is back-end loaded to ensure diversity of tree species can be achieved. Numbers are based approxmately on tree removals. Does not include developer planting.
  Planting based on 2:1 replacement and assumes some County planting and some volunteer planting; ratio to be determined. Increased planting will extend beyond 2021.

[7]Forest Manager salary based on Grade 8 scale with benefits.

[8]Forest Manager operating assumes vehicle, equipment, training needs and other.

[9]Policy contracts for risk management ($10,000), public tree by-law ($15,000), for inventory preparation ($1,000), Urban Site Index ($2,000) and training staff pruning ($5,000).

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Appendices

Appendix I. Haldimand tree inventory variables collected with description.

VARIABLES	Data Type	Description/units
FID		
SHAPE	Numeric	UTM coordinates
ID	Numeric	Tree number (designated individual values given to each tree).
Street	Numeric/ Text	Address and street name are recorded for the given area of said tree.
Mun Number	Numeric	Street Address # or 911 #
Township	Text	
Town	Text	The following towns were visited: Caledonia, Cayuga, Dunnville, Hagersville and Jarvis.
Siting	Text	Street, Park, or Cemetery.
Ownership	Text	County, Private Landowner, Shared (both county and private landowner or not clear).
Access	Text	Notes on access/location and aerial imagery.
Specie	Text	Drop down menu of 242 species that contains common and scientific name.
DBH	Numeric	Cm – measured-Diameter at Breast Height with Biltmore stick.
Height	Numeric	Meters – Ocular Estimate of total height.
Crown Diameter	Numeric	Meters – Ocular Estimate.
Structure	Text	**Good**: Growing straight without competing leaders, forks and or low branches. This can be dependent on specie. **Fair**: Tree is growing in a manner that corresponds to that individual specie and site conditions. **Poor**: Numerous defects and abnormalities are affecting the growth of the tree.
Vigour	Text	**Good**: Tree appears to be growing well with no significant stress or health factors. **Fair**: Tree shows normal stress and health factors for its specie and site conditions. **Poor**: Tree is demonstrating high levels of stress/health damaging defects and is growing slowly. **Dead**
Risk	Text	**High**: The possibility of a person or valued area/thing being obstructed by said tree is great and immediate. **Medium**: The possibility of a person or valued area/thing being

		obstructed by said tree is likely to occur eventually with variability in damage. **Low**: The possibility of a person or valued area/thing being obstructed by said tree is unlikely to neither occur immediately nor cause significant damage.
Risk Problem	Text	There is variability in potential hazards a tree might possess towards a person or valued area/thing such as hanging branches, deadwood, etc.
Maintenance Required	Text	There are several options available for removing or limiting risk problems a tree may have. This can vary from pruning, crown reduction, deadwood removal, etc.
Maintenance Priority	Text	**High**: The risk problem associated with said tree can potentially cause significant harm or damage and must be dealt with immediately. **Medium**: The risk problem associated with said tree has the potential to cause harm or damage and should be dealt with in a timely manner. **Low**: The risk problem associated with said tree is minor in severity and will unlikely be an issue any time soon.
Wire Conflict	Text	Hydro, Phone/Cable - **No conflict**: No aspect of the tree will interfere with wires. **Conflict**: Some aspect of the tree is interfering with the wires such as branches are touching wires. **Potential conflict**: No immediate hazards but as a tree develops its branches may interfere with the wires or the tree itself could fall on them.
Insects	Text	EAB, Gypsy moth, other.
Date Survey	Date	Survey date.
Date Review	Date	Survey review date
Surveyors	Text	Terry Schwan, Kevin Pangborn, Sebastien Rocheleau and Marcus Chatelain
Comments	Text	Free notes generated by the surveyor that they feel are useful information for other parties to know about said tree.

Appendix II. Latin names for trees and shrubs.

Apple sp. (*Malus* sp)
Ash, black (*Fraxinus nigra* Marsh.)
Ash, green (*Fraxinus pennsylvanica (Vahl))*
Ash, white *(Fraxinus americana* L.)
Basswood (*Tilia americana* L.)
Blue beech, (*Carpinus caroliniana* Walt.)
Birch, European white (*Betula pendula Roth.)*
Birch, white (*Betula papyrifera* Marsh.)
Buckeye, Ohio (Aesculus glabra Willd.)
Buckthorn, European (*Rhamnus cathartica* L.)
Butternut (*Juglans cinerea* L.)
Catalpa northern (*Catalpa speciose* Warder*)*
Cherry, black (*Prunus serotina* Ehrh.)
Cedar, eastern white (*Thuja occidentalis* L.)
Cedar, red (*Juniperus virginiana* L.)
Chestnut, American (*Castanea dentata (Marsh.) Borkh)*
Cottonwood *(Populus deltoides* Bartr.)
Dogwood, flowering (*Cornus Florida*)
Douglas fir (*Pseudotsuga menziesii* Mirb.)
Elm Siberian (*Ulmus pumila L.*)
Elm, white (*Ulmus americana* L.)
Fir, balsam (*Abies balsamea* (L.) Mill.)
Hackberry (*Celtis occidentalis* L.)
Hawthorn sp. (*Crataegus* sp.)
Hickory, bitternut (*Carya cordiformis* (Wang.) K. Koch)
Hickory, shagbark (*Carya ovata* (Mill.)Koch)
Horse chestnut (*Aesculus hippocastanum* L.)
Ironwood (*Ostrya virginiana* (Mill.) K. Koch)
Lilac, Japanese tree (*Syringa reticulata* 'Ivory silk')
Linden, little leafed (*Tilia cordata* Mill.)
Locust, black (*Robinia pseudoacacia* L.)
Locust, honey (*Gledisia triacanthos* L.)
London Plane-Tree (*Platanus acerifolia* (Ait.)Willd.)

