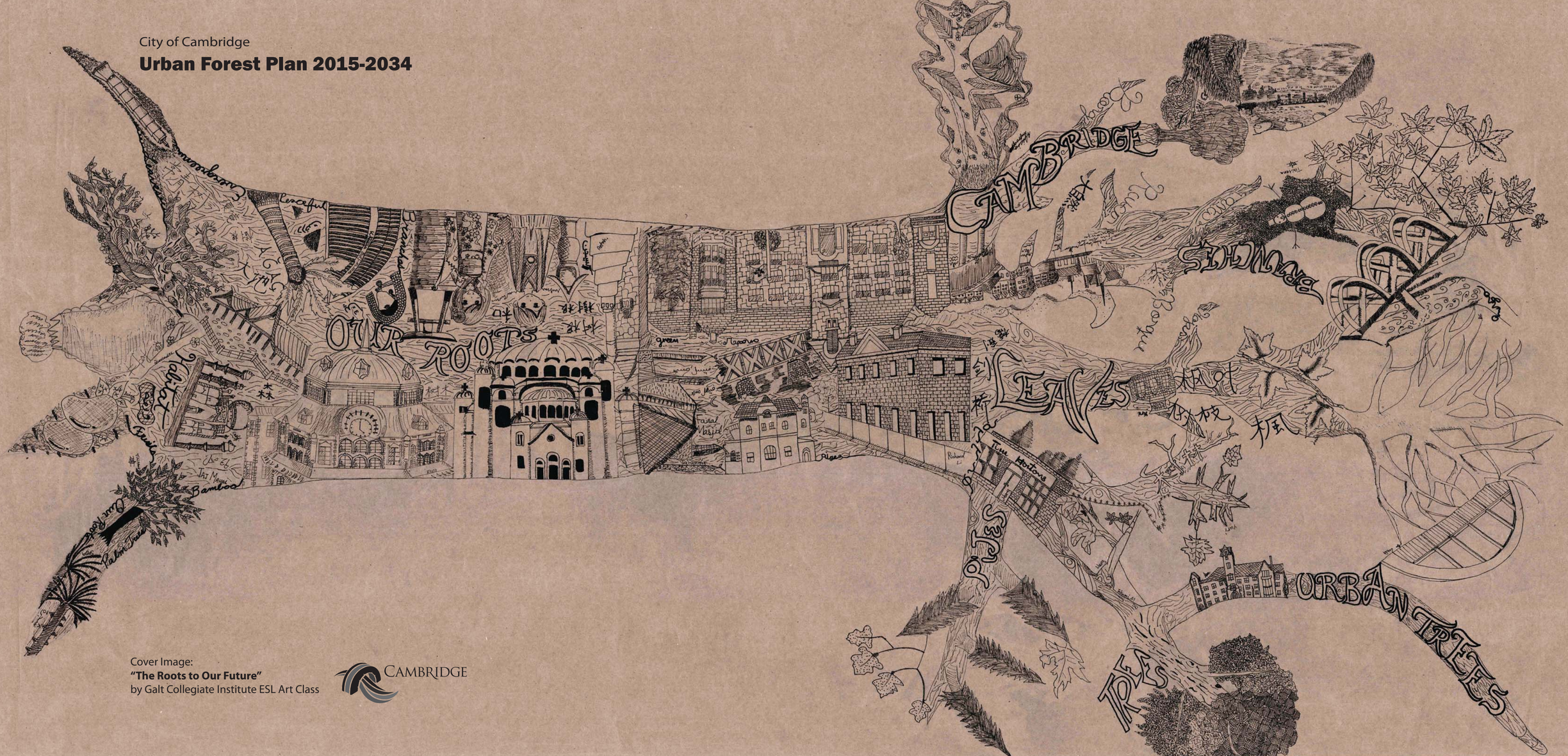
City of Cambridge

Urban Forest Plan 2015-2034



Cover Image:
"The Roots to Our Future"
by Galt Collegiate Institute ESL Art Class

CAMBRIDGE

Prepared by:

Urban Forest Innovations Inc.

and

Beacon Environmental Ltd.

June 2015

Photo Credits:

- **Above Left: mature trees preserved through the development process, Barnes Rd., Cambridge (Paul Willms)**
- **Above Middle: walking in Cambridge (City of Cambridge photo gallery)**
- **Above Right: Shade's Mill canopy (Kelly Pritchard)**

Cover Image:
"The Roots to Our Future"
(Reproduction of a 300 cm x 100 cm image by Galt Collegiate Institute ESL Art Class)

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"This tree is a group project with various images intertwined throughout the roots, trunk, and branches. At the roots and running up the trunk are images of buildings, trees, and objects important to the students' "roots" of their culture. These students are from all over the world: Japan, China, Pakistan, Iraq, Serbia, Taiwan, Ethiopia, El Salvador, Colombia, St. Vincent, Guyana, and Greece. Continuing up the trunk, students have drawn trees they see in Cambridge as well as the buildings that are important and interesting to them. Intertwined throughout the images are words in English and their first languages that represent trees and what trees mean to them. This project has been a great opportunity for these students to get together as unified residents of Cambridge."

Focus on Trees in Cambridge Contest - Winning Submissions

The objective of the contest was to reach out to the Cambridge community and incorporate the "beauty of trees" into the Urban Forest Plan. The contest was sponsored by the Cambridge & North Dumfries Community Foundation (CNDCF) and Ages Foundation – founding and ongoing sponsors of the Cambridge Stewardship project, which has seen thousands of native trees, shrubs, and wildflowers planted by volunteers, and through Cambridge City Green, at sites across the city since 2007. The City, CNDCF and Ages Foundations thank all of those who took the time to submit an entry. The seven winning submissions are found on this page and on the cover of the Urban Forest Management Plan. A tree was planted on behalf of each winning submission to mark the launch of the 20-year Cambridge Urban Forest Plan.

Above Left: Jennifer Depencier. *"After the first snowfall one year I came home from Woodland Park inspired to start painting and capture how beautifully Mother Nature had frozen the end of autumn."*

Above Middle: Debora Xi. *"I like walking in the forest with my parents."* (Teacher – Sandra Fuller, Centennial Public School)

Above Right: **Blair Road Public School grade 4 class**. *"Our digital forest."* (Teacher – Donna Pilkington)

Below Left: Sarah Dyer. "*Mature trees silently bridge the generations, never revealing the secrets, stories and conversations of the many who have passed over the years."*

Below Middle: Zohra Kharodia. *"I represented Cambridge and the seasons it goes through by using various bright colours and I also wanted to make sure the beautiful trees of Cambridge were shown and lovely bridge downtown."*

Below Right: members of Community Living Cambridge LINKS program (Kerri Galvao, Manager of LINKS/Recreation/Seniors)

Acknowledgements

The City of Cambridge Urban Forest Plan would not have been possible without the dedication, participation, and contributions from the following individuals, groups and organizations (listed alphabetically):

City of Cambridge Staff

- Justin Armstrong, Manager of Design and Construction
- George Barnes, Director of Community Services Operations
- Diana Danila, Business Systems Analyst GIS
- Joey DePinto, Forester
- Ian Dooley, Forester
- Shawn Falcao, Communications / Website Associate
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- Tom Slater, Forestry Lead Hand
- Rafique Turk, Senior Development Engineer
- Beau Wansbrough, Senior Environmental Planner
- Paul Willms, Sustainability Planner
- Chris Ziemski, Manager of Community Services Operations

Agencies

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- John Brum, Resource Planner, Grand River Conservation Authority
- Sarah Colvin, Manager, Cambridge Hydro, Energy+
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- Shade Work Group (Stephanie Ellens-Clark, Lindsay Button, Georgeanne MacGregor-Fox, Dennis Wendland)
- Southwood Secondary School (Christopher Giesler and students)
- Waterloo Region Homebuilders Liaison Committee (Dave Aston, Al Alendorf, Kevin Brousseau, Amanda J. Froese, Ron Beatson, Carlos Da Silva)

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- Ian Hanou, Plan-it Geo
- Richard Thurau, Plan-it Geo

Executive Summary

The urban forest in Cambridge encompasses all trees within the city's boundaries, whether they are on public or private lands, and includes their growing environments. The urban forest provides a wide range of vital environmental, economic and social benefits to the community. While current urban forest canopy cover is 27%, the city's trees face threats and challenges which are anticipated to intensify over the next two decades. While these challenges are numerous, the major threats include:

- Competition with built infrastructure, especially as land use density intensifies
- Invasive plant species, which threaten the ecological integrity of natural areas
- Invasive pests and pathogens, including Emerald Ash Borer (EAB), which threatens to eliminate all ash trees within the city
- Tree-related risk, particularly among mature trees and ash trees
- Land use change and development
- Climate change and associated extreme weather events, which threaten tree health
- Limited resource allocation, with a current Forestry Services staff of six and a budget of $600,000 to manage an asset with $85 million in replacement value, and
- Fragmented ownership of trees across multiple jurisdictions on public and private lands, which results in less consistency in management and requires public engagement and stewardship.

Faced with such challenges, a 'business as usual' approach to urban forestry would be expected to result in a significant decline in the health and extent of Cambridge's urban forest, and result in a reduction of vital urban forest benefits . A long-term, strategic approach with implementable action items is required to ensure effective urban forest management.

City of Cambridge staff, members of the public and other stakeholders consulted during the development of this Plan have consistently expressed a strong desire to maintain and enhance the urban forest, and recognize the importance of trees in a healthy and sustainable community. The vision, guiding principles, strategic objectives and targets of this Plan address the need for proactive planning for and maintenance of trees where the City has jurisdiction, ongoing engagement of community members and other stakeholders in stewardship of their lands, and sustained investment to support the management of this valued community asset.

Thirty-two recommended actions are presented in this Plan, and are based upon based on careful consideration of the state of the urban forest, the current status of the management program, best practices and precedents from other jurisdictions and the scientific and technical literature, and investigation of practical opportunities for improvement. The 20-year Plan is divided into four 5-year management periods. In recognition of the fact that current capacity and resources will not enable the implementation of all recommended actions in the near terms, an implementation framework has been developed that prioritizes the various recommendations by management period or specific year.

High Priority Actions – Management Period 1 (2015-2019)

Some of the Plan's highest-priority recommended actions address the need to:

- improve knowledge about the City's trees, including ash trees in parks and woodlands (recommendations #19 and 26)
- mitigate and reduce tree-related risk (#16, 20 and 21), and
- update the EAB management strategy to consider newly-available information (#25).

In addition, recommended high-priority actions recognize the need for collaboration, outreach and partnership, and include:

- creating an internal 'Urban Forest Group' (#2) and an external 'Urban Forest Plan Steering Committee' (#3),
- continuing to build upon and expand partnerships (#4),
- exploring opportunities for support from various agencies (#5), target outreach (#30), and
- increasing efforts to coordinate and implement community-based urban forest stewardship (#31)

The value of proactive planning is recognized through high priority recommendations for:

- a comprehensive tree preservation planning policy and procedure review (#11), and
- a change in tree establishment practices (#13), whereby developers shall deposit funds with the City to cover the cost of tree planting and necessary maintenance within the establishment period.

Finally, regular review of the Urban Forest Plan and reporting to Council in each of the four five-year management periods, are identified as a high priority (#1).

Medium Priority Actions – Management Period 2 (2020-2024)

In the second management period (2020-2024), several high-priority actions from the first management period will need to be continued, and new actions are recommended for implementation.

Actions to be continued include those related to Emerald Ash Borer and ash tree management, support for ongoing outreach, partnership and funding, and expansion of community-based stewardship. In addition, practices and policies reviewed and revised in the first management period will be implemented.

Recommended actions to be implemented in the second management period focus largely on proactive tree maintenance and establishment, as well as review of policies and by-laws. Recommended actions include:

- development and phased-in implementation of a cyclical pruning program and young tree structural pruning program (#17 and 18)

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Recommended actions to be implemented in the second management period focus largely on proactive tree maintenance and establishment, as well as review of policies and by-laws. Recommended actions include:

- development and phased-in implementation of a cyclical pruning program and young tree structural pruning program (#17 and 18)

- review and updating of Official Plan policies related to tree establishment (#7), City tree establishment policies and standards (#12), and the public tree and grading by-laws, as they relate to tree replacement and other Urban Forest Plan objectives (#9)
- preparation of a pest vulnerability assessment (#24), and
- increasing the number of trees planted as part of Forestry Division operations, to help achieve urban forest canopy targets (#28).

Finally, a comprehensive review of the Forestry Division workloads and service levels is recommended at the end of the second management period, in order to inform resource requirements for the next 10 years of Plan implementation (#15).

Resource Requirements – Management Periods 1 and 2

Currently the City does not have the capacity to pursue the implementation of these recommendations with its existing staffing and resources, with the exception of some less resource-intensive action items that could potentially be accommodated within existing workloads. Based on the priorities identified through this Plan, within the first two 5-year management periods the City will need to:

- Determine the human resources required to complete the tasks and recommendations detailed in Table 4 (pages 92-97). Human resources may involve a combination of existing staff, new staff or equivalent contracted services and are to be subject to the budget approval process.

- Invest approximately $5.2 million in the provision of services, including tree inventories, priority-based and cyclical tree maintenance, and tree establishment.

Resource requirements for the third and fourth management periods shall be identified through the recommended comprehensive review at the end of the second management period.

Recommended Actions – Management Periods 3 and 4

Urban forest management during the third and fourth management periods will include ongoing implementation of a number of actions recommended in the previous periods, including increased tree establishment, improved policies and practices, and outreach and stewardship.

In addition, recommendations to enhance urban forest health and resilience to be implemented in the third and fourth management periods include:

- development of improved streetscape guidelines (#8) and a master list of tree species to guide establishment on public and private lands (#14), along with improved tree stock selection (#27)
- completion of an inventory of City-owned woodlands (#22) and priority-based woodland management (#23)

- improvement of the City's forestry webpage (#29) and exploration of incentives for improved tree management on private lands (#32), and
- consideration for development of a private tree protection by-law (#10).

The urban forest is a complex and dynamic living entity. It can take many years and substantial resources to establish healthy and mature urban trees, but many threats can rapidly and adversely affect urban forest health and sustainability. Strategic planning and effective management are necessary to ensure the protection, maintenance, restoration, enhancement and expansion of the urban forest. This Urban Forest Plan provides strategic direction to enable the City of Cambridge to more effectively manage all aspects of the urban forest so that the many benefits it provides will be sustained and enhanced for current and future generations.

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1. Introduction and Local Context

Located at the confluence of the Grand and Speed Rivers, the City of Cambridge is a vibrant and innovative community rich in natural and cultural heritage. Formed in 1973 by the amalgamation of the former City of Galt, the Towns of Preston and Hespeler, and the Village of Blair, Cambridge is now the second-largest community in Waterloo Region, and one of the fastest-growing cities in Canada.

Cambridge residents enjoy a high quality of life in a healthy and prosperous community, and among the most important contributors to this quality of life is the urban forest.

The urban forest is an integral part of the City's community fabric. Trees within the City's parks and natural areas are critical components of the City's green infrastructure, and are as important as its grey infrastructure to maintaining a functioning, healthy and livable community. A healthy and sustainable urban forest ensures that vital ecological services such as clean air, water, shade and habitat connectivity are sustained, and that such services will continue to be available to community residents and visitors.

The City's urban forest will face increasing challenges as Cambridge continues to grow. Therefore, now is the time to take action and ensure that practices, policies and guidelines are put in place to protect, establish and maintain the urban forest well into the future. This twenty-year Urban Forest Plan (2015-2034) recognizes the value of Cambridge's urban forest, and supports the City's commitment to the continued and improved stewardship of this valuable asset. The recommended actions outlined in this document will enable the City to more effectively manage its existing trees, achieve greater success in tree establishment, and promote community support for, and stewardship of, the urban forest.

Autumn street scene in Cambridge. Credit: S. Jobber.

1.1 Cambridge's Urban Forest

1.1.1 Defining the Urban Forest

In keeping with the common definition of the term, the Cambridge Official Plan (Section 3.B.4.1) defines "the urban forest in Cambridge" as:

> ***"the treed environment, consisting of remnant wooded areas, trees in city parks and open space, street trees and trees on private property."***

Cambridge's urban forest encompasses all trees within the City's boundaries, whether they are on public or private lands, in woodlands or along streets, newly established saplings or 150 year-old specimens. This also includes consideration of the soils and substrates in which these trees grow.

Cambridge has designated Countryside (i.e., rural and prime agricultural areas) within its urban structure (see Official Plan 2012 Maps 1A and 1B) which are not, strictly speaking, within the urban portions of the City. This Urban Forest Plan considers lands both within Cambridge's Urban Area Boundary as well as the Countryside areas, while recognizing that different planning and management considerations may apply to trees in each of these areas.

1.1.2 The Value of the Urban Forest

The benefits and services provided by the urban forest, both valued and invaluable, make critical contributions to the daily quality of life and health of those who live, work and play in Cambridge. They are a critical component of the City's green infrastructure, defined by the Green Infrastructure Ontario Coalition as *"the natural vegetation and vegetative technologies that collectively provide society with a broad array of products and services for healthy living."* (Green Infrastructure Coalition Ontario, 2014).

Cambridge – Local Context

Demographics

Population: 133,000 (2013)
Households: 47,800 (2013)
Land Area: 112.86 km^2 (11,286 ha)
Major Economies: manufacturing, automotive, technology, pharmaceutical, business, financial services, and hospitality/retail

Biophysical Conditions

Plant Hardiness Zones (2010): 6a/6b
Forest Regions: Great Lakes – St. Lawrence, Carolinian
Major geographic features: Grand and Speed Rivers
Parkland (2014): 365 hectares in more than 80 parks
Urban Forest Canopy Cover (2013): 27% (3,080 ha)
Possible Plantable Area: 25% (2,899 ha)

An ever-increasing body of scientific and technical literature continues to demonstrate and discover more about the wide-ranging ecosystem services provided by trees and green spaces in urban areas. For example, current research indicates that a healthy urban tree can provide positive returns that range between two and thirteen times the cost of its management every year (TD Economics, 2014). In fact, as trees grow in size and leaf area, the value of the benefits they provide can increase exponentially, making the urban forest perhaps the only form of urban

infrastructure that appreciates in value as it ages. Well-planned urban forest management will extend the duration for which trees provide positive value.

The trees in Cambridge, and the benefits they provide, have tremendous functional and economic value. While not all urban forest benefits are readily quantifiable, tools are available to estimate some of the ecosystem services provided by urban forests. As shown in Table 1, the urban forest in Cambridge currently provides more than $3 million annually in carbon sequestration and air pollution control services, including avoided costs for alternative methods. This is in addition to the basic replacement value of the urban forest, estimated at nearly $850 million and the estimated $22 million worth of carbon that is stored in the trees themselves.

Table 1: Ecosystem services provided by Cambridge's urban forest. Source: City of Cambridge Urban Forest Canopy Assessment (December 2013)

Ecosystem Service	Estimated Amount (Monetary Value)
Carbon Sequestration	37,000 tonnes annually ($727,000 estimated value)
Air Pollution Removal	243 tonnes annually ($2.3 million estimated value)

Many additional valuable ecosystem services provided by the urban forest are more difficult to quantify and place a monetary value on. Cumulatively, these services make significant contributions to community sustainability through environmental, economic and community benefits, discussed briefly in more detail below.

Environmental Benefits

Environmental benefits provided by the urban forest documented in the scientific literature include:

- Improving air quality by binding airborne pollutants to leaf and bark surfaces (Cavanagh *et al.*, 2009; Nowak *et al.*, 2006)
- Conserving soil resources and improving stream water quality by reducing surface runoff rates (Endreny, 2005)
- Moderating urban flooding through rainfall interception and water absorption (Inkiläinen *et al.*, 2013)
- Moderating 'urban heat island' temperatures, through shading and evapotranspiration (Akbari *et al.*, 2001, Müller *et al.*, 2014)
- Reducing the greenhouse effect by storing and sequestering climate change contributing atmospheric carbon (McHale *et al.*, 2007; Nowak, 1993)
- Reducing energy consumption in homes and buildings by shading buildings or sheltering them from cold winds (Akbari, 2002), and
- Providing vital habitat for urban and migratory wildlife such as mammals, birds, and other organisms (Faeth *et al.*, 2011).

Trees and Climate Change Adaptation / Mitigation

Although climate change presents one of the most pressing challenges for urban forests, the protection and enhancement of the urban forest presents a unique, practical and effective opportunity to both mitigate and adapt to climate change. By moderating local temperatures through shading and evapotranspiration, removing pollution from the air, and moderating storm water flows, trees help the urban environment adapt and be more resilient to the effects of climate change. Trees also sequester and store carbon, thereby reducing the concentrations of this significant greenhouse gas and potentially helping to mitigate the severity of climate change. The specific strategies for adapting to and mitigating climate change effects include many approaches that are consistent with good urban forest management practices and the management actions recommended in the Cambridge Urban Forest Plan.

Economic Benefits

Although trees in urban environments are not generally managed for their timber value or for the production of merchantable goods, urban trees have measurable positive impacts on the local economy. In addition to the environmental benefits provided by trees, studies have established that:

- The presence of larger trees in yards and streetscapes can add between 3% and 15% to the value of homes, even if the trees are on neighbouring properties (Wolf, 2007)
- Homes on wooded lots typically sell faster than comparable untreed properties, and
- Shoppers express a willingness to pay, on average, between 9% and 12% more for goods and services in well-treed business districts, and are also willing to travel longer distances to such areas. Once there, they will often spend more time browsing and shopping (Wolf, 2003; Wolf, 2005)

Trees and natural areas are also considered economic assets by virtue of inviting visitors and supporting local tourism, as well as attracting new businesses who must consider the attractiveness of the municipality for their employees and their families.

Community and Health Benefits

There is growing evidence that trees also provide important community and human health benefits, particularly in urban areas where population densities are greater. These include, but are not limited to:

- Reducing exposure to UV radiation and heat by providing shade and cooling (Bowler *et al.*, 2010)
- Encouraging active living by providing settings for physical activity (Thompson Coon *et al.*, 2011)
- Providing social settings that may reduce incidences of crime (Donovan and Prestemon, 2012)
- Promoting human health by reducing exposure to certain environmental risks such as air pollutants (Lovasi *et al.*, 2008)
- Reducing mental fatigue (Tennessen and Cimprich, 1995)

- Building stronger communities by providing settings for social interactions (Coley *et al.*, 1997), and
- Increasing safety of community streets by calming traffic flow (Moka *et al.*, 2006).

Although many of these community and health benefits cannot be monetized or included in a traditional cost-benefit analysis of urban forest management, their contributions are vital to making the City of Cambridge a desirable and livable community.

1.1.3 Urban Forest Canopy Cover

A common method to describe the extent of the urban forest is to measure the amount of canopy cover, which is typically expressed as a percentage of land area covered by tree canopy. Canopy cover is a two-dimensional measurement of the horizontal surface area of the forest as seen from a 'birds-eye' view.

Some jurisdictions use canopy cover percentage as a comparative metric to assess the success of their urban forestry programs in relation to other comparable jurisdictions, and/or to set canopy cover targets as part of urban forest management. Although it is a popular and easily understood metric, canopy cover is limited in so far as it does not address other important aspects of the urban forest, such as species diversity, urban forest structure (i.e., size and age ranges) or condition, levels of maintenance, or community engagement in urban forest stewardship. The use of canopy cover as a metric can also be problematic because different methods can provide varying estimates and differing levels of accuracy. Furthermore, overemphasis on canopy cover targets can unduly focus urban forest management on tree planting at the expense of other equally important strategic initiatives, such as maintenance and monitoring. Therefore, canopy cover assessments should be understood to be only estimates, and should not be the focus or underpinning of urban forest management planning or program delivery. In spite of these shortcomings, canopy cover remains a readily understood and useful urban forest metric to be considered as one part of a comprehensive urban forest management approach. Canopy cover data can also be used to facilitate and guide outreach and stewardship, as recommended in this Plan (see Section 3.4).

A canopy cover assessment for Cambridge was completed in December 2013. The analysis employed both top-down (high-quality satellite imagery) and bottom-up (field-based) approaches to assess the distribution of canopy cover across the city at various scales. The study also examined possible future scenarios based on Business As Usual (BAU) and alternative management practices, and provided a modelling tool for prioritizing tree planting based on an analysis of potential plantable areas.

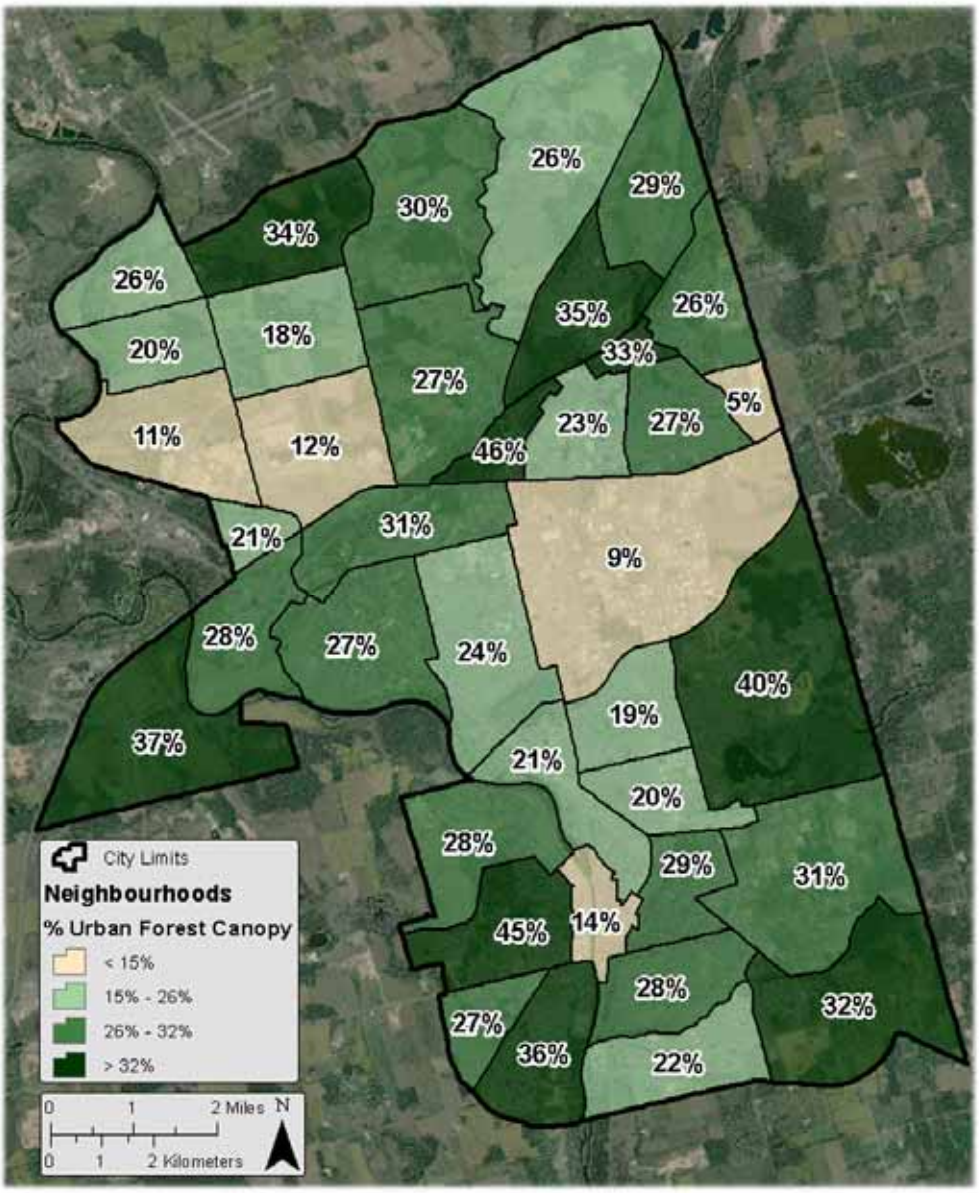


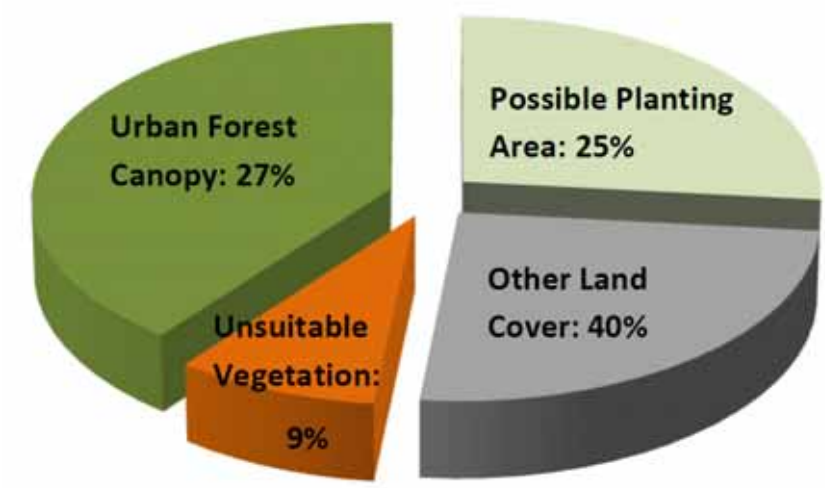
Figure 1: Urban forest canopy cover in each of Cambridge's 38 neighbourhoods.

The results of the canopy cover assessment show forest canopy covers 27% (3,080 hectares) of Cambridge's land area (Figures 1 and 2). As described in the *City of Cambridge Urban Forest Canopy Assessment* (2013), canopy cover ranges from 5% to 46% across the City's 38 neighbourhoods, and from 1% in lands zoned as Commercial and Institutional to 49% in lands zoned as Open Space. The remaining land cover mapped in Cambridge as part of this assessment consisted of:

- Potential Plantable Areas (PPA): non-forest vegetation areas suitable for tree planting, such as grassed areas (2,899 hectares, or 25% of the city)

- Unsuitable Potential Plantable Areas: vegetated areas, such as recreational fields, agricultural lands and golf course fairways, that are generally unsuitable for tree planting due to land use considerations (1,003 hectares, or 9% of the city), and
- Other: other land cover types, such as impervious surfaces, open water, and buildings unsuitable for tree planting (4,585 hectares, or 40% of the city).

The identification of PPAs as part of this assessment shows that if all non-forested vegetated areas suitable for planting were stocked with trees, Cambridge's canopy cover could theoretically be increased by 25%, to 52%. However, this broad scale assessment does not account for the various realities that need to be considered, particularly in urban areas, such as: the need to accommodate planned growth, potential conflicts with below and above-ground infrastructure, the need or desire for sight lines, and the need or desire to maintain some grassed open spaces as untreed. Planting trees in all PPAs also assumes that the resources for planting and maintaining all these additional trees are readily available; like most other forms of infrastructure, trees require periodic maintenance if they are to provide continued benefits. More discussion of a pragmatic tree canopy cover target for Cambridge is provided in Section 2.4.2.



Urban Forest Canopy: Forest cover, when viewed and mapped from above.

Possible Planting Area (PPA): Non-forest vegetated areas considered suitable for tree planting and growth.

Vegetated but Unsuitable for Planting: Vegetated areas identified for active uses not compatible with tree planting (i.e., sports fields, agricultural fields, and golf course fairways) were excluded as potential plantable spaces.

Other Unsuitable for Planting: All other land cover classes (buildings, pavement, water) not considered suitable for planting.

Figure 2: Percent coverage for each of four land cover types mapped across Cambridge.

1.1.4 Street and Park Trees

Existing Tree Inventory

The City completed a GIS-based inventory of 55,000 street trees in 2014, in response to the threat posed by the Emerald Ash Borer (*Agrilus planinpennis*) (EAB) beetle to the City's ash trees. Although the inventory does not include the thousands of trees located on public lands in the city's parks and natural areas, data were collected for virtually every street tree, including attributes such as species, size (diameter at breast height, or dbh), structural and biological condition, and risk rating.

The inventory also assessed ash trees for signs or symptoms of EAB infestation in order to determine the current extent of the beetle's presence in the City. A summary of the findings of the street tree inventory is provided below.

The inventory found that the City's street tree population is made up of a relatively large number of tree species (135 unique species), but that overall diversity could be significantly improved, as Norway maple (*Acer platanoides*) and ash species (*Fraxinus* spp.) alone make up over one-third of all street trees (Figure 3). Even less diversity exists at the genus level, where maples (genus *Acer*) account for 40% of the street tree population.

The inventory also reveals that Cambridge's street tree population is dominated by relatively younger, smaller trees. An 'inverse-J' dbh distribution curve (Figure 4) suggests that the street tree population, if maintained at optimal health and provided with adequate growing space, will continue to provide a wide range of urban forest benefits over time. The majority (75%) of Cambridge's street trees have good canopy vitality, more than half (54%) have fair structural condition, and less than 5% have poor structure or canopy vitality. However, it is anticipated that various urban forest health challenges, as described throughout this Plan, may prevent many of these young trees from reaching their full genetic potential for stature and longevity. For example, it is likely that as existing mature trees age and younger trees in many newer developments reach the growth limits imposed by sub-optimal growing sites, overall tree health and condition across the city will decline and increased efforts to maintain and improve tree condition and growing sites will be needed.

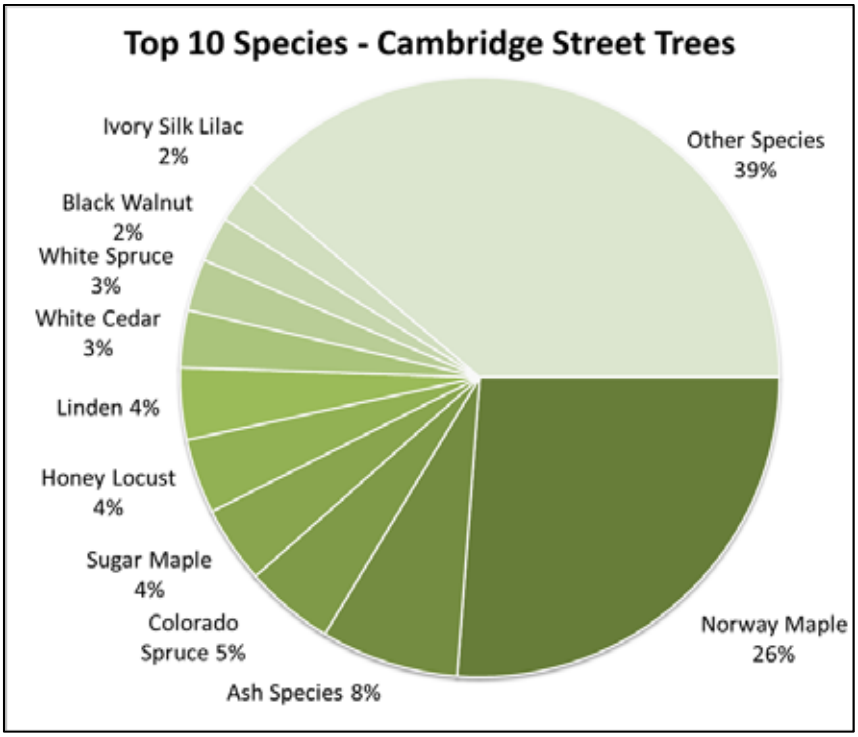


Figure 3: Top ten species of street trees in Cambridge, 2014.

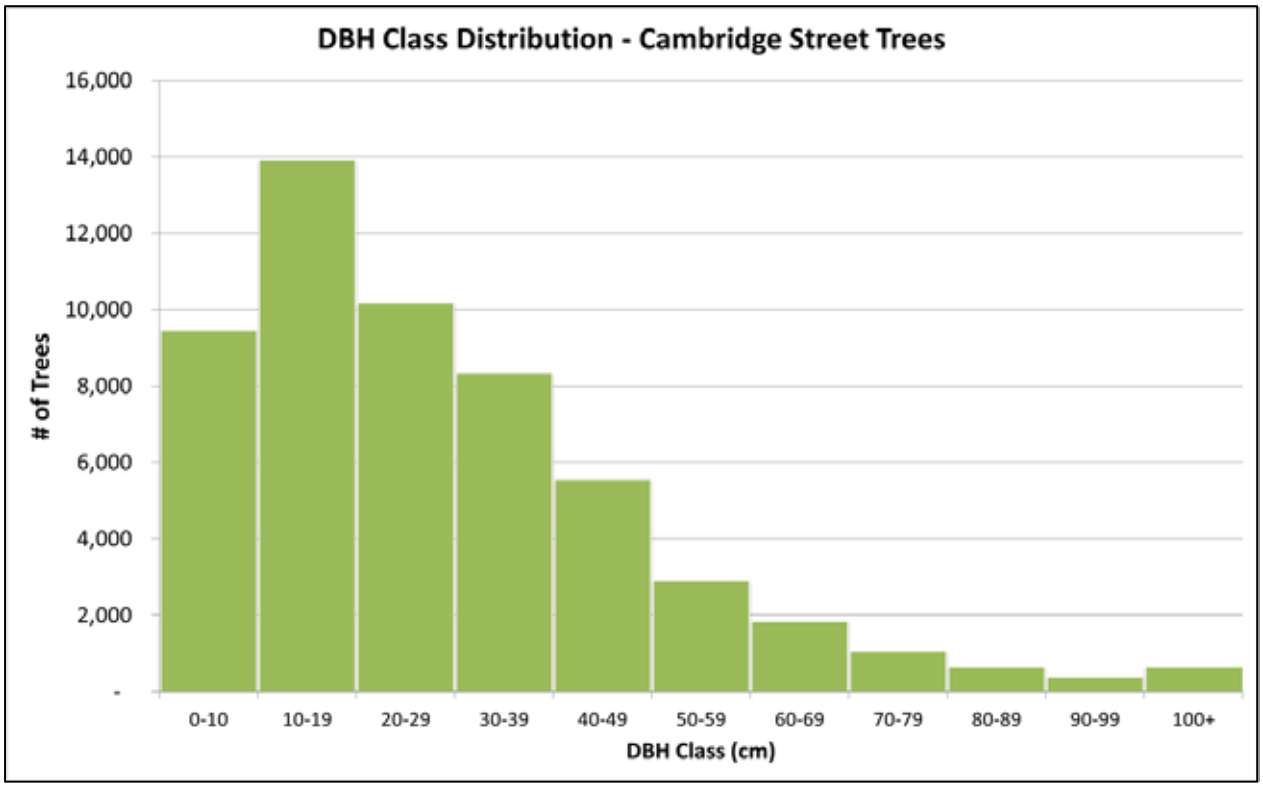


Figure 4: Diameter at breast height (dbh, 1.37 m above grade) distribution of street trees in Cambridge, 2014. Note that the majority of trees are in smaller or mid-size classes.

1.1.5 Woodlands

The City of Cambridge is located at the southern limit of the Great Lakes-St. Lawrence forest region, and just north of the Carolinian forest region. The City is bisected by the confluence of the Speed and Grand Rivers, and contains a diversity of upland and lowland remnant woodlands in both public and private ownership.