Maple, black *(Acer nigrum* Michx.*)*
Maple, Freemans (Acer x Freemani)
Maple, Manitoba (*Acer negundo* L.)
Maple, Norway (*Acer platanoides* L.)
Maple, red (*Acer rubrum* L.)
Maple, Silver (*Acer saccharinum* L.)
Maple, sugar (*Acer saccharum* Marsh.)
Mountain Ash, European (*Sorbus aucuparia* L.)
Mountain Ash, oak-leaf (*Sorbus hybrid*)
Mulberry, white (*Morus alba L.)*
Oak, bur (*Quercus macrocarpa* Michx.)
Oak, English (*Quercus robur* L.)
Oak, red (*Quercus rubra* L.)
Oak, Swamp white (*Quercus bicolor* Willd.)
Oak, white (*Quercus alba* L.)
Pine, Austrian (*Pinus nigra* Arnold)
Pine, red (*Pinus resinosa* Ait.)
Pine, Scots (*Pinus sylvestris* L.)
Pine, white (*Pinus strobus* L.)
Poplar, Carolina (*Populus x Canadensis* Moench cv. Eugenei)
Plum, Canada (*Prunus nigra Ait*.)
Redbud (*Cercis canadensis L.)*
Redwood, dawn (*Metasequoia glyptostroboides* Hu & Cheng
Serviceberry (*Amelanchier sp*.)
Spruce (*Picea sp.)*
Spruce, Colorado blue (*Picea pungens* Engelm.)
Spruce, Norway (*Picea abies* (L.) Karst.)
Spruce, white (*Picea glauca* (Moench.) Voss)
Sumac, staghorn. (*Rhus typhina* L.)
Tulip-tree (*Lirodendron tulipifera* L.)
Walnut, black (*Juglans nigra* L.)
Willow, weeping (*Salix alba* L. var. *vitellina* Stokes cv, Pendula
Willow (*Salix sp.*)
Yew (*Taxus sp.*)

Appendix III. List of acceptable trees

Numerous municipalities have developed lists of acceptable and unacceptable trees for planting. The intent here is not to reproduce a list but to provide examples and resources.

Resources

York Region Street Tree Manual

A 30 page booklet with numerous species characteristics and pictures.

https://www.york.ca/wps/wcm/connect/yorkpublic/bb324eff-7281-49d9-b859-1af7eb978e96/York+Region+Street+Tree+Manual.pdf?MOD=AJPERES&CACHEID=bb324eff-7281-49d9-b859-1af7eb978e96

City of Hamilton Tree List

A list of species available to Hamilton residents.

http://old.hamilton.ca/parks/forestry/Tree-Planting-Program_NB/forestry-library.asp

Waterloo Shade Tree List

A list of 13 trees with numerous characteristics. Not meant to be comprehensive but easy to read and very useful.

http://www.cambridge.ca/relatedDocs/shade%20tree%20list.pdf

City of Toronto -Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual

In this manual there is a Tree Species Suitability List with about 35 species with attributes, limitations and more.

https://www1.toronto.ca/city_of_toronto/parks_forestry__recreation/urban_forestry/files/pdf/TreePlantingSolutions_BestPracticesManual.pdf

Design Specifications & Requirements Manual – City of London

The City has a list over 80 approved street trees with limitations and other information.

https://www.london.ca/business/Resources/Consultant-Resources/Documents/Specs%20and%20Reqs%202015/12-DSRM-2015-TreePlanting.pdf

Appendix IV. Tree Risk Management Program Planning and Design - Detail
Pokorny et al.

Step 6. Prioritize Inspection and Corrective Action Needs

In all likelihood, a community cannot handle 100 percent of its forestry workload each year. Limited budgets and personnel will require that tree inspections and corrective actions be implemented or phased in over a period of years. The community must carefully evaluate the condition of the community forest and visitor usage patterns within public areas, and target the use of limited community resources where they are needed the most - in the areas with the greatest risk to public safety. Communities should prioritize inspection and corrective action needs, identifying those that require immediate attention and those that may be delayed with minimal impact on public safety and tree health.

Identify specific areas or situations that will be excluded from the program. For example, trees located on private property are often excluded from the jurisdiction of a community tree risk management program. The community must decide to include or exclude borderline trees or trees abutting public property as part of the program. Wooded areas located away from structures or trails, undeveloped green belts or corridors, wetlands, or low use trails might be designated as "natural areas" that will be excluded from the program and will not receive risk inspections. Some tree risk management plans have made it a policy to inspect only trees that are greater than 6 inches in diameter, since most documented tree failures occur in trees greater than 6 inches in diameter.

We will discuss how to prioritize tree inspection and corrective action needs, based on a process that 1) divides the community into tree risk zones, 2) establishes tree risk inspection methods and schedules, according to tree risk zones, and 3) implements corrective actions in a reasonable and timely manner. Both large and small communities can effectively implement this process.

Divide the community into tree risk zones. To assist communities as they prioritize inspection and corrective action needs, the community can be divided into tree risk zones, ranging from zones where trees pose a very high level of risk to public safety to zones associated with low public safety risks. Each zone is managed and inspected on a defined schedule, based on the level of risk posed to public safety. For example, high-risk zones are scheduled to receive more frequent, in-depth inspections, and tree maintenance work is performed on an expedited basis. A color-coded map of risk zones, ranging from very high to low risk, can be developed for use as a management tool for forestry staff, and as a visual aid for educating the public about the levels of risk that trees can pose to public safety.

Determine the level of risk posed to public safety based on risk criteria that assess roadway characteristics (type, traffic volume, and congestion patterns); public use and occupancy patterns (high, moderate, and low) within public areas; and tree resource characteristics including tree condition (risk rating, age, and density), and location factors such as branch interference with pedestrian traffic or utility lines, and root interference with sidewalks. For example, high-use parks and playgrounds should always be considered high-risk zones based on high public use patterns and the presence of relatively large tree populations. Inspect these areas frequently and implement corrective actions on an expedited basis. Similarly, consider

trees or tree branches that obstruct pedestrian and/or vehicular traffic very high risk, and dispatch maintenance crews immediately to perform clearance pruning as soon as the problem is identified.