The *Urban Forest Canopy Assessment* (2013), which was based largely on remote sensing, determined the total canopy cover in each of the City's 24 subwatersheds and drainage areas. While this assessment found that total subwatershed canopy cover ranges from as low as 8% to as high as 92%, with most subwatersheds having between 23% and 33% canopy cover, the assessment could not provide information about (a) the proportion of wooded areas in each subwatershed (or City-wide), or (b) the composition of the dominant woodland types.

Figure 5: Examples of trees of varying diameters at breast height (dbh) and dbh measurement. Left: cross-section of a 20 cm dbh tree, hand for scale. Centre: measuring dbh (photo courtesy Eastern Forest Consultants). Right: cross-section of a 76 cm dbh mature tree, arm for scale.

Some information about Cambridge's woodlands can, however be gleaned from the subwatershed studies (SWS) that have been completed over the past two decades. The SWS data have some limitations; these studies do not cover the entire City or provide the same level of detail, some of the SWS are dated, and some include areas that extend well beyond the City limits. Nonetheless, these studies confirm that dominant tree species in the City's upland woodlands include sugar maple, white pine, American beech, white ash, ironwood, black cherry, red oak and white oak. Common lowland species include white cedar, green ash, black ash, red maple, silver maple, Freeman maple (a hybrid of red and silver maple), white elm, willow, white birch, aspen, poplar, and basswood. Less commonly noted species include bur oak, black walnut, ironwood, hemlock and hickories, as well as Carolinian species such as sassafras and tuliptree. Notably, buckthorn, an invasive species, has been found in many of these natural areas, and ash is identified as a dominant or co-dominant species (in terms of abundance) in many of the wooded communities described, suggesting it may represent as much as 10% to 20% of the city's natural wooded cover.

For the few SWS where such data are available (four of 24 SWS), it appears that at least one-half of the current canopy cover in those areas is (or was at the time of the SWS) found within natural wooded cover. An overview of the data from the available SWS related to the City's woodlands is provided in Appendix B.

1.2 Responsibility for the Urban Forest

Currently, approximately 10% of the City's tree canopy is situated on City-owned lands, another 10% is under the ownership of other public agencies (e.g., Grand River Conservation Authority (GRCA), Infrastructure Ontario, Ministry of Transportation) and the remainder is owned privately. Therefore, the responsibility for protecting, maintaining and growing the urban forest is truly shared, as discussed throughout this Plan. This section provides an overview of different governmental responsibilities related to the urban forest, as well as key pieces of legislation and policy that provide the framework for urban forest planning in Cambridge.

1.2.1 Federal Government

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.

1.2.2 Provincial Government

Similar to the federal government, 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 2.

Other provincial documents that support local urban forest initiatives include:

- *Go Green: Ontario's Action Plan on Climate Change* (2007), which sets a planting target of 50 million new trees in Southern Ontario by 2020, and provides funding for volunteer-driven tree planting projects
- *Ontario Invasive Species Strategic Plan* (2012), which identifies high level strategies that various partners can use to help fight invasive species, and
- *Ontario's Biodiversity Strategy* (2011) which sets out a framework for engaging people, reducing threats, enhancing resilience and improving knowledge in relation to native biodiversity and ecosystems, including woodlands.

Table 2: Provincial statutes and policies with relevance to urban forest management.

Statute or Policy	Relevance
Planning Act, 1990	Establishes the framework for municipal planning in the province. Empowers municipalities to develop official plans and regulate development, including requiring landscaping with trees and shrubs on the site (s. 41) and parkland dedication (s. 42, s. 51.1). Municipalities may also take cash in lieu for parkland dedication, or may reduce the cash in lieu required if lands proposed for redevelopment meet established sustainability criteria (s. 42).
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", as well as certain provisions pertaining to boundary/shared trees.
Conservation Authorities Act, 1990	Establishes conservation authorities as watershed-based authorities with various responsibilities, including regulation of lands adjacent to watercourses, wetlands and shorelines.
Municipal Act, 2001	Establishes municipal powers. S. 223.2 allows any municipality greater than 10,000 people to regulate the injury or destruction of trees on public and private lands, while S.135 to 146 provides the legal framework for such tree and site alteration by-laws.
Provincial Policy Statement, 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

1.2.3 Region of Waterloo

The City of Cambridge is an area municipality in the Region of Waterloo. The Region provides protection for significant woodland features in the City through its *Official Plan* (2010) which prohibits development within significant woodlands and other Core Environmental Features. It also requires area municipalities to consider non-significant woodlands, and supports stewardship of these features. The Region also provides financial support for stewardship through the Community Environmental Fund (CEF). The Region has also enacted a Woodland Conservation By-law (No. 08-026) which regulates the destruction or injury of trees in all woodlands of at least 1 ha. Finally, the Region owns and manages 16 Regional Forests, three of which are located in Cambridge.

1.2.4 City of Cambridge

The City of Cambridge bears the primary responsibility for the planning and implementation of urban forest management within the City. To this end, the City has policies in its Official Plan as well as supporting guidelines and a public tree by-law (discussed further in Section 4), that address specific aspects of urban forest management.

Staff from various City departments are tasked with planning, protection, maintenance, enhancement and replacement / expansion of the urban forest on City-owned lands and, to a degree, development lands, as described below:

- Urban forest management and maintenance is largely administered by the City's Forestry Division in the Community Services Department. Currently, the Forestry Division consists of four Foresters[1], one Forest Technician / Inspector and one Forest Manager. Key responsibilities include overseeing the protection and maintenance of the City-owned portions urban forest (street trees, parks, and natural areas). Forestry staff also assist in development plan review to ensure compliance with City standards and policies concerning the urban forest.
- Planning & Development Department and Community Services staff are tasked with protection of existing trees through the planning process, Council-adopted policies, zoning (49% of the City's current canopy is within protected Open Space designations within the Zoning By-law) and legislative tools.
- The Transportation and Public Works Department protects existing trees and plants new trees during road reconstruction and other infrastructure projects.

The City's properties, especially parks and natural areas, already support a relatively high proportion of canopy cover (with many having 75-100% canopy cover) but still contain some opportunities for canopy cover expansion. The *Urban Canopy Assessment* (2013) shows that the City owns approximately 18% of the city's total canopy (430.5 ha in properties and 157 ha in right-of-way street trees = 587.5 ha) but that its lands also contain approximately 11% or 308.3 ha of potential plantable spaces.

1.3 Threats and Challenges – the Need for an Urban Forest Plan

With a growing population, new and infill development, climate change, and other stressors, the range of threats and challenges to the City's urban forest is expected to intensify in the coming years. As these stressors intensify, the urban forest will become increasingly important. In this context, a 'business as usual' approach would almost certainly result in a decline in the health and the extent of Cambridge's urban forest.

1.3.1 Threats and Challenges

There are numerous and varied challenges to the sustainability of Cambridge's urban forest, including:

- Competition with built infrastructure
- Invasive plant species
- Invasive pests and pathogens
- Tree-related risk
- Land use change and development
- Climate change (and associated extreme weather events)
- Limited resource allocation
- Fragmented ownership

[1] Although some Forestry Division staff are designated as Foresters by the City of Cambridge, they are not currently Registered Professional Foresters (RPF) pursuant to the Ontario *Professional Foresters Act, 2000.*

These challenges are described in greater detail, below.

Competition with Built Infrastructure

Since the retreat of the Wisconsin Glacier some 10,000 years ago, generations of trees in Southern Ontario have evolved to grow in natural forest conditions. The growing conditions in urban areas, however, are typically characterized by 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.

Invasive Plant 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. While there are dozens of documented invasive plant species in southern Ontario, including trees, shrubs and herbaceous plants, only some of these present serious threats to forested areas, and only under certain conditions.

Invasive plants, such as Norway maple, buckthorn or garlic mustard, are prevalent in urban woodlands and forests, and can threaten local ecosystems by outcompeting and displacing indigenous plant communities.

It is recognized that 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.

Invasive Pests and Pathogens

The challenge of controlling invasive pest and pathogen species has become more urgent for urban forest managers as elevated levels of global traffic and movement of commercial goods continue to bring new invasive species to North American forests. Once introduced, invasive pests and pathogens can be difficult to detect, limiting management options and increasing the difficulty of effective control. Although natural areas are frequently the targets of intense invasive species pressure, urban forests are under significant threat as well. The textbook example of the highly destructive potential of an invasive

species is Dutch elm disease, which has destroyed a large portion of the North American elm tree population. Other prime examples of invasive species that have significant negative impacts on urban forests across North America include Emerald Ash Borer, Asian Long-horned Beetle, and Gypsy Moth.

Trees in urban areas can be more susceptible to the effects of pests and pathogens than trees in natural settings due to sub-optimal growing environments. The problem of minimizing urban forest pests and pathogens can be further compounded by management practices, such as insufficient management to promote urban tree health and vigour, 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.

Across North America, urban forests have been affected by a number of invaders. Today, the greatest threat to eastern North America's urban forests is the Emerald Ash Borer, which has the potential to eliminate virtually the entire ash tree population. In Cambridge, 7.5% of the City's street trees are at risk. The 2013 *Cambridge Urban Forest Canopy Assessment* estimated that approximately 4% of the City's entire urban forest canopy is ash, although subsequent analysis (i.e., street tree inventory, review of subwatershed studies – see Appendix B) suggests this figure is likely closer to 8%. Without adaptive planning and dedicated funding, this wide-scale pest infestation may affect Cambridge's ability to provide basic urban forestry services from 2015 to 2024, as available resources may need to be mobilized to address EAB-related tree mortality, treatments and other immediate management needs.

Tree-related Risk

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 vulnerabilities that predispose them towards higher likelihoods of component part or whole-tree failure. Risk is also relative to the presence of potential 'targets' of tree failure (i.e., people and/or property), and is therefore elevated in more densely populated urban environments. As municipalities bear the responsibility to manage municipally-owned trees according to a reasonable standard of care, the prospect of personal injury or property damage leading to possible action is magnified if urban tree risks cannot be appropriately mitigated. 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.

Land Use Change and Development

Cambridge is the second fastest growing city in Waterloo Region, with anticipated population growth of approximately 36% above 2011 levels by 2029 to 173,000 residents (Sec. 2.3 – *Cambridge Official Plan*, 2012). As both greenfield and infill housing developments proceed to accommodate this growth, along with upgrades and expansions to infrastructure, preservation of existing trees and long-term integration

of new trees into developed landscapes will become more challenging, and pressure on remaining natural areas will increase. In order to adapt to the realities of population growth and development while working towards the goals and objectives of urban forest sustainability, policies and regulations regarding new and infill development will need to be sufficiently robust to protect significant trees, while retaining enough flexibility to allow for project-specific solutions. Protecting existing trees and finding suitable, long-term locations for new trees will require careful planning and support from various City departments, landowners, and the community at large.

Climate Change

Climate change is expected to intensify periodic drought stress for trees and natural areas and to increase the frequency of other extreme weather events, such as ice and wind storms. 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 (Johnson, 2004; McKenney *et al.*, 2007).

Limited Resource Allocation

Urban forest management, planning and maintenance can be a costly undertaking, although the costs are often not considered in the context of the longer-term positive returns on investment. Currently, six Forestry Services staff and a $600,000 operating budget are committed to the maintenance of the urban forest – a green infrastructure asset worth at least $850 million in replacement value alone. 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 vital to keeping Cambridge a vibrant and livable community, with good governance, maintenance and due diligence over its urban forest assets.

Fragmented Ownership

The benefits provided by the urban forest are the aggregate effect of trees on public and private properties. In Cambridge, as in most Canadian communities, approximately 80% of the urban forest canopy is on private lands and owned by many individuals, institutions or agencies. The challenges of managing the urban forest do not stop at property boundaries, and many property owners may not be aware of or engaged in sustainable urban forest management and stewardship. Promoting stewardship of the privately owned urban forest requires a combination of good planning (including regulatory measures where appropriate) and a concerted effort to build awareness and encourage stewardship.

1.3.2 Responding to the Challenges – the Need for an Urban Forest Plan

A strategic Urban Forest Plan is an effective tool to ensure that that available municipal resources are efficiently directed, efforts are coordinated and cooperative, and existing and potential partnerships are leveraged so that the City's urban forest is established, managed and protected in such a way that it remains resilient to various stresses and sustained for generations to come.

The primary purpose of this Urban Forest Plan is to identify the most effective ways to achieve urban forest sustainability and improve the urban forest management program, with careful consideration for Cambridge's biophysical, land use and social context. The recommended actions (see Sections 3 and 4) are based upon achievable targets, are proportionate and consistent with the City's size and available resources, and their implementation will lead, over time, to marked improvements in the health and functioning of the City's urban forest.

2. Plan Framework and Direction

2.1 Urban Forest Plan Framework

The Cambridge Urban Forest Plan is based on a twenty-year planning horizon (2015 to 2034). This time frame will ensure that the critical components of the Plan, such as its vision, guiding principles, targets, and recommended actions, are carried forward to inform the implementation of the City's urban forest management program even as the technical aspects of urban forest management change or new challenges to urban forest sustainability arise. This time frame will also provide a realistic opportunity for the City and its partners to realize the Plan's vision.

2.1.1 Three-tiered Urban Forest Planning and Implementation

This strategic Urban Forest Plan is the top tier (Tier 1) of a broader urban forest planning and implementation framework, which is structured in three tiers and includes a built-in periodic review cycle. The three-tiered framework is described below and illustrated in Figure 6:

Tier 1: 20-year Strategic Direction (2015-2034)

- Identifies a long-term vision, guiding principles and strategic objectives
- Sets targets to be achieved in the 20-year period
    - Reviews current practices in Cambridge
- Considers best practices from technical and scientific literature
- Identifies opportunities to improve Cambridge's urban forest management practices and programs that are appropriate for the City's context and consistent with the long-term vision

Tier 2: Four 5-year Management Periods

- Links guiding principles and long-term objectives with daily practices and on-the-ground operations
- To be developed collaboratively by staff in various departments
- To be implemented by the appropriate departments
- To be linked to recommended budgets and current priorities but consistent with longer-term Urban Forest Plan vision and guiding principles
- To be reviewed and updated every 5th year of implementation and updated in response to new or changing objectives, implementation successes and shortcomings, and changes in conditions, resources and challenges/threats
- To remain consistent with the vision, principles and objectives of the Strategic Plan

Tier 3: Annual Operating Plans (AOP)

- For internal use to provide applied and specific guidance for day-to-day operations in a specific calendar year
- Includes operational plans for planting, pruning, removals, inspections, inventory maintenance and public engagement/outreach
- Considers budgets and current priorities, as well as the vision and objectives outlined in the Urban Forest Plan
- To be developed by Forestry and Horticulture manager with other department input as needed

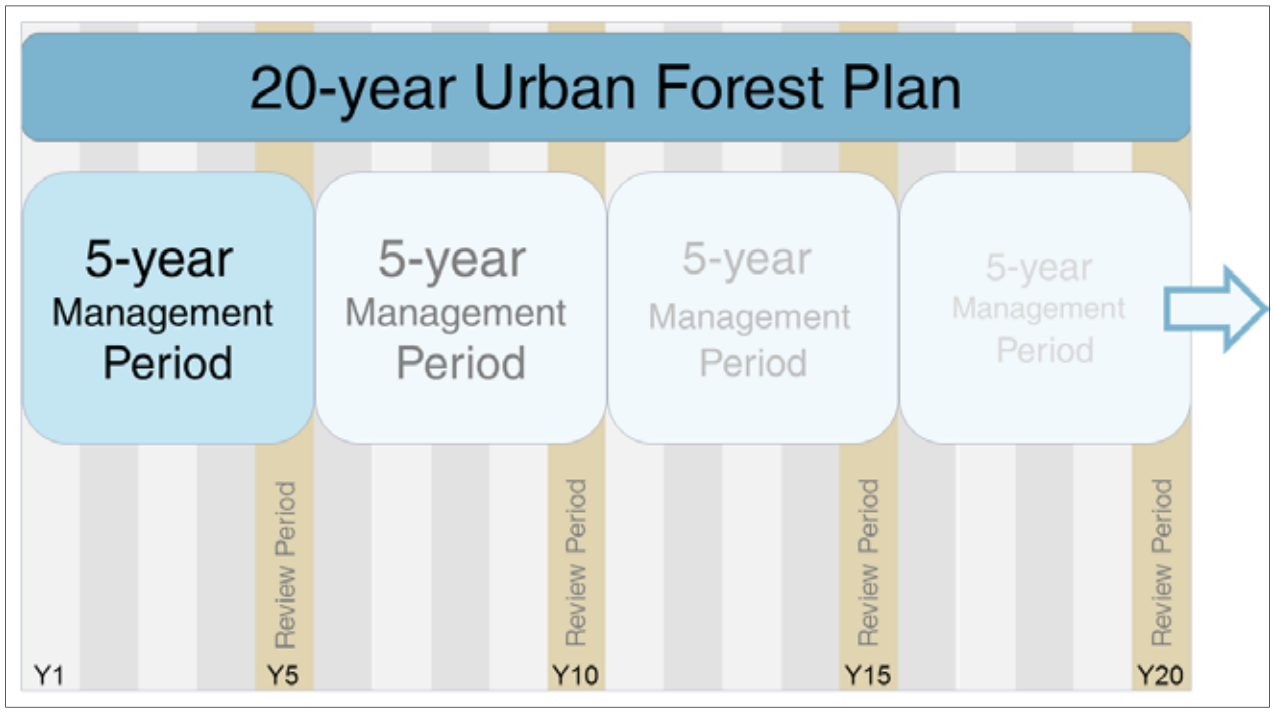


Figure 6: Three-tier urban forest planning and implementation framework

This Plan represents the Tier 1 level and provides City staff with the guidance to develop more detailed 5-year Management Plans and Annual Operating Plans. This Plan also provides implementation guidance for all recommended actions and anticipated resource requirements for the first ten years.

2.1.2 Plan Content and Structure

The Vision, Guiding Principles and Strategic Objectives for this 20-year Plan are presented in Section 2.2 through 2.4, followed by the recommended mechanisms for Plan review and monitoring in Section 2.5. In Section 3, the Urban Forest Plan addresses the key urban forest issues in Cambridge under four key topic areas, including:

- **The Urban Forest as a Shared Asset,** which considers interdepartmental coordination, internal and external information sharing, and stakeholder partnerships
- **Planning for the Urban Forest**, which examines relevant legislation, policies and guidelines and explores how planning tools can promote urban forest sustainability
- **Managing the Urban Forest,** which considers the management of urban forest health, implementation of tree maintenance, and risk management, and
- **Outreach and Stewardship,** which identifies opportunities for promotion of the urban forest, community and stakeholder engagement, and stewardship.

For each of the four topic areas, the Plan summarizes:

- The **Current Status** of practices and policies implemented by the City
- **Best Management Practices and Precedents** from the technical and scientific literature, and from comparable municipalities in southern Ontario and beyond
- **Opportunities for Improvement** of the urban forest management program, based on a 'gap analysis' considering current and best practices, and focusing on actions that are practical and cost-effective, and
- **Recommended Actions** developed based on consideration for identified opportunities for improvement under each topic area, and on extensive consultation with City staff and stakeholders.

The Plan also includes a **Conclusion and Implementation** section (Section 4) that:

- highlights priorities for the next ten years and the need to implement this Plan to support the long-term sustainability of Cambridge's urban forest, and
- includes a comprehensive implementation table that lists the recommended actions and provides associated recommended timing, anticipated resource requirements (for the first ten years of the Plan), and responsibilities and guidance for implementation.

2.2 Vision

The vision for Cambridge's urban forest, which is to be realized through the implementation of the actions recommended in this Urban Forest Plan by the end of the twenty-year planning horizon, is:

> ***The City, stakeholders, and members of the community work together to protect, maintain, restore, enhance and expand the urban forest to provide the valuable environmental, economic, and social benefits recognized as essential for a healthy and liveable community.***

This vision has been developed with input from City staff, agencies and other key stakeholders, and members of the community that have participated in the consultation process for this Plan. The Urban Forest Plan will be considered successful if various urban forest stakeholders can agree that today's vision, when read in 2034, accurately represents the state of the urban forest at that time.

2.3 Guiding Principles

The following principles have guided the development of the Urban Forest Plan, and are also intended to guide the implementation of the City's urban forest management program throughout the 20-year planning horizon:

1. **Engage the community to maximize the provision of urban forest provides benefits and services:** Most of the urban forest is found on private property in the city. Regardless of where they are located, trees provide important environmental, economic and social (including human health) benefits for all residents of, and visitors to, the City of Cambridge. Therefore, it is critical to engage all sectors of the community in supporting municipally-led urban forest initiatives, and undertaking urban forest initiatives themselves.

2. **Recognize the urban forest as a valued municipal asset:** Trees are immensely valuable assets that provide, among other things, services complementary to conventional constructed infrastructure. The urban forest should be recognized as a network of low-cost, renewable infrastructure components that are vital to the maintenance of a liveable and healthy community, and should be given the same consideration as conventional infrastructure and other municipal assets in planning, maintenance and development.

3. **Place more value on the establishment and protection of large-statured trees:** Large-statured shade trees provide exponentially more benefits and ecosystem services than smaller trees. Mature, healthy trees take many years to establish themselves, and many years to replace. In an urban environment, providing such trees with an opportunity to establish and reach their full genetic potential means starting with good quality nursery stock, provision of adequate above and below-ground growing space, and post-planting care. Policies, guidelines and regulations, along with outreach and education, should ensure that these investments and assets are given a high priority.

4. **Increase knowledge to improve urban forest management:** Managing an urban forest is difficult without comprehensive and current knowledge about its extent, structure, composition, and other factors. A fundamental component of the urban forest management program must include ongoing collection, analysis, refinement and updating of information, such as a street and park tree inventory and canopy cover assessment.

5. **Lead by example, learn from others and build on existing partnerships:** The City is the largest single steward and owner of the urban forest canopy in Cambridge and its actions set an example to inform and inspire other urban forest stewards. Therefore, the City should strive to be innovative, continue to learn from neighbouring municipalities and best practices, and lead by example in all aspects of urban forest management. Collaboration, information exchange and ongoing partnerships among all urban forest stewards will ensure the effective protection, care and renewal of the urban forest across the entire community.

6. **Grow the urban forest through more than tree planting:** Ongoing tree planting to support urban forest expansion (i.e., planting more trees than are removed) through operations and volunteer stewardship is an important part of a comprehensive urban forest program. However, planting must be supported by other measures such as post-planting maintenance, planning and development policies, incentive programs, partnerships and other means of increasing tree establishment and urban forest renewal on lands it does not own. In addition, the presence of suitable conditions (such as soil volumes and overhead space), should complement tree planting so that trees are able to reach maturity under urban conditions and maximize the provision of benefits.

7. **Ensure the strategic Urban Forest Plan and management and operating plans relate to other City plans and are a primary consideration for all municipal planning and management that relate to the urban forest:** It is important take a multi-disciplinary approach to urban forest planning and management if all potential opportunities for integration of trees into the urban environment are to be realized. For example, the City and its partners have developed and are implementing several environmental and strategic plans and studies, such as the *GHG Reduction (Energy Management) Plan* (2013), in which trees play a significant role. The Urban Forest Plan should support and complement City plans and policies wherever appropriate, and the Urban Forest Plan should also be a primary consideration for future environmental and management planning.

2.4 Objectives and Targets

2.4.1 Strategic Objectives

Through the development and implementation of the Urban Forest Plan over its 20-year planning horizon, the City of Cambridge seeks to achieve the following strategic objectives:

1. Ensure that **adequate human, capital and operational resources** are allocated to urban forest management, planning and monitoring to meet the targets identified in this Plan.

2. **Increase the proportion of urban forest management that is undertaken in a proactive manner** and reduce the amount of reactive management required.

3. **Increase urban forest biological diversity with more indigenous tree species and fewer invasive species** in order to improve urban forest resilience to urban forest stressors such as climate change, pests and diseases, and difficult growing conditions.

4. Recognize the urban forest as a key asset for ensuring community health and well-being by **creating and implementing policies, regulations and procedures that support urban forest protection and enhancement**.

5. **Build awareness and engagement** among City staff and public and private stakeholders, including residents, about the importance and value of the urban forest, the City's efforts to sustain this resource, and the benefits of stewardship on private lands.

6. **Increase and improve knowledge** about the condition, extent, function and value of the urban forest on an ongoing basis to support effective and adaptive management.

2.4.2 Targets

This Urban Forest Plan recognizes that urban forest sustainability requires a coordinated and multi-disciplinary approach that addresses: (1) planning for treed assets, (2) engagement of the community and other stakeholders, and (3) on-the-ground maintenance and management of treed assets. Therefore, the Plan has adopted a series of 25 Criteria that have been developed specifically to assess progress towards urban forest sustainability. For each of these criteria there are four categories of indicators (Low, Moderate, Good and Optimal) to assess the City's performance level and establish targets for improvement.

This framework of Criteria and Indicators was originally developed by Clark *et al.*, (1997) and was recently refined by Kenney *et al.*, (2011) to make it more readily adopted for monitoring and evaluating the status of municipal urban forest planning and management.

The Criteria and Indicators framework can be used to assess the community's status in three key areas: (1) Community Framework, (2) Resource Management Approach and (3) Vegetation Resource.

The City has completed a "baseline" assessment (see Appendix A) that assesses current performance relative to the 25 Criteria. This baseline assessment indicates that the City of Cambridge's current performance is "low" or "moderate" for 15 of the Criteria, and "good" or "optimal" for 10 Criteria. **The overall target over the period of this Plan is for the City to achieve a "good" or "optimal" performance assessment for each of the 25 criteria for Strategic Urban Forest Planning and Management.**

Canopy Cover Target

The 2013 *Cambridge Urban Forest Canopy Assessment* found that the city's maximum Potential Urban Forest Canopy Cover, which includes the existing canopy (of 27%) and total Possible Planting Area (PPA) (of 25%), is 52%. To achieve this extent of canopy cover, every available plantable space in the city would need to be planted and covered by tree canopy, and no loss of existing canopy could occur.

Given anticipated population growth and urban development, numerous tree health stressors, and the need or desire to maintain some open spaces, achieving full potential urban forest canopy cover is not a realistic objective. Given numerous urban forest challenges and stressors, even maintaining the existing cover of 27% represents a challenge. Maintaining and increasing tree canopy cover is not simply a matter of protecting existing trees and planting new trees - it requires a comprehensive approach to urban forest management that considers all activities affecting trees.

For these reasons, *the Urban Forest Plan establishes a canopy cover target of 30% by 2034*, which is considered achievable over the implementation period. Although a 3% increase above existing canopy cover could be considered modest, it is estimated that approximately 128,000 new caliper-size trees will need to be planted and successfully established by 2034 to achieve this target. In other terms, a 3% increase in canopy cover will require an additional 340 ha to be fully covered in mature tree canopy - an area equivalent to about 630 football fields.

This target for canopy cover has been included as one of 25 Criteria within a comprehensive monitoring and assessment framework adopted for this Plan and intended to guide the City towards urban forest sustainability (see Appendix 1).

2.5 Monitoring and Adaptive Management

Forested ecosystems are complex and dynamic entities, particularly with the addition of a human element. Urban forest managers cannot easily predict the changes or events, such as severe weather, pest infestations, or changes to resource allocation priorities, which may impact the ability to achieve urban forest sustainability. For this reason, the concept of active adaptive management is firmly embedded in the Urban Forest Plan.

Adaptive management requires that a problem or issue be carefully assessed and understood before a strategy to solve it can be designed and implemented. The outcomes of the initial strategy are then monitored in a systematic manner, and any required adjustments are made based upon experience gained and new information collected. The adjusted approach is implemented and the evaluation cycle continues for as long as is necessary to accomplish the desired goals and/or to accommodate changing environmental, social or policy directions.

What is Active Adaptive Management?

Adaptive management is "a systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, management is treated as a deliberate experiment for the purpose of learning."

United Nations Millennium Ecosystem Assessment, 2005

Active adaptive management will be implemented concurrently through two key processes over the course of the 20-year Urban Forest Plan horizon and beyond, as follows: 1) periodic Plan review and updating and 2) assessment of the 25 Criteria and Indicators for strategic urban forest planning and management (see Section 2.4.1 and Appendix A). Typically this review should be undertaken once every five years in accordance with the Plan framework (see Figure 6), but may be done more frequently in response to new circumstances or if otherwise required.

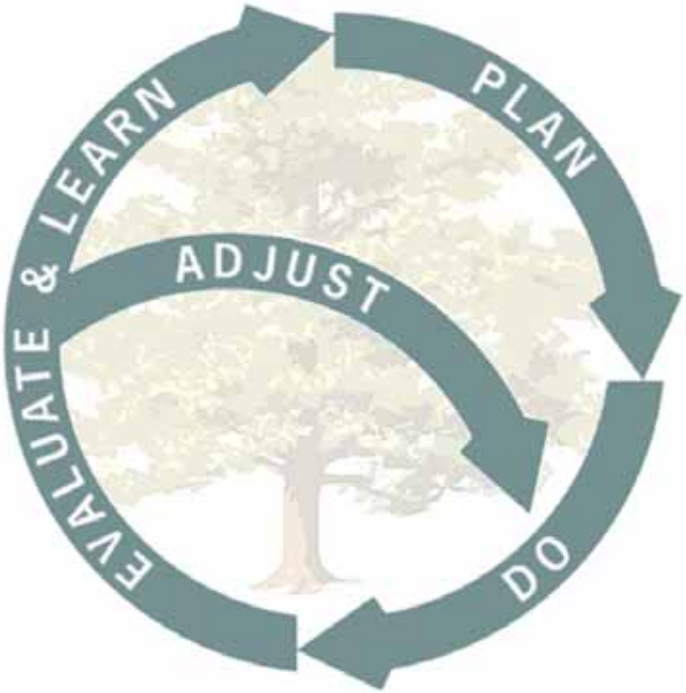


Figure 7: The active adaptive management process for urban forest management.

2.5.1 Plan Review and Monitoring

In order to remain effective as a guide for urban forest management in Cambridge, the Urban Forest Plan must be periodically reviewed and, if necessary, updated and adapted. As such, mechanisms for review are built into the strategy through the three-tiered framework (as described in Section 2.1.1). In keeping with the principle of active adaptive management, the successes and shortcomings experienced during each five-year management period should be formally reviewed and findings should be incorporated into the subsequent management period. This review should be undertaken every fifth year by a City urban forestry working group. The review process should include a review of the status, timing and anticipated budgetary requirements of each action of the strategic plan, as well as a review of the Criteria and Indicators for strategic urban forest planning and management (see Section 2.4.2 and Appendix A for the baseline assessment of Criteria and Indicators).

The review process is intended to:

- inform City staff responsible for and involved in implementation of the Plan about where progress is or is not being made related to implementation the recommended actions;
- provide an opportunity to refine or revise the next five-year management plan in response to the review as well as changes in the condition of the asset, available resources for urban forest initiatives, and / or community priorities; and
- provide an opportunity to engage Council and the public about urban forestry issues by providing an update on the status of the Plan and its related targets.

Recommended Action: Plan Review and Monitoring

1. Undertake a comprehensive review of the Urban Forest Plan and report to Council.

Implementation Notes: A review of the status of Plan recommendations and progress towards achievement of Good or Optimal Indicator rankings for each of the 25 Criteria should be undertaken before the end of each five-year management period. This review should inform City staff responsible for and involved in implementation of the Plan, provide an opportunity for refining or revising the next five-year management plan, and provide an opportunity to engage Council and the public.

Mature trees line a serene Blenheim Rd. in Galt. June 2004. Credit: Cambridge Living Gallery/Cambridge Photo Gallery.

3. Current Practices, Opportunities for Improvement and Recommended Actions

3.1 The Urban Forest as a Shared Asset

3.1.1 Interdepartmental Coordination and Information Sharing

Current Practices: Interdepartmental Coordination and Information Sharing

The City of Cambridge is currently divided into departments, each with a number of divisions, which provide a wide range of services. Every City department has some connection to urban forest issues. The Community Services, Planning & Development, and Transportation & Public Works Departments have a relatively high level of involvement in multiple tree and urban forest issues

Interdepartmental (and inter-agency) roles and coordination are key to healthy trees and the urban forest. This photo shows Public Works leaf pickup along a mature treed street (for stormwater management reasons) as well as a hydro pole (and the importance of pruning for continuation of service) as well as maintaining streetscape aesthetics that increase property values and other urban forest benefits detailed in the Cambridge Urban Forest Canopy Assessment.

Credit: Cambridge Photo Gallery

Best Practices and Precedents: Interdepartmental Coordination and Information Sharing

Planning and managing the urban forest requires a multi-departmental and multi-disciplinary approach. Targeted interdepartmental coordination and information sharing around urban forestry within municipalities can be used to:

- keep Directors and Managers informed and on-board with approved plans and projects
- enable consideration for trees in the early stages of planning (for both private and public projects) to help ensure opportunities for tree protection and/or planting are identified, and
- keep staff in various departments and at all levels informed about current policies, by-laws, guidelines and practices so that these can be implemented in a consistent manner.

Many southern Ontario municipalities actively working to become more proactive about their urban forestry practices (e.g., Ajax, Mississauga, Milton, Oakville, Guelph) have developed internal multi-departmental groups of key staff who regularly work with trees that meet to share information and identify ways to improve municipal processes.

Opportunities for Improvement: Interdepartmental Coordination and Information Sharing

In Cambridge, creation of an internal "Urban Forest Group" that includes key staff from Community Services, Planning & Development, and Transportation & Public Works would help ensure improved interdepartmental coordination, provide a mechanism for the identification and collaborative resolution of urban forest-related issues, facilitate transfer of knowledge, and help ensure consistent application of municipal standards and adherence to policies. This group should meet on a regular basis, include individuals from other departments on an as-needed basis, and liaise with appropriate individuals from government agencies (e.g., Region of Waterloo, GRCA, Ministry of Transportation) or other organizations (e.g., Cambridge and North Dumfries Hydro Inc.) as needed. For example, the City has recently (Summer 2014) completed a street tree inventory that, among other things, identified high risk trees as priorities for management. This committee could be a mechanism for sharing this information with Cambridge and North Dumfries Hydro Inc., and helping the utility company to undertake proactive maintenance to reduce the risk some trees may pose to electrical service delivery.

Recommended Action: Interdepartmental Coordination and Information Sharing

2. Create an internal "Urban Forest Group" that includes key City staff involved in work related to trees.

Implementation Notes: The group should be led by the City's Manager of Forestry and Horticulture, include staff from Community Services, Planning and & Development, and Transportation & Public Works, meet regularly, and liaise with staff from other departments, agencies or organizations as needed.

3.1.2 External Coordination and Information Sharing

Current Practices: External Coordination and Information Sharing

In addition to private landowners and businesses on whose lands the majority (about 80%) of the city's urban forest is found, there are a number of governmental agencies and other organizations whose activities directly and indirectly impact the urban forest. Such organizations include the Region of Waterloo, the Grand River Conservation Authority (GRCA), Cambridge and North Dumfries Hydro Inc., the Waterloo Region and Waterloo Catholic District School Boards, and various community groups.

The City of Cambridge is fortunate to have a number of dedicated volunteers who are knowledgeable about trees and active in urban forest stewardship. The City also has been building connections with the Region's Public Health Department and school boards to develop and implement policies and practices supportive of providing more shade, particularly in school yards and public play areas, as well as along active transportation routes.

Best Practices and Precedents: External Coordination and Information Sharing

Municipalities working to implement more proactive urban forestry practices and programs generally try to coordinate with local hydro providers, as well as other utility companies and external agencies that can impact trees. These include the upper tier municipality (where applicable), local conservation authorities, and Ministry of Transportation (typically as part of provincial road Environmental Assessments).

An arm's-length advisory or technical steering committee composed of knowledgeable community members and stakeholders can help to implement some aspects of urban forest planning and management. For example, the City of London has a Trees and Forests Advisory Committee (TFAC) that meets monthly. The TFAC provides input to the City's urban forest policies and management plans, and also includes members who play key roles in coordinating and implementing volunteer stewardship activities that enhance and expand the urban forest.

Information sharing between forestry staff in different municipalities can also help inform and guide practices, and in the case of adjacent municipalities and pest management, inter-municipal coordination can be essential to the implementation of successful management approaches. In the Region of Peel, the area municipalities of Caledon, Brampton and Mississauga sit on a joint Urban Forest Working Group, along with the two local conservation authorities. This group both shares information and works to advance shared urban forest issues and projects, such as the Region-wide Priority Planting Index or Urban Forest Study.

Additional examples of external partnerships that relate to stewardship are identified in Section 3.4.3.

Opportunities for Improvement: External Coordination and Information Sharing

Based on consideration for current activities, there appears to be an opportunity for improving external partnerships in support of the urban forest by establishing an Urban Forest Plan Steering Committee composed of appropriate staff from the City, Region, GRCA, school boards, local businesses, active community groups, and members of the public. This committee could be a standing committee the City's Environmental Advisory Committee.

This committee would be responsible for: (a) facilitating information sharing between these different organizations and groups involved in various aspects of urban forest management, (b) engaging residents and businesses to participate in supporting the Plan through their own initiatives, (c) helping to implement this Plan (e.g., by seeking joint funding for projects, undertaking projects, etc.), and (d) providing a forum for information sharing on forestry topics among Forestry staff in the Region's other area municipalities and municipalities in nearby jurisdictions.

Recommended Actions: External Coordination and Information Sharing

3. Establish and coordinate an "Urban Forest Plan Steering Committee".

Implementation Notes: To be composed of appropriate individuals from the Region, City, GRCA, school boards, local businesses, community groups, and members of the public. To meet as a standing subcommitee of the Cambridge Environmental Advisory Committee in order to facilitate (a) information sharing with partners, (b) engaging residents and businesses to support the Plan through their own initiatives, (c) implementation of this Plan, and (d) information sharing among Forestry staff in the Region's other area municipalities and municipalities in nearby jurisdictions.

3.1.3 Leveraging Partnerships and Funding

Current Practices: Leveraging Partnerships and Funding

Over the past decade, Cambridge has been quite successful at leveraging partnerships and funding to both promote the urban forest and help support stewardship initiatives. The City also maintains some resources for disaster management and a dedicated account for natural heritage donations. However, the City currently lacks a mechanism to specifically collect and allocate dedicated funds to support tree-related storm response on City lands, or to support tree planting (and related maintenance) on private lands.