Analysis of tree inventory data can be an effective tool in identifying high-risk zones within the community tree population. For example, if high winds caused tree damage within the community, analyzing tree inventory data that includes tree condition and general location variables can identify storm-damaged areas. Designate storm-damaged areas as high-risk zones, and direct maintenance crews to conduct post-storm tree risk inspections as a top priority. Similarly, a neighborhood with a large number of mature or over mature trees might be red-flagged as a high-risk zone in need of more frequent risk inspections and more extensive corrective pruning. If the community has compiled a list of "problem" tree species (species with the highest rates of tree failures, storm damage, structural decay, repetitive crown dieback, or a short life-span), target neighborhoods or areas that contain a high density of "problem" species to receive more frequent risk inspections.

Identify criteria to define tree risk zones. Below are criteria that can be used to establish and map risk zones within a community.

Criteria to Establish Tree Risk Zones (See Table 2.1)
- **Roadway characteristics:** Prioritize according to key public safety issues such as emergency accessibility, and traffic volume and congestion factors. Top priority areas include:
  - Emergency access routes
  - Congested intersections
  - Major detour routes
  - Roadways or intersections where tree branches obstruct visibility of traffic signs or stop lights, or physically obstruct pedestrian or vehicular traffic
  - Streets that have had major reconstruction or underground utility work
  - Main thoroughfares
- **Public use and occupancy patterns**: Prioritize according to importance to public safety (fulfilling emergency and medical needs) and occupancy patterns. Top priority areas include:
  - Emergency and medical facilities, handicap access areas
  - Extensively used public areas and buildings
  - Neighborhoods with high population densities
- **Tree resource characteristics:** Prioritize by tree condition factors such as high average risk rating, areas with older or dense tree populations; and tree location factors such as branch interference with pedestrian or vehicular traffic, utility lines, or root interference with sidewalks. Top priority areas include:
  - Areas with a high proportion of high to very high tree risk ratings, as determined by the preliminary inventory survey data, tree risk inspections, or "hazard" reports submitted by the public of city staff
  - Areas severely damaged by storms
  - Areas with old growth trees
  - Areas with high a density of "problem" tree species
  - Areas with root injury caused by sidewalk or road construction
  - Areas where tree roots interfere with sidewalks and cause buckling

Table 2.1 provides an example of a color code system and includes examples of roadways, public buildings and use areas, and tree resource characteristics within each tree risk zone category. Very high-risk areas (color coded in red) include emergency access routes, medical and emergency facilities and

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shelters, school playgrounds, permanent structures, and drive-in campsites within high-use parks. High-risk areas are color coded in orange; moderate risk areas in yellow, and low risk areas in green.

Table 2.1. Tree risk zone categories; color codes; and examples of roadways, public buildings and use areas, and tree characteristics that pertain to each tree risk zone.

Hazard Zone Categories	Color Codes	Examples

Very High Hazard	**Red**	1. Emergency access routes
		2. Medical and emergency facilities and shelters, handicap access areas
		3. School playgrounds
		4. In high-use parks/public areas: permanent structures and drive-in campsites
		5. Individual trees or neighborhoods with very high-risk tree characteristics such as :
		  • standing dead trees or those with very poor condition class ratings
		  • severely storm-damaged trees
		  • trees that visually obstruct traffic signs, stop lights, or security lights
		  • tree roots causing severe sidewalk buckling

High Hazard	**Orange**	1. Main thoroughfares: congested intersections and visually obstructed traffic signs and stoplights
		2. High-use parks, playgrounds, and picnic areas
		3. Golf courses
		4. Parking lots adjacent to high-use public areas
		5. Bus stops along high-use thoroughfares
		6. Individual trees or neighborhoods with high-risk tree characteristics such as:
		  • old growth trees
		  • high density of large diameter, mature, or "problem" tree species
		  • root injury caused by sidewalk or road construction
		  • storm-damaged trees

Moderate Hazard	**Yellow**	1. Secondary roadways: congested intersections and visually obstructed traffic signs and stoplights 2. Neighborhoods with a moderate density of large diameter, mature or "problem" tree species 3. Moderate-use parks, playgrounds and picnic areas 4. Parking lots adjacent to moderate-use areas
Low Hazard	**Green**	1. Low-use roads and public areas with dispersed recreation 2. Open areas, woods, riparian zones, and peripheral areas with limited use or access 3. Neighborhoods with a low density of large diameter, mature, or "problem" tree species

Map tree risk zones. The next step is to develop a color-coded map of the community that highlights designated tree risk zone categories. This map will serve as a handy visual reference of tree risk zones within the community, and will be useful in establishing inspection schedules and tree risk assessment methods. Start by constructing a map of the community that contains the roadway system, public buildings, and public use areas. Many city departments have developed computerized data layer or Geographic Information System (GIS) files that contain the information needed to map tree risk zones

within the community. For example, the transportation or public works department often has maps or data layer files of the roadway system and traffic volume and congestion levels. The department in charge of planning and zoning will have information on the location of public buildings such as hospitals, fire, police, and other emergency medical facilities; schools; libraries; city administration buildings and community centers; and public use areas such as golf courses, city parks, and swimming areas. The parks and recreation department will have information on the location and usage patterns of public parks and other recreational areas. If computerized data files are not available to construct a community map, work from a standard city map of the roadways, manually identify public buildings and high use public use areas, and color-code these features on the map, using a different color for each tree risk zone. Using stick pins of various colors to mark the map works well and allows the map to be updated easily to reflect changes in risk levels. Figure 2.9 is a manually generated map that illustrates tree risk zones, using the above mentioned color-code system, for the city of Grand Rapids, Minnesota.