Partnerships

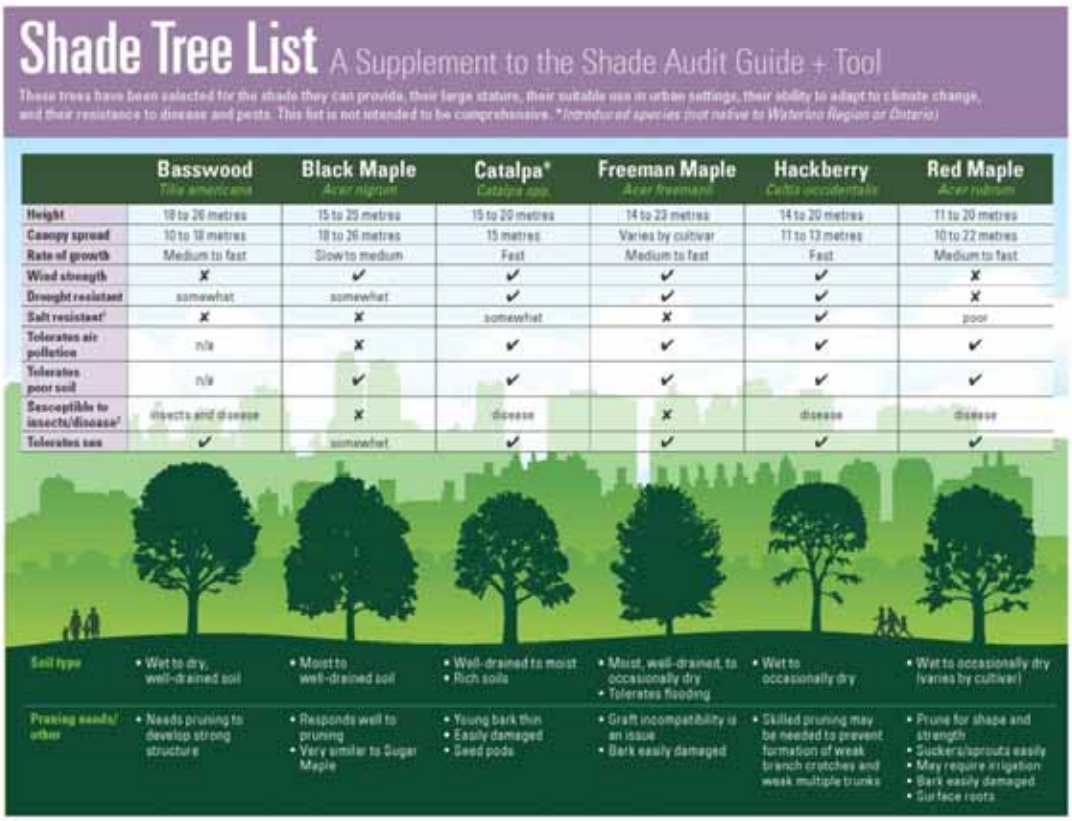
Some examples of successful funding partnerships include:

- In 2005 a Cambridge Natural Heritage Tour user-friendly colour map and booklet were produced by Cambridge's Environmental Advisory Committee (CEAC) with the support of a TD Friends of the Environment and Ages Foundation grant. This map and booklet highlight a number of notable woodlands in the city including: portions of Shade's Mills Conservation Area, Portuguese Swamp and

Hilborn Knoll, the oak-pine woodland in A. Wayne Taylor Park, Scheidel Woodlot, portions of Forbes Creek Headwaters, Boxwood Woodlot, portions of Riverside Park, and portions of Victoria Park.

- In 2007, Cambridge City Green, a subcommittee of CEAC, together with the City, created the Cambridge Stewardship project, which works with dozens of community partners from various sectors with funding from a variety of sources (e.g., TD Friends of the Environment, Evergreen, Waterloo Stewardship Network, Cambridge and North Dumfries Community Foundation / Ages Foundation, and Tree Canada's Edible Tree Program) to plant more than 9,000 trees and many shrubs and wildflowers. Partners have included local businesses, community groups, governmental and non-governmental organizations, Committees to Council, and schools.

- Recently, the City has been working with the Shade Work Group of Waterloo Region (which includes staff from Region of Waterloo Public Health and Emergency Services, Region of Waterloo Planning, Development and Legislative Services, City of Cambridge, City of Kitchener, the non-profit organization Evergreen, and a community representative.) The group to date has developed a Shade Audit Information Guide + Tool and Shade Tree List, and has worked to incorporate shade-supportive policies in local Official Plans and school board sun protection policies. It also hosts an annual Shade Forum that is attended by local Councillors, area municipal and Regional staff, school board staff, residents, and representatives from local landscaping and tree businesses.



Shade Tree List A Supplement to the Shade Audit Guide + Tool

These trees have been selected for the shade they can provide, their large stature, their suitable use in urban settings, their ability to adapt to climate change, and their resistance to disease and pests. This list is not intended to be comprehensive. **Introduced species (not native to Waterloo Region or Ontario)*

	Basswood *Tilia americana*	Black Maple *Acer nigrum*	Catalpa* *Catalpa spp.*	Freeman Maple *Acer freemanii*	Hackberry *Celtis occidentalis*	Red Maple *Acer rubrum*
Height	18 to 26 metres	15 to 25 metres	15 to 20 metres	14 to 23 metres	14 to 20 metres	11 to 20 metres
Canopy spread	10 to 18 metres	18 to 26 metres	15 metres	Varies by cultivar	11 to 13 metres	10 to 22 metres
Rate of growth	Medium to fast	Slow to medium	Fast	Medium to fast	Fast	Medium to fast
Wind strength	✘	✔	✔	✔	✔	✘
Drought resistant	somewhat	somewhat	✔	✔	✔	✘
Salt resistant[1]	✘	✘	somewhat	✘	✔	poor
Tolerates air pollution	n/a	✘	✔	✔	✔	✔
Tolerates poor soil	n/a	✔	✔	✔	✔	✔
Susceptible to insects/disease[2]	insects and disease	✘	disease	✘	disease	disease
Tolerates sun	✔	somewhat	✔	✔	✔	✔
Soil type	• Wet to dry, well-drained soil	• Moist to well-drained soil	• Well-drained to moist • Rich soils	• Moist, well-drained, to occasionally dry • Tolerates flooding	• Wet to occasionally dry	• Wet to occasionally dry (varies by cultivar)
Pruning needs/ other	• Needs pruning to develop strong structure	• Responds well to pruning • Very similar to Sugar Maple	• Young bark thin • Easily damaged • Seed pods	• Graft incompatibility is an issue • Bark easily damaged	• Skilled pruning may be needed to prevent formation of weak branch crotches and weak multiple trunks	• Prune for shape and strength • Suckers/sprouts easily • May require irrigation • Bark easily damaged • Surface roots

Figure 8: Page from the recommended shade tree guide developed by the Waterloo Region Shade Work Group.

Two key partners that the City collaborates with regularly on planning and other areas of service are the Region and the GRCA. The GRCA currently plants about 250,000 saplings across its jurisdiction annually, with many of these native trees coming from its nursery in Burford. The Region is responsible for the maintenance, removal and planting of all trees on regional roads. The Region also undertakes some limited management in the three Regional Forests within Cambridge, while the GRCA does the same within portions of it conservation areas.

Funding Mechanisms

The City does not currently have any mechanisms in place to collect funds specifically for tree-related storm response on City property, or tree planting (and related maintenance) on private lands. However, the City does have a Natural Heritage Trust Fund (NHTF) as a result of the CEAC goal to provide the community with a way to make financial contributions for the purpose of purchasing and maintaining local natural areas. Securement of natural areas through their purchase, and subsequent stewardship and maintenance, is recognized as a valuable tool in the long-term protection of natural areas, especially in urban settings. The Fund contains less than $20,000 at the present time and has never been used.

The Region of Waterloo Community Environmental Fund can also be accessed to purchase lands (woodlands or forested areas in the case of implementing the Urban Forest Plan) and could be used to leverage the NHTF. Given the relatively small amounts available from both of the above funds for the acquisition of lands, only undevelopable flood plain lands would likely ever be acquired, but these could be afforested to work toward canopy or other targets.

To date, limited effort has been committed by the City to soliciting support and funding from higher levels of government, in part because the provincial and federal governments have failed to recognize municipal urban forestry as a priority. With the advent of serious pests (e.g., Asian Long-horned Beetle, Emerald Ash Borer) that pose significant threats to urban forests (and forests in general) across southern Ontario and the growth of groups such as the Green Infrastructure Coalition, this is beginning to change. For example, the 2014 Provincial Policy Statement introduced a new policy for planning authorities to promote “green infrastructure” which is defined to include urban forests.

Large storm events (e.g., infrequent ice storms, annual summer storms) and pest infestations are currently addressed through the capital budget (e.g., contractors for emergency clean up) and operating budget (i.e., staff diverted to storm response). In special circumstances, the Province may provide funding (e.g., for the December 2013 -2014 ice storm response), but no such funding has been extended to deal with the Emerald Ash Borer (EAB). The current practice, as proposed in the capital budget and related operating budget, is to fund major urban forest challenges as a growth item (i.e., increased taxes) that is evaluated and competes against other City priorities on an annual and long-term basis.

Best Practices and Precedents: Leveraging Partnerships and Funding

Partnerships

There are a number of funding opportunities available either directly, or indirectly, to municipalities to support urban forest management and enhancement. Most of these are community-oriented and require partnerships with established non-profit groups, local schools, community groups, or businesses. A summary of available funding sources is provided in Appendix C. As indicated above, the City of Cambridge is aware of some of these and has already been quite successful in leveraging some of these opportunities for natural heritage and tree planting initiatives.

Increasingly, initiatives that benefit the urban forest are being pursued under the broader umbrellas of community health and sustainability, as well as climate change mitigation and adaptation. The efforts Cambridge has made with the Shade Work Group of Waterloo Region are comparable to the work done by the Shade Policy Committee of the Toronto Cancer Prevention Coalition in collaboration with Toronto's Parks, Forestry and Recreation Department with the support of Toronto Public Health. A similar initiative has been undertaken in Durham Region where the Health Department works with local area municipalities to promote the benefits of shade, including shade provided by trees.

Funding Mechanisms

Several municipalities with progressive urban forest management programs have established internal mechanisms for sustaining selected urban forestry activities. In 2012, following Council approval of its Urban Forest Management Plan, the City of Guelph established a "Greening Guelph Donation Program" for private individuals, with all funds being dedicated to supplementing ongoing tree planting initiatives. Many municipalities also account for disaster relief as part of their reserve funding.

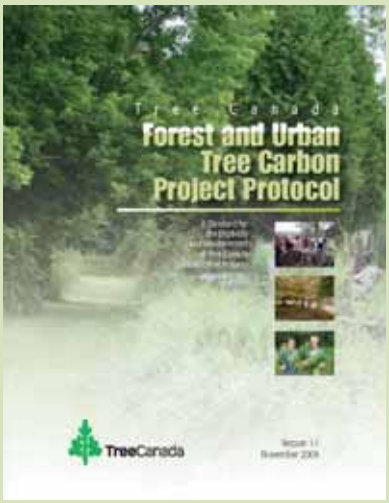
The Canadian Federation of Municipalities has a "Green Municipal Fund" that offers grants to cover up to 50% of eligible costs to a maximum of $175,000, as well as loans, to support selected "green" plans and feasibility studies.

Although there currently are no well-established mechanisms for such small-scale carbon credit trading in Ontario or Canada, the concept of carbon or GHG emission offsets has gained interest nationally and internationally in recent years. Two options potentially available to the City are described below. Both options could provide funding for tree planting projects, but would require some resources for the initial application and subsequent documentation of the project(s). Such projects typically require a commitment that the tree plantings are to be long-term, that the activities are in addition to what would normally be occurring, and third-party verification.

- Tree Canada has developed a Carbon Credit Standard for Urban Tree Planting Projects (cover, below). It is anticipated that the City would be the Landowner, Tree Canada would be the Project Proponent and a Funding Partner (business or organization) would provide the funds to implement a

tree planting program and in return would receive the carbon credits. Tree Canada has completed a successful project with TD Bank and the Muncee-Delaware Nation, near London.

- Another option is to develop a tree planting program in accordance with the ISO 14064-2 standard, which provides specifications at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements. After implementation, the carbon reductions gained through urban tree planting would have to be verified by an accredited third-party ISO 14064-2 verifier. The verified emission reduction credits could then be sold through a carbon credit retailer. An example of this type of arrangement is the Community Ecosystem Restoration Project in the District of Maple Ridge, B.C.



Seeking funding and resource support from both the provincial and federal governments for municipally-based urban forestry is a priority for an increasing number of lower and upper tier municipalities as they struggle to address serious urban forest pests and work to maintain and enhance their green infrastructure. The Peel Urban Forest Strategy (2009) identifies this as one of the top action items and members of Ontario's Green Infrastructure Coalition are actively soliciting the provincial government for this kind of support.

Opportunities for Improvement: Leveraging Partnerships and Funding

Over the past decade, the City of Cambridge has become increasingly active and successful at pursuing funding to support initiatives related to tree planting and promoting the benefits of trees in concert with other partners at the local and Regional level. These efforts and activities can be built upon and expanded if the City is to maintain and increase its current canopy cover over the next two decades (per the targets identified in Section 2.4.2).

Partnerships

These should include:

- Continuing to support and work with a range of local community groups, schools, and non-profit organizations to pursue funding for tree planting projects. Note the list provided in Appendix C is current to November 2014 but should be updated periodically over the course of this Plan
- Pursuing carbon credit programs with interested local businesses through the Trees Canada program (see in Appendix C)
- Exploring the possibility of establishing a longer-term, in-store native tree / shrub program with Local Enhancement and Appreciation of Forests (LEAF) through local nurseries; and

- Continuing to work with Regional partners through mechanisms such as the Shade Work Group, and explore other potential partnerships (e.g. for shading local and regional roads) to support and contribute to the development of resources and guidelines that support urban forest objectives.

Funding Mechanisms

The City of Cambridge should also:

- Explore additional areas of support for urban forest planning, management and / or monitoring that may be available from the Region and GRCA through ongoing initiatives related to active transportation, climate change / sustainability, and / or human health
- Work with the Region and other area municipalities (potentially through the Urban Forest Plan Steering Committee recommended above) to solicit direct financial support from the provincial and/or federal governments for green infrastructure and/or municipally-based urban forest activities which help ensure more livable and sustainable communities; and
- Identify mechanisms for setting aside dedicated funding for (a) a tree-related disaster relief on public lands, and (b) tree planting (and related maintenance) on private lands. The reserve fund would be dedicated to tree-related management of disaster response and mitigation in response to events such as ice storms, future invasive species or tree pests / diseases, and summer storm damage). A "tree planting account" could be supported by funds arising from tree compensation (e.g., where cash-in-lieu is provided by development proponents where trees removed can't be replaced on site), donations and partnerships. These funds would be exclusively dedicated to tree planting initiatives, primarily on private lands, as well as related young tree maintenance.

While the Region and GRCA already provide some support for the City's urban forest program, as described above, Federal and Provincial support for trees and other municipal green infrastructure continues to be limited, despite the immense value of these assets. The City of Cambridge (along with the Association of Municipalities of Ontario and the Federation of Canadian Municipalities) should build on the work of the Green Infrastructure Ontario Coalition and advocate for provincial and federal support for green infrastructure, and in particular for urban forest management. Despite greater awareness about the importance of the urban forest, grey infrastructure continues to be relatively well-funded (e.g., the gas tax to support road building and maintenance), while green infrastructure funding from higher levels of government is limited.

Recommended Actions: Leveraging Partnerships and Funding

4. Build and expand partnerships for securing funding from a range of sources to sustain urban forest stewardship projects across the City.

Implementation Notes: Pursue these partnerships with local community groups, local schools, businesses, and non-profit organizations to engage a range of community sectors, land uses, and geographic areas in the City. Acknowledge the contributions and successes of these partners (e.g., through letters and/or plaques, on the City's website, possibly through awards for special or large partnerships). Create a part or full-time position in the City to help pursue, promote, develop and expand such partnerships and to help implement and monitor related stewardship activities.

5. ***Explore opportunities for direct and indirect support for municipally-led or supported urban forest activities from the GRCA, Region, Province and federal government.***

   Implementation Notes: Explore opportunities for supporting urban forest initiatives in Cambridge through GRCA and/or regional initiatives related to human health (e.g., shade), active transportation, climate change / community sustainability, and broader forest monitoring. Coordinate with other upper and lower tier municipalities within and outside the Region to send a strong, unified message to the provincial and federal governments that this issue is a priority, including advocating for provincial and federal funds through the Association of Municipalities of Ontario and the Federation of Canadian Municipalities.

6. ***Establish mechanisms for dedicated funding for urban forestry in the form of: (a) a reserve fund for tree-related disaster response on City lands and (b) a "tree account" to support tree planting and young tree maintenance.***

   Implementation Notes: The reserve fund would be dedicated to tree-related management of disaster response and mitigation in response to events such as ice storms, future invasive species or tree pests / diseases, and summer storm damage. A "tree planting account" could be supported by funds arising from tree compensation (e.g., where cash-in-lieu is provided by proponents where trees removed can't be replaced on site), donations and partnerships.

Autumn arrives in a Cambridge park. Credit: S. Jobber.

3.2 Planning for the Urban Forest

3.2.1 Official Plan Direction

Current Practices: Official Plan Direction

The Region of Waterloo's updated Official Plan (2010)[2] includes a number of objectives and policies in Chapter 7 (The Greenlands Network) that are relevant to Cambridge's urban forest, and that illustrate the Region's intent with respect to different categories of treed assets within its jurisdiction. Key objectives and policies are as follows:

- Objective 7. 5: *"Increase forest cover in appropriate locations to achieve an overall target of 30 per cent or more of the region's total land area".*
- Policy 7.A.2 requires area municipalities to designate and zone what are considered the most significant natural heritage features and areas in the Region, generally prohibit development within those features / areas, and require a minimum of 10 m naturalized buffer between these features / areas and other land uses. These include a number of features and areas that are or could be treed in whole or in part (i.e., Landscape Level Systems - including Blair-Bechtel-Cruickston Environmentally Sensitive Landscape (ESL) which extends into Cambridge's west side, and the Speed and Grand River corridors; and Core Environmental Features - including significant woodlands, significant wetlands, Environmentally Sensitive Policy Areas (ESPAs), habitat for endangered and threatened species, and significant valleys).
- Policy 7.A.3 also encourages area municipalities to identify and designate other supporting natural heritage features and areas (such as ecological linkages).
- Policy 7.C.6 defines "significant" woodlands as areas that are at least 4 ha, consist primarily of native trees, and qualify as "woodlands" according to the Region's definition.
- Section 7.I includes several policies that support woodland management on both public and private lands, require area municipalities to "*consider the importance of woodlands during the development review process*", and commits the Region to providing advice on land stewardship in partnership with the Province, GRCA and area municipalities.

The City of Cambridge's *Official Plan* (2012) builds upon the direction provided by the Region's Official Plan with respect to woodlands and wooded areas, and provides additional policy direction targeted at treed areas both within and outside of natural heritage features and areas.

- In addition to protection of Landscape Level Systems and Core Environmental Features (as described above) from development, the Policies 3.A.4.2 and 3.A.4.3 specify Locally Significant Natural Areas (LSNAs) (including wooded areas identified by the Ministry of Natural Resources and Forests (MNRF) which do not qualify as Core Environmental Features) as areas whose ecological functions need to

[2] The Region of Waterloo's updated Official Plan, which was approved by the Province in December 2010, has been under appeal in its entirety since January 2011, but is referenced here because it reflects the Region's most current direction and intent.

be maintained, enhanced or, where feasible, restored. This policy provides an opportunity for potential protection, in whole or in part, of wooded features not considered as Core Environmental Features, and feature or canopy cover replacement / restoration.

- Policies under 3.A.6 further require consideration of treed areas outside of any significant natural features or areas as part of the plan of subdivision or site plan approval process through the submission of a Tree Management Plan. Such a plan allows for the identification of opportunities for tree preservation and/or replacement.

Both the Regional and City Official Plans include several policies that encourage the use of indigenous species, particularly within or adjacent to natural heritage system features and areas.