Update the community tree risk zone map to reflect significant changes within the tree population, roadway traffic patterns, or public use patterns. Keep up to date on the incidence of very high-risk trees. Mark very high-risk trees that are identified during ongoing tree risk inspections or post-storm damage surveys, or that are reported by tree planting or pruning crews with red pins on manually produced maps or color code these areas red on computer generated maps. Remove the red pins or color coding when corrective actions are completed. Delineate neighborhoods that have a large number of storm-damaged trees on the map until corrective actions are completed. Some communities' red-code neighborhoods with large, mature trees that have undergone sidewalk reconstruction projects because severe root severing has occurred and the risk of tree failure is very high. Roadway repair or construction projects that result in serious congestion traffic patterns problems should also be tracked and coded appropriately.

Establish tree risk inspection methods, according to tree risk zone categories. Tree risk assessments estimate the degree of risk associated with a given tree to fail and potentially injure persons or damage property, and should be capable of measuring risk levels ranging from low to very high. Within a tree risk management program, implementation of more than one inspection method may be useful. In-depth inspection methods that examine the full range of tree defects and site conditions present are most useful when conducting risk assessments to determine the likelihood of a tree to fail and strike a target. Less intensive methods can be effective tools for identifying very high-risk trees and pinpointing high-risk zones within the community, and for conducting post-storm tree damage surveys. We will describe two basic methods: 1) walk-by (individual tree) inspections and 2) drive-by (windshield) inspections, and discuss the appropriate use of each of these methods within the context of a tree risk management program. See Table 2.2

Walk-by (individual tree) inspections. This method requires inspectors to walk through an area and rate individual trees for their potential to fail, based on the presence of defects, evaluation of targets, and other site conditions. All trees located within striking distance of a target receive a 360-degree visual inspection. Diagnostic tests are performed as needed.

Strengths of walk-by inspections. Walk-by tree inspections represent an in-depth evaluation method that provides the level of information necessary to make cumulative decisions about tree defects, site conditions, and the level of risk associated with a given tree to fail and strike a target. To accurately

assess the potential risk that a tree will fail, it is important to thoroughly examine the tree and determine the full range of defects and site conditions that are present and could contribute to tree failure. Tree risk assessments should be capable of measuring a variety of risk levels, ranging from low to very high, and should include examination of all sides of the tree including the rooting zone, root collar, main stem, branches, and branch unions. A 360-degree inspection method is especially critical when defects occur on only one side of the tree and might be missed using the drive-by/windshield inspection method. It is not uncommon to find a tree that displays a full, green canopy and/or no major defects when viewed from only one side (Fig 2.10). The same tree, when viewed from the other side, may reveal a serious wound with extensive decay that causes the tree to be at a very high level of risk for failure (Fig 2.11).

Walk-by inspections represent an inspection method that provides communities with the level of cumulative information needed to conduct tree risk assessments within all tree risk zones. They are the suggested inspection method for conducting tree risk assessments in very high, high, and moderate risk areas.

Defects can occur anywhere on a tree, an inspection method that examines all sides of a tree will provide the most complete information to determine the potential risk for that tree to fail

Weaknesses of walk-by inspections. Walk-by inspections are more labor intensive and costly to conduct than less intensive methods such as drive-by surveys. Because of the higher cost of implementing walk-by inspections, it may be necessary to limit their use to areas with the highest degree of risk such as very high, high, and moderate risk zones. This could be an effective way to streamline program costs and focus limited community resources to areas of greatest risk.

Drive-by (windshield) surveys. This method involves inspectors visually scanning trees for the presence of hazardous defects while traveling at slow vehicle speeds. It is recommended that a follow-up individual tree inspection be conducted on all trees noted by the drive-by survey to have hazardous defects present. Two people should be present in the vehicle: one to drive and one to assess trees and record data.

Strengths of drive-by inspections. Drive-by surveys are quick and easily implemented, and can be a cost effective planning tool to provide preliminary data on very high-risk trees and to pinpoint high-risk zones within the community tree population. They can detect overt hazards such as standing dead trees, trees with significant numbers of dead branches, or major tree architectural problems visible from the road. They could be used as a scoping tool to conduct a preliminary survey of the community's tree resource and provide an estimate of the number of highly hazardous trees. This information can be very valuable in building community support and documenting the need to establish a tree risk management program. As a supplemental survey tool, drive-by surveys can be used to augment efforts to divide the community into tree risk zones, and assist communities to focus the use of limited resources to the areas of highest risk. Drive-by surveys could also provide a quick and timely response after storms to identify areas where damage to trees occurred and where corrective actions are likely to be needed. This is possible since many storm-damaged trees will have defects in their crowns such as broken branches or cracked branch unions that are visible from the road.

Under situations of limited community resources, it may be feasible to use drive-by surveys to conduct tree risk inspections in low hazard zones and as a supplemental survey method in moderate hazard zones during "off-years" when individual tree inspections are not scheduled. Under conditions of extremely limited community resources, some communities have made a short-term decision to exclude low risk areas from the tree risk inspection program. In this case, tree risk inspections would not be conducted within low risk areas, but rather informal tree risk observations would be made as part of the ongoing tree maintenance program.

Weaknesses of drive-by inspections. Although drive-by surveys are an effective method for conducting preliminary surveys or post-storm tree damage surveys, their usefulness for conducting individual tree risk assessments is very limited. Drive-by surveys collect incomplete data on tree defects, site conditions, and potential targets because they rely on information inspectors collect during a visual scan, while traveling in a moving vehicle, viewing only one side of the tree. Many trees with hazardous defects will go undetected using this method of survey. For example, drive-by surveys will not detect defects (overt or subtle) that occur on the side of the tree facing away from the road. Additionally, more subtle defects such as narrow cracks or girdling roots, even if they occur on the side facing the road, may go undetected simply because they cannot be readily seen from the road. Clearly, defects present in a tree, but not able to be observed with a drive-by survey, can cause a tree to have a high risk for tree failure (Figs 2.12 and 2.13). The data collected with drive-by surveys is limited to what an inspector can readily see from the road, and restricts the usefulness of this method to the detection of very high-risk trees that have hazardous defects visible from the road. Within the context of a tree risk management program, drive-by surveys are best used a preliminary or supplemental survey tool, not as a stand-alone tree risk assessment method.

Establish tree risk inspection schedules based on tree risk zone categories. Frequent inspections are essential for a successful tree risk management program. Tree structure and vigor necessarily change over time since trees are living organisms. Systematic inspections detect and monitor potentially deleterious changes. If tree inspections are not conducted on an ongoing and regular basis, many hazardous defects and situations will go undetected, and the fundamental goal of reducing risk to public safety cannot be met.

In addition to improving public safety, frequent tree risk inspections provide a continuous source of tree resource data, and can eliminate the need to conduct separate, periodic tree inventory assessments as part of the tree planting or pruning programs. This integrated approach establishes a foundation for making informed management decisions, validating budget requests, and documenting program success.

Tree risk inspection schedules, like tree risk inspection methods, can be established according to identified tree risk zones as discussed in Step 6. High-risk zones should be inspected frequently, using in-depth tree inspection methods. Lower risk areas can be inspected less frequently and may employ the use of walk-by/individual tree inspections as well as less intensive drive-by surveys. This approach allows the community to target the use of limited fiscal resources to the areas of greatest risk. Inspections can be conducted at any time of the year, leaf-on or leaf-off, with the exception of times when snow cover prevents the examination of root conditions.

Table 2.2 outlines suggested minimum guidelines for inspection methods and inspection schedules within a community tree risk management program. The suggestions contained in this table present a range of inspection options within most risk zone categories. Individual communities must assess their tree resource needs and community resources, and adopt program guidelines that address their specific situations. It is critical to remember that the community is ultimately responsible for maintaining the publicly owned tree resource and shouldering the liability that may result from improperly caring for it. Not having funds to maintain the resource does not absolve a community of this responsibility or accountability in lawsuits arising from personal injury and property damage claims resulting from a fallen tree or tree branch. Moreover, the cost of a judgment against the community or the defense costs in a lawsuit could conceivably pay for a tree risk management program for many years (Tate 1985). Communities should always seek professional legal advice when drafting specific language governing inspection methodology and frequency to ensure that professional standards are met and reasonable care is demonstrated.

Table 2.2. Suggested minimum guidelines for inspection methods and inspection schedules within a community tree risk management program.

Hazard Zone Categories	Color Codes	Timing of Inspections	Suggested Inspection Method	Comments
Very High	**Red**	Annual	Walk-by/Individual Tree Inspections	
High	**Orange**	1-2 years	Walk-by/Individual Tree Inspections	
Moderate	**Yellow**	3-5 years	Walk-by/Individual Tree Inspections	Consider conducting a drive-by/windshield survey on an "off-year" when individual tree inspections are not scheduled.
Low	**Green**	5-7 years	Walk-by/Individual Tree Inspections or Drive-by/Windshield Surveys	
All Rated Zones	**NA**	After Severe Storms	Drive-by/Windshield Surveys	If potentially hazardous trees are detected, follow-up with individual tree inspections.

The information contained in this table is offered as suggested guidelines and presents a range of inspection options within most risk zone categories. Individual communities must assess their tree resource needs and community resources, and adopt program guidelines that address their specific situation. Communities should always seek professional legal advice when drafting specific language governing inspection methodology and frequency.

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Appendix V. Introduction to Urban Site Index and Methodology

Introduction
A critical step in the successful management of the urban forest is putting the right tree in the right location.   The right tree in the right location is as much about tree hardiness as it is about tree size. If an urban forester can match tough tree species to harsh sites and more sensitive tree species to higher quality sites, a community can utilize a wider variety of species in their urban forest and create a more stable, sustainable tree population. Urban Site Index is a systematic approach for evaluating sites with a corresponding species evaluation.

History
In August of 2009, Alan Siewert and Stephanie Miller, Urban foresters with the Ohio Division of Forestry, developed the Urban Site Index (USI) process to allow Tree Commission Academy students to successfully and accurately evaluate street tree planting sites inexpensively and simply.

Process
USI is a rapid assessment tool that utilizes eight observations, four soil and four street, to assess the quality of the planting site on a tree lawn. The four soil observations are scored 0-3 and only require a soil probe or shovel to do the assessment. The four street assessments are scored 0-2 and need no equipment to assess. The USI assessment assigns a number between 0 and 20 for a street or site. A score of 20 is a very good site and any species can be expected to do well there. A score of less than about 8 appears to be incapable of supporting plant life. An entire community can be surveyed in a relatively short time.
Ongoing studies in Ohio and elsewhere in the Northeast United States seek to build a database of tree species and assign a USI for each species. The USI number, similar to the USDA climate zone number, can be used to select appropriate species for each street. Some species for Northeast Ohio have been documented, however most species have yet to be evaluated or the evaluation is not robust enough to confidently assign a number to the species. Currently, tree species have been divided into three groups (tough, intermediate and sensitive) based on the experience of the state urban foresters as well as arborists, nursery people and urban foresters from around Ohio. The USI scale has been divided into four groups 0-8 no tree, 9-11 harsh site, 12-15 moderate site, 16-20 good site. Tough trees can be used in harsh sites, intermediate trees in moderate sites, and sensitive trees in good sites.