The City's updated Official Plan (2012) also introduces a new section specifically focused on the urban forest (3.B.4) titled Urban Forest and Biodiversity. These policies:

- define the urban forest as "*the treed environment, consisting of remnant wooded areas, trees in city parks and open space, street trees and trees on private property*"
- recognize the importance and value of the city's trees by, acknowledging the "*significant environmental, social, cultural heritage and economic benefits*" provided by the urban forest as well as "*the environmental, aesthetic and heritage value associated with trees lining both urban and rural boulevards and streets*", and
- generally support the "*protection, restoration, wise management and expansion*" of the city's urban forest and specifically require that trees removed from an existing right-of-way due to development or public utilities projects be replaced.

Outside of its Natural Heritage System and Urban Forest policy sections, the City's *Official Plan* makes several direct and indirect references to the integration of trees in urban design by:

- providing some protection for cultural heritage resources, which are defined as including "*culturally significant natural features (tree and landforms)*" (Policy section 4)
- promoting "resilient natural environments that support wildlife and their habitat and are better connected to residential areas" (Policy 5.12)
- accommodating tree planting in boulevards (Policy 5.14), and
- encouraging shade in the City's Open Space system (Policy 7.12).

The City of Cambridge, as illustrated in the Official Plan policies and heritage district plans, places a high value on its cultural heritage. In this context, the City has previously designated a 130 year old white oak tree as part of a cultural heritage landscape under the legislative framework provided by the *Ontario Heritage Act* (Dearlove, 2012), and maintains the ability to protect other selected trees in this manner.

Best Practices and Precedents: Official Plan Direction

Official plans are typically tailored to the unique land use, biophysical, and socio-political context of each jurisdiction, and so specific policies cannot be necessarily compared in a "best practice" context. However, on a higher level, an increasing number of municipalities in southern Ontario with active urban forestry programs have introduced urban forest policies into their Official Plans to highlight the value of this asset and support its protection, maintenance and enhancement. Examples include the Town of Oakville, Town of Ajax, City of Guelph, City of Brampton and the City of Mississauga. Some other nearby municipalities with active urban forest programs, such as the City of Toronto, City of London and the Town of Milton, have policies specifically related to the urban forest in their Official Plans that are embedded in other policy sections. The City of Cambridge, since its last updates, has both a specific section for urban forest policies in its Official Plan, and policies supportive of various aspects of the urban forest in other sections of its Official Plan.

With respect to treatment of significant woodlands, and other "core" natural heritage components of municipally identified natural heritage systems, jurisdictions such as the Town of Oakville and the City of Guelph have elected to designate these features and go beyond the Provincial Policy Statement by generally prohibitting development within these features. The City of Cambridge, being consistent with the Regional direction in its Official Plan, also designates significant woodlands and other Core Environmental Features (including a number of treed areas) and prohibits development within them.

Utilizing cultural heritage resource policies (supported by the *Ontario Heritage Act*) as a mechanism to protect trees has occurred in Cambridge, and elsewhere (e.g., Oakville) for selected mature specimens. However, this method is not typically adopted as an approach for the preservation of mature trees.

Opportunities for Improvement: Official Plan Direction

The City of Cambridge has, with its updated Official Plan (2012), adopted policies related to wooded areas both within and outside of its Natural Heritage System, that are largely consistent with current best practices and precedents (as described above). There are two possible opportunities for updates to the Official Plan as it relates to tree planting based on discussions with City staff and consideration of specific plan policies, as follows:

- The current Official Plan provides policies supportive of tree replacement, but only requires it for trees removed in rights-of-way. More stringent requirements for tree replacement could help balance the need to accommodate growth and development, with the need to maintain and expand the City's canopy cover. Specific mechanisms and options for tree replacement as part of the development process should be identified and tested through updates to the Tree Management Policies and Guidelines (as discussed in Section 3.2.4). Solutions determined to be appropriate for Cambridge can then be used to guide Official Plan policy updates.

- Section 42 of the *Planning Act* includes a clause (6.2) that states: *"If land in a local municipality is proposed for redevelopment, and part of the land meets sustainability criteria set out in the official plan …"* then Council can accept prescribed "sustainability items" in lieu of other payments required related to park / recreational conveyances. This could be used as a mechanism to get more costly tree plantings, such as large stature trees in engineered rooting environments suited to largely impervious areas, integrated into re-development projects, particularly in the downtown area.

The use of cultural heritage resource policies (supported by the Ontario Heritage Act) as a mechanism to protect mature or unique trees is generally not considered practical or appropriate as part of a jurisdiction-wide approach to preservation of mature (sometimes called "heritage") trees. This approach can be somewhat onerous and would typically only capture trees within properties or landscapes that meet a series of other heritage value criteria. Nonetheless, when opportunities arise for such designations they could be pursued under the existing policy framework.

Recommended Actions: Official Plan Direction

7. Explore adding policies related to tree planting and replacement as part of the next Official Plan update.

Implementations Notes: Considerations should include requiring tree replacement for both public and private sector development-related removals, as well as exploring the use of "sustainability items" in lieu of payments for park / recreation land dedications and ensuring that these items include trees.

3.2.2 Urban Design Guidelines

Current Practices: Urban Design Guidelines

The City has developed specific urban design and streetscaping guidelines for Main Street, a central area within Downtown Cambridge, and the Hespeler and Preston Core Areas. The goals of these projects were to provide information and a vision for future streetscaping improvements, and specific design guidance for new development proposals. Among other strategies, the Guidelines advance several design recommendations and requirements related to the integration of trees into streetscapes:

- Planting street trees to provide social and environmental benefits such as aesthetic enhancements and buffering from street traffic;
- Utilizing engineered rooting environments (specifically Citygreen StrataCells™) to provide uncompacted soil and increased soil volumes;
- Using tree grates within designated pedestrian priority areas to allow unimpeded pedestrian traffic;
- Planting one tree for every eight parking spaces to improve surface parking conditions;
- Providing office building setbacks to accommodate planting spaces for trees and other vegetation;
- Building sidewalk "bump-outs" into on-street parking spaces for additional tree planting areas, and;
- Selecting Freeman maple (*Acer* x *freemanii*), ginkgo (*Ginkgo biloba*), and honey locust (*Gleditsia triacanthos*) as appropriate species for street-side and public space tree plantings.

The *Site Plan Approval Reference Guide* (2014) lists several criteria for landscape designs that pertain directly to trees and the benefits provided by trees:

- Providing plant and seasonal variety;
- Protecting from wind, sun, rain and snow;
- Screening street edge parking, and;
- Achieving energy conservation and water efficiency through, for example, shading buildings and parking surfaces

Best Practices and Precedents: Urban Design Guidelines

A healthy and resilient urban forest does not happen by accident, but rather though careful and considered planning, especially with regards to the design of urban spaces. Good urban design practices strive to harmonize built and natural environmental features, creating coherent and well connected urban landscapes. The integration of trees and other components of the urban forest into streets and park spaces begins with effective urban design criteria as they are laid out in municipal planning documents.

Conditions required for successful tree establishment and long-term survival must be integrated into the design, planning and construction of all urban streetscape projects, if trees are to serve as functional streetscape elements. Inadequate soil volume, quality, drainage and density are the chief limiting factors for tree growth in urban areas. As such, urban design guidelines should consider innovative approaches to enhance the growing conditions for urban trees, particularly in 'hardscape' areas such as Central Business Districts or parking lots. Best practices for enhancing urban tree growing environments implemented in other jurisdictions include innovative approaches such as:

- Engineered soil solutions such as CU-Soil™ and other engineered soils, which combine mineral soils and structural elements such as gravel
- Structural soil alternatives, such as structural pavement support systems, which suspend pavements above uncompacted soils
- Alternate construction methods such as pavement bridges, break-out zones, or open planters.
- Minimum required soil volumes for trees, depending upon size (30 m^3 of available soil per large-growing tree is considered a minimum adequate volume)
- Lower-impact surface treatments such as permeable pavers, cellular confinement systems, or stabilized aggregates in lieu of tree grates

In 2013, the City of Toronto published a comprehensive manual for *Tree Planting Solutions in Hard Boulevard Spaces*, which provides design and construction guidelines for several innovative tree planting approaches in urban areas. Toronto's comprehensive *Streetscape Manual* also outlines numerous approaches for integration of trees into the urban streetscape, and the *Design Guidelines for 'Greening' Surface Parking Lots* provide specific strategies to integrate green infrastructure elements into those landscapes.

Other municipalities, such as Markham (*Trees for Tomorrow Streetscape Manual*) and Guelph (*Streetscape Manual*, *Built Form Standards, & Conceptual Design for St. George's Square*) also provide comprehensive guidance for integration of trees into streetscape and urban design.

Opportunities for Improvement: Urban Design Guidelines

The City of Cambridge Official Plan supports the integration of trees into urban landscapes and the conservation and enhancement of the City's natural features. The Hespeler and Preston Core Area Urban Design Guidelines provide guidance for enhanced tree growing environments, including provision of streetscape elements such as tree grates, guards and engineered soil cells. While these guidelines provide a starting point for successful integration of trees in difficult growing spaces, there is room for improvement and more successful tree site design in future Urban Design Guideline projects, or in supplements to existing guidelines.

Opportunities to enhance guidelines for tree growing environments in urban spaces include the development and inclusion of the following in urban design guidelines:

- Site-specific provision of alternate engineered soil solutions, such as structural soils or different cell systems, rather than specification of a single type of system
- Consideration for strategic placement of trees to optimize provision of shading for pedestrians and cyclists, buffer and barrier provision, and other benefits
- Alternative construction methods
- Specification of minimum soil volumes, which can vary depending upon species or planting arrangements, and
- Provision of standard cross-sections for different solutions.

As such, comprehensive supplementary guidelines for tree growing environments should be developed, and future Urban Design Guideline projects should provide more detailed guidance for tree growing space design and construction. This will ensure that; urban development projects give the necessary consideration to successful and long-term tree establishment, adequate resources are dedicated towards innovative and effective tree planting solutions, and design and implementation on projects where the City has authority is consistently informed by guidelines modelled on best practices.

Recommended Actions: Urban Design Guidelines

8. Develop comprehensive streetscape guidelines for integration of high-quality tree growing environments and trees into urban streetscapes.

Implementation Notes: Guidelines should supplement existing urban design guidelines and be incorporated into/referenced by future urban design guidelines. Guidelines should provide different implementation options depending upon site specifics but should encourage consistency in approaches. Include guidelines for 'greening' of urban surface parking lots, including green infrastructure such as bioswales and trees.

3.2.3 Tree By-laws

Current Practices: Tree By-laws

Tree By-laws for Public Property

There are currently two by-laws in Cambridge that directly regulate activities related to tree injury, destruction or removal: the Region's Conservation of Trees in Woodlands By-law (No.08-026), and the City's public tree by-law (No. 71-06). The City's public tree by-law (enacted 2006) regulates "*… the planting, propagation, preservation and removal of trees on land owned by the municipality or over or adjacent to highways under the jurisdiction of the municipality*". This by-law regulates the unauthorized damage or removal of all trees in City-owned properties, as well as along rights-of way. In addition, clause 6 of this by-law requires compensation of "*an amount equal to the value thereof in accordance with the most recent shade tree valuation formula as set out by the International Society of Arboriculture*" when healthy City-owned trees are approved for removal in order to provide access to or utilities for a private building.

Tree By-laws for Private Property

The Region's Conservation of Trees in Woodlands By-law (2008) regulates all woodlands of at least 1 ha in the city such that a permit is required for any tree-related activities in such features. Notably, because woodlands above 4 ha are designated as "significant" at the Official Plan level, and no development is permitted within them, this by-law really applies to woodlands between 1 ha and 4 ha. Permit exemptions are provided for woodlands with approved management plans. Permits are generally provided for selective cutting in woodlands, as well as partial or entire feature removal "*if in the opinion of the Tree By-law Committee, the injuring or destruction of the tree or trees is desirable for the appropriate development or use of the property and the general intent and purpose of this by-law is maintained*". However, woodlands between 1 ha and 4 ha identified as Locally Significant Natural Areas in Cambridge would also need special consideration if development is proposed within them, as per the Official Plan policies discussed above.

A draft Tree Preservation By-law, developed in consultation with various stakeholders and the community and focusing on trees on private property, was drafted and released for public comment in 2012. Ultimately, the draft by-law was not approved or enacted. The draft by-law was developed to address identified issues related to tree clearing prior to development application submissions and post-development protection of trees identified for preservation through the planning process. It was also intended to regulate the removal of trees on private lands, with an emphasis on trees greater than 76 cm dbh. Up to three trees with a dbh between 20 cm and 76 cm dbh could be removed on a given property per calendar year without a permit.

Records of the consultations undertaken as part of the draft by-law review process indicate a mixed and occasionally polarized response. Some respondents completely opposed a tree by-law on private property, while other respondents wanted a more restrictive by-law than the one being proposed. Others still favoured such a by-law, but suggested changes to the draft. Ultimately, Council chose to

defer consideration of a private tree by-law until it could be considered through a more comprehensive urban forest management strategy, as provided through this Plan.

The City also has a Grading By-law (160-09) "*to regulate or prohibit the alteration of the grade of land and the placing of or dumping of fill within the City of Cambridge*" on areas of land of 0.5 ha or more. This by-law requires the identification and assessment of all trees of at least 10 cm dbh that may be impacted by the proposed grading.

Best Practices and Precedents: Tree By-laws

Tree By-laws for Public Property

Public tree by-laws may be passed by a municipality in Ontario to regulate the removal or injury of trees on their own land, and have been passed by dozens of municipalities across southern Ontario (e.g., London, Waterloo, Oakville, Hamilton and Burlington). Such by-laws typically prohibit damage or destruction of trees on municipal lands, and allow the municipality to issue a fine for contravention of the by-law (which is typically applied to replacement tree establishment). They can also clarify the process for dealing with "boundary" or "shared" trees, which can become an issue between adjacent property owners. Such by-laws are a tool (among others) to help protect the municipality's investment in green infrastructure, and also demonstrate a municipality's willingness to regulate tree protection (and replacement) on its own lands.

Tree By-Laws for Private Property

Lower-tier municipalities in Ontario are able to regulate trees on private lands within their jurisdiction under the authority of the *Municipal Act*, last updated in 2001. The *Municipal Act* also enables by-law harmonization between upper and lower tier (i.e., area) municipalities. In Cambridge, the municipality has adopted a harmonization approach by allowing the Region to regulate all woodlands of 1.0 ha and above within city limits.

In general, upper tier municipalities tend to focus on woodland protection / management, while lower tier municipalities tend to focus on individual tree protection / management. More than half of the upper tier municipalities in southern Ontario have private woodland or forest by-laws, and many (more than 28) lower (or single) tier municipalities have some type of "individual" private tree by-laws.

The decision of whether or not to pursue implementation of a private tree by-law is often tied to the local political and social environment, as well as the land-use context and the types of development pressures that may exist in the given jurisdiction. When by-laws are pursued, they tend to be a very polarizing issue with proponents of private property rights on one side, and proponents of tree protection on the other. When they are implemented, no two private tree by-laws are identical, as each one is tailored to address different municipal needs and concerns.

In some municipalities of comparable size to Cambridge (such as the City of Guelph and the Town of Richmond Hill) private tree by-laws that focus on protection of trees above a certain size have been

enacted, but with exceptions for invasive species and, in Guelph, lots smaller than 0.2 ha. The Town of Oakville and City of Mississauga both have by-laws that allow for a certain number of trees to be cut without a permit each year (e.g., three) to try and balance private property rights with regulation of this community asset. Other municipalities, such as Burlington, Milton and Ajax, have opted not to pursue a private tree by-law as part of their short-term urban forest management planning because other management needs were considered as higher priorities for resource allocation.

Although no comprehensive analyses have been undertaken on the effectiveness of tree by-laws in Ontario to date, feedback from lower or single-tier municipalities where they have been implemented to date indicates that such by-laws: (a) are more effective when used as educational tools than punitive mechanisms, and (b) are not useful unless there are adequate municipal resources to promote and enforce them.

Opportunities for Improvement: Tree By-laws

In order to succeed in maintaining and increasing its current canopy cover, the City of Cambridge will require by-laws in place to regulate the removal or destruction of trees on both public and private lands. These tools will be part of a broader outreach and awareness initiative about the value of the city's urban forest.

Two key opportunities for improvement identified for the City of Cambridge are: (1) updates to its existing Public Tree By-law (71-06) and Grading By-law (160-09), and (2) finalization and implementation of a private tree by-law.

Tree By-laws for Public Property

While the City's Public Tree By-law (71-06) firmly establishes regulatory control over trees on lands under the its jurisdiction, and also requires compensation under specified circumstances, it should be updated:

- with a better definition for "tree" (that ideally is consistent with the other related by-laws)
- to require replacements for trees removed under all circumstances (not just for private entrance allowances), or cash-in-lieu (to be put into a City tree fund) where replacement is not feasible
- to update the reference from the International Society of Arboriculture (ISA) to the Council of Tree and Landscape Appraisers (CTLA) as the source of guidance for tree valuation
- to require tree protection zones to be identified and implemented where trees are identified for preservation as part of the works undertaken
- to specifically encourage planting of indigenous trees when compensation is required (particularly within or adjacent to natural areas), and
- to address the issue of boundary trees shared between the City and another landowner.

Tree By-laws for Private Property

The City's Grading By-law (160-09), could also be updated to include requirements for tree protection zones to be identified and implemented where trees are identified for preservation as part of the works undertaken, and to require some form of compensation for the removal of healthy trees (e.g., either replacement elsewhere or cash-in-lieu). In terms of process, permit applications that have the potential to impact trees should be reviewed by someone with arboricultural expertise.

Although they can be useful tools, private tree by-laws can polarize communities, and may not be high priorities for communities with limited urban forestry resources and other more urgent urban forest priorities (such as dealing with EAB). In the case of Cambridge, re-considering a private tree by-law once the EAB issue has been addressed and the City has had time to expand its urban forestry resources and improve maintenance practices on its own lands is, however, recommended. Cambridge is fortunate that it has many areas of well-established and mature trees that contribute to its overall 27% canopy cover. Furthermore, review of the consultations feedback received to date suggests that there is a very high level of concern for preservation of heritage, including natural heritage, and that there is a moderate to good level of support for some type of private tree by-law (Bray Heritage *et al.*, 2008; Cambridge, 2012b).

As the City continues to grow, there will be more pressure on natural areas as a result of infill and greenfield developments. While a private tree by-law is not effective when an application under the *Planning Act* is in progress, it can help prevent tree removals prior to a development application being submitted, and also help regulate the removal of trees identified for preservation through the planning process. Perhaps more importantly, a private tree by-law creates a platform and opportunities for educating landowners, and a mechanism for requiring replacements for trees removed, or cash-in-lieu that can be directed towards a City tree fund.

The City has already demonstrated that it is striving to strike an appropriate balance between private property rights and the need to regulate the urban forest. Once the more pressing needs related to management of the urban forest are adequately addressed, the City should consider developing and implementing a new private tree by-law that includes requirements for compensation for trees approved for removal. This by-law should not, however, be implemented without the required additional administrative, legal and arboricultural resources, as well as an educational campaign.

Recommended Actions: Tree By-laws

9. ***Update the City's existing Public Tree By-law (71-06) and Grading By-law (160-09) to be more supportive of urban forestry objectives in this Plan.***

   Implementation Notes: These updates should focus on implementing broader tree replacement or compensation requirements, addressing boundary tree issues, and be implemented in conjunction with the establishment of a tree fund account for the City where cash-in-lieu related to tree removals can be placed.