Uses
The USI can be used to recommend species for a tree planting, however it is a critical tool in developing a Master Planting Design (MPD) for the smallest villages to the largest cities. A MPD combines the USI with the size limitation of each street to assign a species or group of species to each street segment in the community. By assigning a species to a street segment, the urban forester can plan for a diverse species population, test for species site compatibility, and provide spatial and temporal diversity in the urban forest before planting. A MPD does not necessarily consider what is currently growing on a street, but looks to the future and what should be planted to allow a holistic plan to be phased into a community over time. Without a holistic planning approach diversity, and therefore sustainability, is nearly impossible.
The Master Planting Design process has other advantages. Planned planting based on site conditions and community-wide management shifts tree selection from a beautification effort to urban infrastructure management on par with streets, utilities, and other hardscapes. It adds credibility, confidence, and efficiency to tree commission and public staff efforts. A MPD allows coordination with nurseries to grow non-traditional street trees. Finally, species segments allow for both management and aesthetic continuity, adding service value and increasing management efficiency within local urban forestry programs.

The MPD illustrates potentially drastic changes in neighborhoods as well. USI data has been used to quantify the degradation of soil quality after road construction. Pre and post scores indicate the damage to the soil. Together the USI and MPD have been the basis for reexamining construction practices and soil restoration budgets.

Dr. Burnell (Burney) Fischer of Indiana University, Bloomington is using USI protocols to not just determine survival of a species, but predict productivity of a species on a given site. He believes that USI can predict canopy size, and consequently ecological services, for a given species on a given site.

Documentation and Testing

In 2012 Oleksandre Dramova, a masters candidate at the University of Toronto, Supervisor Dr. Sandy M. Smith, used the USI process as her masters project. Ms. Dramova used the USI and concluded there is a significant relationship between USI scores and tree conditions.

Dr. Bryant Scharenbroch, Soil Scientist, at The Morton Arboretum began a study with Stephanie and Alan to assess the ability of the eight measurements to quantify the limiting factors to tree growth. In this study Dr. Scharenbroch collected the 8 USI measurements along with additional field measurement soil samples and increment cores to take back for further laboratory analysis. Results are expected in spring 2015, however preliminary results suggest the USI is a good indicator of the results of the more complex testing.

For additional information contact

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Urban Site Index Site Analyses

Introduction

The Urban Site Index (USI) is a tool for conducting a community soil inventory. The resulting soil inventory will provide urban forest managers and community tree commissions with valuable information for making local species selection decisions and anticipating existing tree growth and performance. A USI inventory is among the most stable and long-lived inventories conducted by urban foresters. The information remains valid for many years or decades barring soil disturbance. New USI data will need to be collected following street reconstruction, sewer, water, or gas reconstruction or other major soil disturbance.

Methodology

How to Conduct an USI Inventory

Timing

USI data should be collected when the soil is moist but not saturated. In Ohio this is usually in the spring and early summer (April, May, and June) then in late fall (October/November.) However, timing may vary significantly depending on the weather.

Tools
- Soil probe or shovel

- o 36-inch tube type soil sampler with step and 12"x $^3/_4$ inch diameter sample tube is recommended
- Clip board and pencil or pen
- USI Data Sheets
  - o PDF available on Division of Forestry web site
- Small street map of municipality
- Highlighter
- Vehicle (optional)

Procedure
It is advised to proceed with a crew of two people. One person will drive and record scores (Recorder) and the second person will take samples (Sampler.) The team will travel around the community or survey area stopping on each public block.

Sampling
At the beginning of each block or sample area, the Sampler will take 2-4 soil samples and walk the first property or two reporting the 4 soil scores to the Recorder. Soil samples may vary and the Sampler will attempt to average what they see to give a representative score for the entire block or sample area. After the initial scoring the Sampler should walk both side of the street taking samples and readings to confirm the initial scores or revise them.
Sample should be taken from the center of the tree lawn. Samples should not be taken near gas or water shutoffs, fire hydrants, or other pieces of infrastructure because these areas have been excavated and will not represent the condition in the rest of the tree lawn. The score for both sides of the street may not be the same. Unless each side of the street is to be managed separately the lower of the two scores should be recorded.
While the Sampler is collecting soil data, the Recorder should be recording the 4 street scores.
If the scores remain constant for the first distance the Sampler can ride to the midpoint of the sample area to do a quick sample to confirm or revise the score then ride to the end of the sample area and repeat. The frequency of stops and the distance sampled will be dictated by the variability of the soil.
Sample areas should be at least one block long dividing at good stopping points such as street intersections. The sample area can be longer than one block if the USI does not change. If the block is longer than ¼ mile and the USI changes the block should be divided into two sample areas.

Data Collection
Soil Scores
The quality of the soil is perhaps the greatest indicator the tree success.

Vegetation: Vegetation is a visual examination of the grass and turf weeds growing on the tree lawn. This vegetation is a good indicator of the quality of the growing space. If grass and weeds cannot grow on the site, trees will not have much of a chance to grow either.

> **3** points are given for good (un-watered) lush grass, some weeds are ok
> **2** for patchy grass and weeds
> **1** for sparse weeds with dirt showing through
> **0** for just bare dirt, gravel, or some sort of pavement

Surface: Surface is a measure of soil compaction. It is measured by walking on the tree lawn and feeling the soil beneath the feet and how much it crushes. Care must be taken not to confuse lush, watered turf with the feeling of the soil giving underfoot. By slowly walking on the turf the Sampler should be able to feel the irregularities of the soil beneath the turf and sense how it gives beneath the weight of the foot.

Soil that gives underfoot is minimally compacted and will allow water and oxygen to seep into the soil providing water and nutrients to growing roots.

> **3** points are given for soft sites, like walking on well-padded shag carpeting
> **2** for moderate, like walking on living room carpeting
> **1** for hard, like walking on office carpeting
> **0** for no soil, pavement

Probe: The probe score is a measure of soil penetration. The Sampler pushes the probe or shovel into the ground and feels the resistance of the soil. Moisture content or the soil texture will impact the probe penetration. See the "Soil Moisture Effects on USI Scores" in related studies. Penetration is another measure of compaction. The easier the probe goes into the soil, the easier it will be for roots to grow through the soil.

> **3** points are given goes in fully with ease, at least 12 inches deep
> **2** for goes in at least 12 inches deep, but requires lots of effort
> **1** for goes, in but not completely
> **0** for does not go into the ground

Layers: Layers is a visual examination of the soil development. Better sites will have original soil layers or horizons still intact. Original soils possess years of organic matter development that supports soil biology and fertilizes the tree. Organic matter turns the soil a deep, rich, black color. As the organic matter moves deeper into the soil, the subsoil begins to darken giving the soil a fading appearance, dark at the top and fading deeper in the sample, the A Layer. A quality soil with organic material will be friable, so the edges within the probe sample will look flakey. Samples of poorer soil with little to no organic material will be slick and smooth. Topsoil in post World War II development is typically removed. After construction a layer of foreign topsoil is laid on top of the crushed subsoil. These soil samples will have a very distinct color change line between subsoil and top soil. Some may even have a gravel layer in-between the top and subsoil. This artificial soil development does not support tree life and is scored low.

> **3** points are given for a good A Layer throughout 12 inch soil sample
> **2** for layering in the soil from the old native soil
> **1** for no top soil un-layered subsoil only *or*
>   a clear separation between topsoil and un-layered subsoil
> **0** for no soil

Street Scores
Environmental factors associated with growing trees in a developed environment influence tree survival and species selection.

Speed: Vehicle speed on streets is an indicator of the amount and distance chemicals, including deicing salt and debris, are thrown onto trees and the tree lawn. The higher the speed the greater the chemical volume & distance throw.

> **2** points are given for speeds less than 30 mph
> **1** for 35 to 45 mph
> **0** for 50 mph or more

Lanes: The number of street lanes is a good indicator of street use volume and maintenance frequency, including salt application.

> **2** points are given for a street with 2 lanes of traffic
> **1** for 3 or 4 lanes
> **0** for 5 lanes or more

Parking: On-street parking provides a periodic buffer between traffic and trees. Parked cars can also act as a traffic calming device, slowing traffic speeds, thus reducing chemical and debris loads from being thrown up on the tree lawn.

> **2** points are given for a street with on-street parking
> **1** for streets without street parking

Length: The length between traffic control devices dictates the average speed that traffic is able to reach. Long distances between stop lights, stop signs, sharp curves, or dead ends allow drivers to reach higher cruising speeds, often above the posted speed limit. Short distances prevent drivers from reaching higher speeds. Frequent stops and starts slow traffic speed reducing chemical and debris loads from being thrown up on the tree lawn.

> **2** points are given for traffic control devices less than ¼ mile apart
> **1** for traffic control devices ½ to ¼ mile apart
> **0** for traffic control devices more than ½ mile

> **Special Note:** It has been Ohio Urban Foresters' experience that visual estimates are unreliable. It is highly recommended that other methods such as the vehicle odometer or Google maps be utilized to better gauge distances.

Data Mapping, Storage, and Use

There is no set procedure for mapping or storing data collected in this inventory. A few commercial street tree inventory software programs include an USI Field for each tree that can be populated after this soil inventory. Other methods can be as simple as a municipal map with the streets highlighted with colors coded to the respective USI Score (see *Master Planting Design*.) GIS layers can be created showing USI scores. No matter which method is used to map the soils, the original field survey sheets should be archived for future use.

> "Once you have a data set, you are only limited by our own curiosity."
> ~ Paul Thiess, Tree Commissioner, Silver Lake Ohio, 2013

There are many uses for a soil survey using the USI method. The most common is as a tool for selecting tree species to plant. Trees with a known USI score should be planted on sites with the same score or higher than the tree score.

Communities may adjust their program depending on their confidence with their tree scores. If a community is relying on a general tree list (see *Division of Forestry Tree List*,) they may choose to plant trees only on sites with a site score one higher than the tree score to account for variability between what other communities have found and what is in their community. A community may also choose to plant species on sites that are 1-3 scores higher, but no higher so as to save higher scoring sites for more sensitive tree species.

The USI survey is the basis for a community Master Planting Design. Details can be found on this web site under *Master Planting Design*.

This soil survey may also be used to develop a list of trees for each community. A community can assign a number for each tree based on the performance of that species in their community based in the USI. For details see *Species Assessment Methodology* on this web site.

The USI survey may also be used to identify trees that need to be monitored. Tree species planted on sites that score less than what the trees should thrive in will be more susceptible to insects, diseases, stress, and decline.

Appendix VI. Recommendations for Soil Volume for Urban Tree Planting

Adapted from: Davey Resource Group.2011. City of Thunder Bay. Urban Forest Management Plan.

The ultimate size of a tree is governed by its genetic make-up and influenced by the prevailing environmental conditions and the quality and quantity of growing media (natural or artificial soil) available for root growth and development. Current research indicates that typically in clay loam type soils, the root system of a mature tree may extend up to two to three times the spread of the crown (extent of the foliage and branches), but usually extends no deeper than one metre from the surface level. Tree roots are opportunistic; that is, they will flourish wherever soil conditions are favourable. Conversely, however, they will not grow where soil conditions are unfavourable. Three things limit root growth and development: available soil oxygen (necessary for root function and respiration), available moisture, and the resistance of the soil to root penetration (degree of soil compaction). Beyond the requirements for normal tree growth, root development is also critical for the anchorage and stability of the tree.