10. Draft and explore implementing a private tree by-law to expand the City's tool kit for acheiving urban forest targets.

Implementation Notes: Developing a private tree by-law should not be considered until the City has adequately addressed its more urgent tree maintenance and management issues on its own lands (e.g., EAB). Once these are addressed, a by-law should be drafted and subject to public consultations. Key considerations for this by-law should include: a requirement for tree replacement or compensation (ideally directed towards a City tree fund or account), and for the City to commit additional resources to education, administration and enforcement related to the by-law before it is passed and implemented.

3.2.4 Tree Protection Policies and Procedures

The protection of healthy and mature trees during site development and municipal works is not only critical to promoting the long-term sustainability of the urban forest (canopy and leaf area lost during construction can take years to replace) but it is also typically less costly than planting and maintaining new trees. Site works may impact all parts of a tree, including roots (cutting and soil compaction), trunks (physical damage, such as abrasion), branches (fractures or poor pruning) and foliage (chemicals or exhaust heat). Trees may be removed during development, or damage can result in decay, structural and stability issues, canopy decline and eventual mortality. Construction-related damage may not become evident until several years after a project is completed. In some situations, tree preservation on development sites may not be feasible. Where protection is possible, however, the implementation of strategies to inventory, protect and monitor trees before they can be adversely affected by construction activities is critical to sustaining the urban forest.

Current Practices: Tree Protection Policies and Procedures

Strategies for protecting trees during development and other site works are specified in several policies. The City's Official Plan identifies the "protection, preservation and restoration of indigenous vegetative cover [as] a priority for the City," and regards the development process as an opportunity to enhance vegetation cover across the city. The City's *Engineering Standards and Development Manual* (2013), outlines the tree protection and establishment procedures required during the land development process. The manual states that all "existing street trees located within a public right-of-way may not be removed or damaged in any way [and developers] shall make every effort to protect existing street trees and maintain the optimum growing conditions during construction." These processes include the required submission of a 'Tree Saving Plan' showing grading, and the inclusion of a street tree planting plan with all engineering and landscape drawings.

Landscape drawings further require plans with proposed tree removals to indicate tree species, size, and condition. Any tree that is intended to be preserved requires page wire tree protection fencing be established at a minimum distance of 1.0 metre beyond its dripline, with all costs assumed by the developer, and any damaged or removed trees are required to be compensated either with replacement trees equal in total diameter to the damaged/removed trees, or else with replacement street tree

planting funds. Removal of municipal trees during development or utilities servicing requires payment of compensation, as determined by appraisal methods laid out in the most recent edition of the CTLA Guide for Plant Appraisal.

The *Tree Management Policies and Guidelines for New Developments* (2002) provide further direction for protecting trees during new subdivision development. All submitted planning documents for development of new subdivisions or site plan approvals require a General Vegetation Inventory and Analysis identifying "areas of significant vegetation." At this level of analysis, the broader characteristics of the existing forest are identified, including the relative number of trees and dominant tree species, average diameters, priority areas for tree management, etc. On the basis of the findings of the general inventory, a Detailed Vegetation Management Plan may be required for lots where vegetation, including trees, have been assessed as warranting preservation. In such a case, a detailed map and inventory of individual trees, including current tree health and condition, size and species, as well as an assessment of tree impacts with regard to the proposed development, are to be submitted. The implementation of tree preservation measures specified in the Detailed Vegetation Management Plan may be ensured by security deposits of up to $50,000. Tree Preservation/Conservation Plans may be required for any application proposing to develop a lot or block at a greater depth than approved in the Detailed Vegetation Management Plan or to revise grading in the area of trees to be retained.

The *Site Plan Approval Reference Guide* (2014) summarizes the review process and documentation requirements for development applications for "new multiple unit residential; commercial; industrial; mixed use, intuitional building(s) and commercial parking lots [as well as] large building renovations or building additions." Site Plan Applications are required to include a Landscape Plan showing trees designated for removal and protection (if any), a list of proposed new plant material, and the separation dimensions between trees and hydro facilities.

Dual zoning and conservation easements may also be used to protect treed portions of Open Space lands. Where dual zoning is applied, areas to be protected are typically zoned Open Space 1, while the remainder of a site remains a particular zone available for development (e.g., residential). On occasion, both zoning and conservation easements put on title may be used together. Currently, only a small percentage of the urban forest canopy is found on such dual-zoned or easement lands. The zoning by-law may be enforced upon complaint or upon a future development application. Some areas designated in this manner have not been effectively protected, as monitoring to ensure ongoing protection has not been adequately undertaken due to resource constraints.

Finally, the Forestry Division's internal *Policy and Procedures Manual* establishes specifications for protecting municipal trees during construction projects. Tree Protection Plans, prepared by qualified arborists, must detail the proposed construction impacts, minimum Tree Protection Areas/fencing, and recommendations for removal and/or tree protection.

Best Practices and Precedents: Tree Protection Policies and Procedures

Education

The first step towards encouraging tree protection and promoting compliance is education – developers, site workers and other involved parties must be made aware of the importance of the urban forest, the regulatory framework for tree preservation, and the opportunities available to achieve tree preservation. In order to discourage pre-development clearing and promote tree preservation, the development-related tree management review process must not be onerous, while maintaining the City's ability to influence the outcome on development sites in favour of tree preservation.

Tree Declarations or Questionnaires

Processes and tools such as 'Tree Declarations' or 'Tree Questionnaire' forms enable applicants and staff to quickly and effectively pre-screen development properties for the need for tree protection, thereby potentially simplifying and expediting the development review process. To be effective, this process must be supported by site inspection, enforcement, and punitive measures for unscrupulous applicants. Submission of photographs in support of declarations forms assists in the review and inspection process. Jurisdictions including Mississauga, Oakville and Toronto, among others, have tree declaration processes.

Tree Protection Policy Manuals

Many jurisdictions, including Cambridge, have developed and implement comprehensive tree protection policies. Clarity, consistency and ease of access are a key starting point to encourage compliance and effective tree protection. Following a policy review, compilation of all relevant tree protection policies, standards and specifications in a single document (such as a Tree Protection Policy Manual) is recommended. Example jurisdictions with Tree Protection Policy Manuals include Barrie, Toronto, and Oakville. Such policies can provide the foundation for effective protection, but cannot stand alone and must be supported by other initiatives.

Tree Protection Zones (TPZs)

Tree protection zones – areas where access is prohibited to protect rooting areas and tree stems – are a critical component of on-site tree protection. Providing the optimal TPZ size should take into account more than the tree's canopy spread, especially if trees have columnar or oddly-shaped crowns. TPZ sizes should be based upon diameter at breast height (as in many jurisdictions) or on canopy spread, whichever provides for a larger zone. If required, encroachments into the TPZ must be undertaken in a root-sensitive manner following municipal approval, and post-injury care and/or injury compensation should be required.

Compliance Inspection and Reporting

Tree protection policies and standards cannot be effective without voluntary compliance and enforcement. Specific mechanisms are required to ensure that tree preservation actions proposed in development applications and arborist reports are implemented, sustained and monitored.

There are two key means to accomplish this: 1) additional resources may be allocated to enable effective inspection by trained planning and/or urban forestry staff, and 2) standards to require regular arborist inspections may be implemented as conditions of development approval or on municipal projects. In the latter scenario, site inspection reports should be required on a periodic basis, and submission of such reports should be carefully tracked. Failure to submit reports and implement required mitigation actions should be subject to enforcement action, as prescribed by law.

Tree Protection Deposits and Letters of Credit

In many jurisdictions, developers may be required to temporarily deposit securities or provide letters of credit to ensure implementation of approved tree protection measures. Various means to determine the value of securities are available, and may include set values or formula-based valuations. Typically, securities are refunded a maximum of two years following completion of development, although opportunities to withhold release of securities for longer periods may encourage compliance with tree protection requirements. Opportunities for early release may be provided if it can be demonstrated that effective tree protection measures have been implemented during development.

Tree Injury and Removal Compensation

Many jurisdictions require compensation for the removal (or injury) of trees during development. Some communities, such as Oakville, require compensation for affected municipally-owned trees. Other communities, such as Mississauga, New Tecumseth, or Toronto, may require compensation for trees on municipal or private property. Compensation may be required on a replacement ratio or based upon appraised amenity value. For example, Burlington typically requires 'aggregate caliper' for replacement of trees damaged in contravention of approved plans. In Toronto, removal of privately-owned and regulated trees must be compensated on a 3:1 replacement to removal ratio, while the amenity value, calculated using the Council of Tree and Landscape Appraisers (CTLA) Trunk Formula Method (TFM), must be paid for City-owned trees. The Town of New Tecumseth, through by-law 2008-123 – 'Tree Compensation and Preservation', requires the payment of TFM-derived amenity value for all trees to be removed during development, whether privately or municipally-owned.

Opportunities for Improvement: Tree Protection Policies and Procedures

Ensuring effective tree preservation during development and site works is challenging, and ultimately relies upon the cooperation of municipal staff, property owners, developers and site workers. Relatively strong tree preservation policies do exist in Cambridge, but the City is not consistently successful in achieving the preservation of significant trees on development sites or in obtaining adequate compensation for their injury or removal.

Tree Protection Outside Development

One critical obstacle to tree protection outside the development process is the current absence of mechanisms (i.e., such as a private tree by-law) to ensure tree preservation or compensation for tree removals. As such, some developers may choose to remove privately-owned trees (prior to submission of any development application materials) which could otherwise be subject to development-related regulation and protection.

Compensation

Policies are in place to provide for compensation for injury or removal of trees under particular circumstances, as described in the 'Current Practices' section, above. Typically, compensation is provided in the form of street, park or stormwater management area plantings, except in the instance that City-owned trees are damaged or the Detailed Vegetation Management Plan is contravened. In the latter instances, compensation must be provided "to the satisfaction of the Forestry Technician," leaving a considerable degree of leeway for negotiation. In practice, the City has had limited success in obtaining full amenity value for trees subject to compensation (typically determined by a CTLA-supported method). In cases where City-owned trees are removed as part of development, the City obtains aggregate caliper or, more commonly, 1:1 removal to replacement ratio compensation plantings through negotiation with the developer. Improved compensation guidelines, outlining specific scenarios and supported by stronger enforcement and clearer compensation valuation methodologies, would support more effective tree preservation and ensure that the value of trees is recognized during the development process.

Tree Protection Policies

An additional challenge to tree preservation during development is occasional inconsistency and difficulty with the application of tree preservation measures, as well as internal inconsistencies among City policies. For example, the policies contained within the *Engineering Standards and Development Manual* (2013) require tree protection to 1 m beyond dripline, while the internal *Tree Protection and Specifications for Construction Projects within the vicinity of Municipal Trees* policy prescribes protection based upon trunk diameter, as is found in other jurisdictions and is more in line with best practices. A lack of clarity when different standards are to be applied can lead to non-compliance and missed opportunities to effectively protect trees. Additionally, tree management plans submitted in support of development applications often do not provide sufficient detail and analysis to engage in a comprehensive review of potential impacts. In some circumstances, such as zoning amendment applications, there may not even be an opportunity for the City to provide adequate comment on impacts to existing trees on affected sites.

Resources

Finally, current staffing levels do not enable the Forestry Division to undertake the inspections necessary to ensure the compliance with approved tree preservation prescriptions. Such monitoring must include: a) a comprehensive review of the tree preservation plans, b) ongoing communications with site developers/agents, c) follow-up on required periodic inspection reports, d) random and pre-arranged site inspections, and e) other tree-related aspects of development file management. Tree protection would therefore be greatly enhanced through additional and dedicated resources.

A comprehensive review of the tree preservation policy would enhance the City's ability to minimize the impact of site development on trees. Such a review should examine mechanisms to streamline tree preservation planning and the review process. An emphasis should be placed on improving the City's ability to mitigate potential impacts early in the development process. For example, a process for early-stage 'tree declarations', followed by a single-stage tree preservation/compensation plan process (i.e., one detailed tree inventory and preservation plan outlining all proposed works), if required, could improve the entire process by enabling more effective City review and site enforcement and by encouraging increased compliance.

Recommended Actions: Tree Protection Policies and Procedures

11. Undertake a comprehensive tree preservation planning policy and procedure review

Implementation Notes: This review should focus on streamlining the tree preservation planning and review process, providing opportunity for early-stage Forestry Division review, and providing clear and consistent guidance for tree injury and removal compensation. Policy review should be coordinated between the Forestry Division and Planning and Development and Transportation and Public Works departments, along with other City staff, as required. Consultation with the Waterloo Region Home Builders Association Liaison Committee should also take place. Options to consider include: streamlining the process by implementating a 'tree declaration' or 'tree questionnaire' form and process for development, a single-stage tree preservation plan process, and enhancement of resources for site inspection and enforcement. Toronto, Mississauga and Oakville are good examples to inform tree preservation planning policy and procedure review.

3.2.5 Tree Establishment – Planning and Development

Current Practices: Tree Establishment – Planning and Development

Unlike forests in natural settings, urban forests require human intervention to ensure their sustainability and expansion. In addition to planting trees, supplying adequate space through the site design process, and identifying areas in need of increased tree establishment, planting decisions must also consider species diversity and distribution, post-planting maintenance, and budgetary requirements.

Street Tree Planting in New Developments

To provide canopy cover and leaf area for new communities, trees are required to be planted along public rights-of-way as a condition of all new subdivision development and redevelopments. All costs associated with new tree planting and establishment are to be covered by the developer. The *Engineering Standards and Development Manual* (2013) stipulates that every 12 m of roadway (8-10 m within industrial zoned areas) shall require at least one tree, although planting sites must minimize interference with the existing features and functionality of the roadway (e.g. by avoiding conflict with underground and above ground utilities, or obscuring driveway sightlines and day light triangles). The *Manual* further details municipal planting stock specifications that require the planting of minimum 70 mm caliper, wire basket or ball and burlap trees with medium-to-large growth potential.

Street trees planted as part of the development process are assumed by the City at the end of the mandatory maintenance period if they meet pre-determined conditions. An inspection by City staff determines if a tree is vigorous and healthy. No tree with more than 20% crown dieback will be accepted. All unacceptable trees are required to be replaced within the following planting season.

Planning for Species Diversity

Species diversification can improve the overall resilience of the urban forest by reducing population susceptibility to various stressors. City documents, such as the *Official Plan* and *Corporate Sustainability Plan*, encourage the selection of indigenous tree species, while planting lists such as the *Community Services Department Tree Planting Guidelines for Developers* (2007) recommend a number of indigenous as well as several non-indigenous, non-invasive species. As outlined in the *Engineering Standards and Development Manual* (2013), species must also be matched to specific site conditions. Species selection is also to consider, among other factors, the available rooting zone, exposure to salt spray and sources of root compaction, and proximity to watercourses and natural areas. To match tree species to their particular growing constraints, the tree planting varieties list is further organized by space requirements of fully grown trees.

Best Practices and Precedents: Tree Establishment – Planning and Development

Minimum Soil Depth/Volumes

Adequate soil volume and quality is critical to long-term tree survival and development. Thirty cubic metres of soil is considered the minimum volume required to sustain a large-stature urban tree. Smaller volumes may be adequate to sustain smaller trees or when multiple trees share a continuous rooting space, such as a soil trench. Few municipalities are able to achieve sufficient soil volumes for trees in new developments, largely due to increasingly intensive land use and higher building densities; greater success has been achieved in urban redevelopment scenarios. However, some municipalities have been successful in improving growing conditions for trees. For example, the Town of Oakville has made significant improvement in providing soil for trees by requiring a minimum depth of 75 cm of topsoil in all treed boulevards in new developments, and Markham requires 30 m^3 for trees through its *Streetscape Manual*. Mechanisms such as engineering standards and topsoil conservation by-laws can be effective tools to ensure minimum soil volumes are provided for trees.

City Planting Implementation

In some communities, such as Ajax and Burlington (in some developments), developers can deposit funds with the City to cover all aspects of tree planting. Such a process can be beneficial for all parties, as developers are relieved from 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.

Planning for Species Diversity

Typically, developers prefer to select the hardiest species possible to reduce the likelihood of post-planting mortality and costly replacements. This may result in an over-abundance of certain species and lead to lower urban forest diversity. As such, staff and developers should plan collaboratively to enhance urban forest species diversity through plantings in new developments. A commonly-cited guiding principle for tree species selection is the '10-20-30' rule, first proposed by Santamour (1990), whereby no tree species exceeds 10% of the population, no tree genus exceeds 20%, and no tree family exceeds 30%. More recently, the Peel Region Urban Forest Strategy (2011) recommended even more stringent guidance (a '5-10-20' distribution). Approved tree species lists can be tailored to promote urban forest diversity, and should be provided to developers during the early stages of pre-development consultation.

Nursery Stock and Planting Inspection

Plant material for installation on development sites, especially on lands to be conveyed to the municipality, should be inspected prior to installation. Additionally, a selection of trees should be inspected during and following planting to assess planting depth, planting hole size, backfill materials, staking and post-planting care. Trees should be inspected by City staff or independent contractors working on behalf of the City (at the developer's expense), and not by agents for the developer. The Town of New Tecumseth, among other jurisdictions, undertakes such inspections periodically, although pre-planting inspection is uncommon in most communities.

Pre-Assumption Maintenance

If not provided with adequate maintenance (e.g., watering, mulching and training) immediately post-planting, new trees have a significantly increased likelihood of transplant shock and mortality. Mortality often occurs after the warranty period and trees must be replaced at the municipality's expense. Adequate maintenance prior to assumption, with scheduled watering, regular mulch top-up, and structural pruning (as required) will ensure that trees are healthier and less likely to die after municipal assumption. Developers should be required to provide tree maintenance prior to and during the Maintenance Period and prior to Assumption. Recently, the Town of Milton committed to implementing such a program through its Urban Forestry Management Strategy.

Opportunities for Improvement: Tree Establishment – Planning and Development

Tree establishment-related development policies in Cambridge are largely consistent with practices in other comparable jurisdictions. However, there are several opportunities for improvement of policies and practices to achieve several objectives, including ensuring policy consistency, reducing rates of post-transplant mortality, and improvement of young tree structure.

Planting Policies

Tree planting requirements outlined in various policy and procedure documents should be reviewed and streamlined. Currently, specifications for tree stock size and planting spacing in the Landscape Design Requirements section of the *Site Plan Approval Reference Guide* (2014) and *Engineering Standards and Development Manual* (2013) are inconsistent, with the latter specifying larger stock at greater spacing. Additional standards, including planting guidelines and a species list, are provided in the *Community Services Department Tree Planting Guidelines for Developers* (2007). These standards, including all tree species selection lists in various City documents, should be brought into alignment to provide clarity and ensure consistency. Optimally, one 'master list' should be prepared to guide species selection for planting in new developments, and a smaller list (adapted from the master list) can be used to guide operations-based tree establishment, especially resident requests. Planting lists should be reviewed and updated on a regular basis, and should be included in the 5-year urban forest management review.

Young Tree Maintenance

Currently, there are no specific provisions in the City's development policies to ensure that newly planted trees are adequately maintained prior to assumption by the City. Policies do require that trees appear healthy upon inspection prior to and upon completion of the subdivision maintenance period, and that mulch be present at the time of final acceptance. However, maintenance in the intervening periods is not specifically required, and the two-year warranty period for trees does not apply to replacement trees. As such, increased rates of tree mortality may occur following assumption due to a lack of post-planting care (e.g., watering, mulching) during the maintenance period, thereby necessitating near-term replacement at the City's expense. Resources should be enhanced to ensure appropriate inspection of all planting stock prior to installation, at the time of planting, and shortly post-planting, to ensure issues such as girdling roots, poor planting stock, inappropriate planting depth, etc., do not compromise the longevity of street trees. To enable effective young tree maintenance, consideration should be given for enabling the City to collect funds from developers and to assume all responsibility for tree selection, planting and post-planting care.