A tree can be sustained on a very small volume of soil (in a nursery container for example) provided that frequent and adequate water is provided. However, in a street situation, where the tree must rely on the infiltration of natural rainfall to the root zone, tree growth and development is limited by the volume and moisture holding capacity of the soil. There are many methodologies for calculating the required soil volumes for trees in a street situation; however the results are extremely variable. Most suggest a minimum volume as of:

Between 5 and 15 cubic metres for a small tree.

Between 20 and 40 cubic metres for a medium sized tree and

Between 50 and 80 cubic metres for a large tree.

These volumes represent the unobstructed soil volume required by the tree, *i.e.,* where the roots can spread to, not the improved soil planting hole. As root growth is limited by available soil oxygen, and this oxygen depletes with depth, there is no benefit in increasing soil volume by increasing the depth of the planting zone beyond a depth of 1.0m. The greater benefit is in increasing the soil volume laterally.

Usable soil volume describes the amount of soil available for tree root growth. For example, if a tree is planted on a severely compacted clay soil, the usable soil volume will be only the soil disturbed during installation or a few inches on the surface loosened by mulching—perhaps less than 0.1 square metre. Tree roots grow primarily in the top 70 cm of soil, and most grow very near the surface. For this reason, soil below 70 cm would not be considered in soil volume calculations in most cases. For example, if a tree is planted in a sidewalk cutout that is 1.2m x 1.2m and the soil is uncompacted, then the usable soil volume could be considered to be 1.2m x 1.2m x .7m. or approximately 1 square metre.

Large shade trees in downtown settings rarely, if ever, have sufficient soil volume to grow to their full potential size. Many models for predicting the volume of soil required have been proposed. A useful rule of thumb is that each 2.2cm (inch) of dbh (trunk diameter at 1.4m above the ground) requires about 1.9 to 2.3 square metres (20-25 square feet) of open ground with uncompacted soil. However, you will find that this amount of soil is rarely provided. Trees do survive, but do not reach their expected size. A tree may establish and grow normally for a few years. Then, when there is no longer enough soil for the tree's increasing size, growth dramatically slows and the tree declines prematurely. Some trees are able to overcome the situation by rooting under sidewalks and through cracks to access adjacent lawn areas.

There are several available soil volume models (listed below). Though the models are United States studies showing imperial values, the observations are important regardless of measurement system. As an example, let's look at a 24" dbh *Zelkova serrata* with a crown spread of 50'. Using the Lindsey & Bassuk

model, this tree would require about 2,200 cu. ft. in a typical soil in Blacksburg, Virginia. The Urban *et al.* model would predict about 1,500 cu. ft. would be required. The Natural Forest method based on upland hardwoods in the Eastern U.S., would predict that between 2,700 and 4,100 cu. ft. would be required, depending on soil quality. The rule of thumb mentioned above (each 2.2cm (inch) of dbh (trunk diameter at 1.4m above the ground) requires about 1.9 to 2.3 square metres (20-25 square feet of open ground with uncompacted soil) would estimate 960 to 1200 cu. ft. To some extent, results will depend upon the species, as some species, such as *Zelkova*, are better able to exploit soil resources under pavement or in compacted areas. The larger soil volumes will support a healthier, more vigorous tree, but these volumes may be unattainable in restricted downtown areas.

Lindsey & Bassuk. This model uses evapotranspirative demand, rainfall data, soil water holding capacity and leaf area index to calculate the amount of soil needed in a given climate to support the water demands of a tree of a given size. See Lindsey, P. and N. L. Bassuk. 1992. *Redesigning the urban forest from the ground below: A new approach to specifying adequate soil volumes for street trees*. Journal of Arboriculture 24 (3): 25-39.

Urban *et al*. This model is for the Eastern U.S. and is based upon the tree's canopy spread and dbh. It was developed using data from a number of authors and the experience of this urban tree expert. See Urban, J. 1992. *Bringing order to the technical dysfunction within the urban forest*. Journal of Arboriculture 18(2):85-90.

Natural Forest. This method is derived from stocking charts for upland hardwoods in the Eastern U.S. (USDA Forest Service Ag. Handbook 355). We assume that density-induced stress begins at approximately 100 ft2 of basal area per acre.
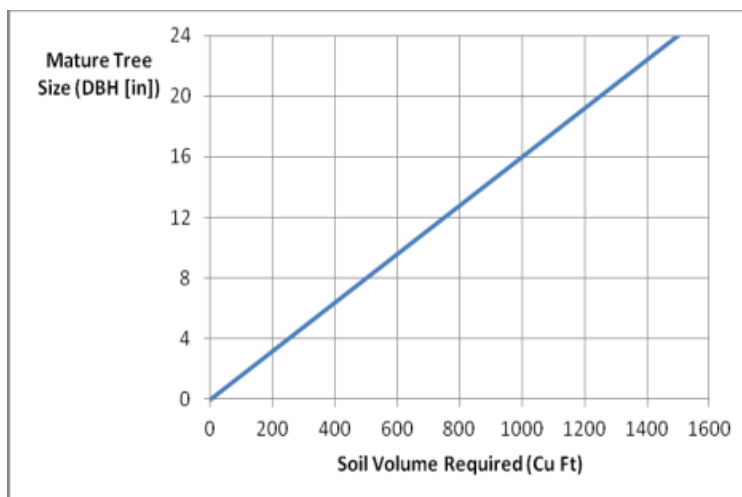
James Urban (1992) synthesized data from Bassuk and Lindsey (1991), Thomas (1985 and 1989), and his own work (Urban, 1989) to determine a relationship between soil volume requirements and mature tree size. The larger the tree, the more soil volume if needs.
Excepted from:
Virginia Urban Tree Selector
http://dendro.cnre.vt.edu/treeselector/FAQ.shtml#modelsForCalculatingSoilVolume
street tree design guidelines; 2008
http://www.landcom.com.au/content/publication-and-programs/the-landcom-guidelines.aspx

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