Trees and Climate Change

Anticipated increases in average annual temperatures associated with global climate change are likely to significantly impact urban trees in coming years (Johnston, 2004). Potential stressors include higher temperatures, precipitation changes (in both quantity and type), increased wind gust velocities, air pollution increases, and soil habitat alterations. Climate change may result in species maladaptation to the changing climate, making current habitats inhospitable for certain species. Tree species selection in urban areas, including Cambridge, should consider the potential impact of climate change and may need to consider hardier and more drought and heat-tolerant tree species, such as those found in more southerly climates. Special consideration should be given to species whose range is expected to extend into Cambridge over the next few decades (McKenney *et al.*, 2007). Species considered 'climate change-ready' should be planted on a trial basis, with regular and long-term monitoring to assess suitability and performance in the urban landscape.

Planting Site Design

Finally, as noted previously, there are no standards or specifications for planting site design for subdivision developments. As such, trees in new developments may be planted in 150 mm of topsoil above a compacted subgrade, or in otherwise suboptimal conditions. While it may not be feasible to require 30 m^3 of soil volume for every tree due to cost constraints, significant improvements can be made to ensure trees are provided with better growing environments. For example, standards should be revised to require increased minimum topsoil depths and supporting infrastructure requirements (e.g., drainage systems) in tree and shrub planting areas in new subdivisions, while enhanced or engineered rooting environments should be considered in other tree establishment areas constrained by more impervious surface.

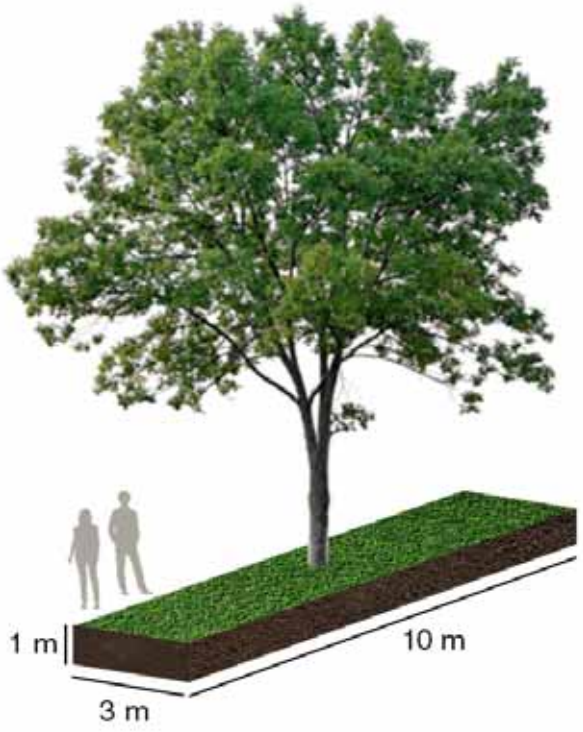


Figure 9: Graphic representation of 30 m^3 of soil.

Planting site design should also give consideration to the effective placement of trees in order to maximize the provision of various urban forest benefits. Planning policies concerning landscape design should consider factors such as provision of shade (through appropriate tree placement), or contribution to site stormwater management, among others.

Recommended Actions Tree Establishment – Planning and Development

12. Review, consolidate and ensure consistency of all development-related tree establishment policies and standards

Implementation Notes: Review main guiding documents, including Site Plan Approval Reference Guide (2014), Engineering Standards and Development Manual (2013) and Community Services Department Tree Planting Guidelines for Developers (2007). Ensure planting process and specifications for various factors such as stock type, spacing, site design, etc. are internally consistent, and in line with best practices. Create one guiding document for all tree establishment-related policies and practices, with separate sections guiding development and community services, as required. Develop and implement improved standards for soil volume, quality, and supporting infrastructure for tree planting areas in all new developments. Potential successful solutions include increased soil depths in tree planting areas, supporting infrastructure such as root barriers, drainage systems, and enhanced soils. Implement engineered rooting environment solutions in hardscape areas.

13. ***In new or infill developments, require (a) regular maintenance of newly-planted street trees, and (b) developers to deposit funds to cover the costs of planting, maintenance and replacement of trees by City staff or contractors***

    Implementation Notes: Trees in new developments to be planted by City forces or contractors, supported by adequate funds deposited by developers to cover cost of planting and maintenance. Newly-planted trees should be watered on a regular basis during the establishment period, and other maintenance such as mulching and young tree pruning/training should be undertaken, as required.

14. ***Compile a 'master' planting list to guide tree establishment on both public and private lands across the city.***

    Implementation Notes: This list should be usable by City staff, contractors for public and private projects, stewardship activities and request-based plantings from homeowners. This information should include: indigenous versus non-native species (invasive species should be excluded), site tolerances, habitat requirements, size at maturity (including height and crown width), and appropriate planting season. The list should also include species that do or could occur in Cambridge but are at or close to the northern limit of their range (i.e., as a climate change consideration).

Establishing a mature urban forest canopy takes time, as seen in this newer community. Credit: S. Jobber.

3.3 Managing the Urban Forest

3.3.1 Program Administration and Asset Management

Current Practices: Program Administration and Asset Management

Program Administration

The responsibility for the management of municipally owned portions of the urban forest rests primarily with the City (as discussed in Section 1.2). The day-to-day management of trees on City-owned property, including road rights-of-way, cemeteries, parks, woodlands and open spaces, is administered by the Forestry Division of the Community Services Department. Forestry Division personnel comprise of the Manager of Horticulture & Forestry Services, one Forest Technician (Inspector), and four Foresters. Depending on the volume and technical nature of required work, external contractors may also be retained to perform arboricultural maintenance.

The tree-related management duties for which the Forestry Division bears responsibility are described in the Division's internal *Policies and Procedures Manual*, and include:

- Planting, according to City planting specifications
- Removing trees and tree stumps, performed as a last resort risk mitigation option and involving grinding stumps and surface roots to a below-grade depth of 10 inches
- Pruning, including deadwood removal, thinning and restoration to "ensure healthy, safe and aesthetically pleasing specimens" that conform to City clearance standards
- Mulching, specified for use to a depth of 10 cm with all newly planted trees and as a corrective measure
- Fertilization and watering, specified for all newly planted trees, trees in high-profile areas, and mature trees exhibiting symptoms of decline or poor vigour
- Monitoring and treating tree pests and disease problems
- Ensuring protection of municipal trees at construction sites, by reviewing and approving Tree Protection/Saving Plans, providing guidance on appropriate supplemental protection measures, and monitoring for compliance with tree protection guidelines
- Performing tree repairs, risk monitoring and hazard abatement, including installation of tree support systems (i.e., cabling and bracing)
- Conducting routine and emergency tree inspections, including issues related to guidelines and specifications compliance, existing tree support systems integrity, and potential risk assessment
- Resolving tree-infrastructure conflicts, including blocked sewers and raised sidewalks

In addition to Tree Protection/Saving Plans, the Forestry Division may, as required, review various other planning application documents such as General Vegetation Inventory and Analyses, Detailed Vegetation Management Plans, Composite Utility Plans, Landscape /Tree Management Plans, Street Tree Planting Plans, Park/Open Space Concept and Grading Plans, General/Servicing Plans, and Subdivision Grading Plans.

Tree Asset Management

An asset management system generally consists of a combination of software tools and processes that facilitate the management of corporate assets, such as infrastructure, facilities, or municipal trees. The City of Cambridge Forestry Division manages tree assets under its purview using ESRI ArcMap Geographic Information Systems (GIS) software. The system assists staff in processing service requests (such as for inspections or new tree planting), generating work orders for operations (such as tree pruning or removal), and logging work orders completed by forestry crews.

A Forestry Call Centre is in place to receive public requests for tree maintenance or planting. Work scheduling depends in part upon order sequence, as well as the nature of the request. All requests are inspected by the Forestry Technician or, as required, by external contractors. Tree attributes such as location, species, condition (Good, Fair, Poor), height, and diameter at breast height (dbh) are recorded for each inspection. Work orders may then be generated on a priority-ranked basis (Emergency, P1, P2 or P3, in descending order), and supported by short descriptions of the work and equipment and personnel requirement notes.

Once coordinated with the existing asset management structure, the recently completed 55,000 street tree inventory will significantly enhance the City's ability to manage trees on a more systematic and proactive basis. The inventory includes all trees within the municipal right-of-way, as well as trees located within approximately 2 metres of the property line. Each inventory record contains information about species, diameter at breast height (dbh), structural and biological conditions, and a risk assessment rating. Other inventory attributes recorded, where applicable, are the presence of nearby utility lines, management recommendation(s), and the presence/absence of visually apparent signs or symptoms of EAB infestation (for ash trees). The inventory is maintained on a Geographic Information Systems (GIS) platform, allowing for easy database querying and record retrieval.

Best Practices and Precedents: Program Administration and Asset Management

Service Delivery Models

Most Ontario municipalities implement a joint service delivery model, using both in-house staff and contractors to undertake urban forest maintenance. A key variable 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, while planting is typically a contracted service.

Importance of a Tree Inventory and Asset Management System

A comprehensive inventory is the foundation of good urban forest management. It is virtually impossible to manage any asset effectively without knowing the nature and condition of that asset. Although many municipalities maintain inventories of a variety of infrastructure elements, such as fleet vehicles or government facilities, far fewer communities fully benefit from maintaining a similar knowledge base of their green infrastructure components, including municipally-owned trees.

Typically, a tree inventory is undertaken to identify individual trees within a given study area and to assess a collection of attributes such as location, size, health and condition, while more advanced inventories will also include maintenance requirements.

A comprehensive tree inventory and asset management system that can track, prioritize and plan maintenance activities is one of the most useful tools available to urban forest managers to accomplish a variety of goals. For example, tree inventories allow priority-based maintenance requirements to be planned in a proactive manner, species-based pest management strategies to be developed and implemented, and tree establishment needs, priorities and opportunities to be assessed. Tree inventories also serve as an invaluable aid to public education and outreach, acting as a centrepiece for awareness and communication efforts by highlighting individual significant trees, species diversity trends, and potential threats or challenges (such as Emerald Ash Borer).

Opportunities for Improvement: Program Administration and Asset Management

The City's administration of its urban forestry program and the mechanisms in place for management of its tree assets are effective, and no significant gaps or opportunities for improvement are identified.

Resources

However, as clearly evidenced by the extensive list of responsibilities of the Forestry Division, additional resources are required to administer the program, provide appropriate levels of service, and fulfill the diverse roles required of the Division. The current staffing complement of six (one Manager, one Forestry Technician and four Foresters / Arborists) is insufficient to enable the Division to adequately fulfill its roles – especially effective tree preservation planning review and various aspects of compliance enforcement. The staffing shortage has been particularly pressing due to a significant increase in urban forest maintenance requirements as a result of the December 2013 ice storm and the ongoing Emerald Ash Borer infestation. Given increasing anticipated stressors upon the urban forest, ongoing development, and additional actions required to manage the urban forest sustainably, the trend of increasing workload for urban forestry staff is anticipated to continue. As such, additional staffing resources are necessary for continued improvement in the administration of the urban forestry program in Cambridge.

Additional staffing requirements, as well as resources required to contract out some services, have been identified and estimated in the implementation section of this Plan (see Section 4). However, the adequacy of approved resources in relation to identified needs should be carefully reviewed at the Plan review period, near the end of the second five-year management period in 2024. The review should: (a) ensure that existing service level commitments are being met, (b) ensure that any required changes in services levels over the latter two five-year periods of the Plan can be adequately addressed, and (c) determine which actions and targets identified in the original Plan may not be fulfilled due to resource constraints.

Recommended Actions: Program Administration and Asset Management

15. Undertake a comprehensive review of Forestry Division workload and service levels to determine appropriate staffing levels to ensure adequate service provision

Implementation Notes: This review should be undertaken before the end of the second five-year management period (in 2024) to assess how the priorities identified in the Plan are being addressed with the additional resources approved up to that point, and what additonal resources may still be required.

3.3.2 Tree Maintenance and Tree Risk Management

Current Practices: Tree Maintenance and Tree Risk Management

Maintenance of the urban forest includes various practices that contribute to preserving and enhancing, where possible, the health and structural condition of trees in the urban setting for the long-term provision of urban forest benefits. Municipalities typically implement a maintenance program that includes a combination of pruning, tree risk mitigation and removal, watering and fertiliztion, among other important practices.

Tree Risk Management

Although the Forestry Division bears responsibility for a wide range of public tree maintenance duties, the current level of service provided by the City with regard to the majority of tree maintenance is directed primarily towards mitigating risk and limiting liability exposure, and typically involves canopy pruning or tree removal. Tree risk management in Cambridge is informed by the Forestry Division's 'Safety and Probability Risk Assessment' policy, which includes guidance for assessment and points-based Tree Risk Rating. Risk associated with publicly-owned trees is typically addressed upon receipt of a public complaint or when potential risks are observed by staff or tree maintenance contractors. Complaints are addressed on a priority basis, but large complaint volumes and Forestry staffing shortages have resulted in periodic backlogs and service delivery delays. Where trees are confirmed by City staff assessments as exhibiting an elevated level of risk to persons or property, any necessary mitigation practices such as pruning, removal or, on a more limited basis, supplemental support systems such as cabling, are undertaken by City staff or contractors. Trees that may require maintenance but do not present immediate concerns are logged for future work. Preservation of trees is the stated preference of the Forestry Division, which opts to administer risk mitigation over tree removal wherever possible. Property owners adjacent to municipal trees that are designated for removal or maintenance work typically are notified of the nature and anticipated timing of the planned work through informational flyers. The City's tree risk management program has been implemented on a largely reactive basis, and the recent completion of the city-wide street tree inventory, including risk assessment in accordance with recently-developed industry standards and Best Management Practices, will enable the Forestry Division to transition towards more proactive tree risk management.

Privately-owned Trees and Risk

Trees located on private property may pose risk to public rights-of-way (and their users) or to neighbouring private properties. Currently, City crews may undertake risk mitigation if privately-owned trees pose an identified risk to public rights-of-way, but the Property Standards By-law (181-04) does not empower City staff to inspect trees on private property or to compel property owners to mitigate tree risk. This may pose significant risk issues as ash trees on private property succumb to Emerald Ash Borer, which significantly increases the likelihood of failure, potentially posing risk to public and private properties.

Utility Pruning

The Forestry Division also works in limited coordination with Cambridge and North Dumfries Hydro Inc., whose contractors maintain line clearances to prevent utility conflicts and service disruptions. Hydro staff report that older neighbourhoods with above-ground utilities tend to be where many of the largest trees in Cambridge are found, and that these trees pose greater potential problems for hydro operations. Norway maples and silver maples are also considered by hydro staff as posing greater potential problems associated with branch failures as they mature. Hydro crews typically prune trees on a more frequent basis than the City does (see Section 3.1.2), which may lead to duplication of efforts or excessive pruning of individual trees, as utility contractors prune to achieve minimum legislated clearance requirements of 3 metres. The utility does not generally remove trees for hydro clearance purposes; if necessary, removals and stumping are undertaken by the City.

Wood Disposal

Wood generated from tree removal and corrective pruning operations is taken to the City's wood disposal site, and bids are advertised annually for the purchase of saleable wood. Owners of property adjacent to municipal lands from which trees are removed are also offered first refusal to any wood (less than 12'' diameter and 4' length) that is suitable for use as firewood.

Best Practices and Precedents: Tree Maintenance and Tree Risk Management

Tree Risk Management Policy

A Tree Risk Management Policy can help to ensure the effective implementation of tree risk management efforts by outlining reasonable expectations (also known as the Standard of Care) and supporting the allocation of necessary resources to reduce tree-related risk, uncertainty and liability. An effective Tree Risk Management Policy will coordinate various aspects of tree risk management, including inspection, mitigation and proactive planning, and should include the following components:

- A Policy Statement, framing the scope of the policy and assigning responsibility, goals and standard of care statement;
- Determination of acceptable risk;
- Minimum training and qualifications of risk assessors;
- Frequency of assessment;
- Management options;

- Record-keeping protocols;
- Strategy funding and/or partnerships, and;
- Program assessment and reporting.

Tree Risk – ANSI Standard and Best Management Practices

In the absence of a Canadian national standard, the American National Standards Institute (ANSI) Standard A300 Part 9: *Tree, Shrub and Other Woody Plant Management – Standard Practices (Tree Risk Assessment a. Tree Structure Assessment)* and the associated companion publication (International Society of Arboriculture 2011 *Best Management Practices – Tree Risk Assessment*) provide the first comprehensive Standard and industry-supported Best Management Practices (BMPs) for tree risk assessment and rating in North America. The Standard and BMPs outline various factors of risk assessment, and should be incorporated into municipal tree risk assessment and management activities.

Utility Coordination

Several municipalities, such as London, Mississauga, Oakville and Toronto, maintain a Public Utilities Coordination Committee (PUCC) or similar working group. Such groups bring together members of different utility stakeholder groups, such as transportation agencies and local utilities, to discuss various issues, including tree maintenance. Such groups meet on a regular and/or as-needed basis, and can increase the effectiveness and efficiency of work planning and implementation.

Property Standards By-laws

In many municipalities, staff is empowered to inspect private property if privately-owned trees are considered to pose risk to neighbouring properties or public rights-of-way. For example, Town of Oakville staff actively enforce the Town's Property Standards by-law by issuing orders for advanced tree risk assessment, tree pruning, or tree removal, and the Town's website specifically states that, "dead and dying trees become high risk and may constitute a violation of the Property Standards By-Law." In many jurisdictions, the municipality may undertake mitigation work on private properties if owners fail to comply and apply the costs to the subject property's tax rolls.

Young Tree Maintenance

Pruning during the 'formative years' of a tree's life, which can be conducted from the ground at little cost, is one of the best possible investments in the future urban forest. Young tree pruning, or "training", provides trees with good form which can be maintained throughout their lives, thereby reducing the risk of future failure and reducing liability and long-term arboricultural maintenance requirements. Immature trees should be pruned at least three times within the first ten years after planting to train them towards good structure. It is typically not practical to incorporate young tree pruning into a broader cyclical pruning program, as the work does not require arborists equipped with aerial lift equipment or wood chippers to tend to small trees reachable from the ground. Instead, annual planting lists should be used to plan young tree pruning, and municipal staff or contractors should be trained in proper young tree pruning methods.

Opportunities for Improvement: Tree Maintenance and Tree Risk Management

Tree Inventory

Currently, the City of Cambridge undertakes street and park tree maintenance on a largely reactive basis. The recent collection of inventory data for 55,000 street trees will significantly improve the City's ability to proactively address maintenance requirements for trees within the municipal road right-of-way, as the Forestry Division integrates inventory findings with the City's tree asset management software to prioritize, tender and track work requirements. The inventory includes over 5,500 tree-specific, priority-based management recommendations such as pruning (risk reduction, deadwood removal, maintenance, utility clearance), hanging branch removal, and tree removal. Additionally, approximately 17,800 trees were noted for the presence of nearby utility line(s) that may require future conflict management interventions.

Cyclical Pruning

Upon completion of priority maintenance, the City should begin phased-in implementation of a cyclical pruning program for all City-owned trees within road rights-of-way. As noted, numerous iterations of a cyclical pruning program are possible, and a solution tailored to the City's operational circumstances must be developed. Factors to be considered in the development and implementation of such a program should include: current and projected resource availability, the condition and distribution of the street tree population, opportunities for interagency collaboration and resource sharing (i.e., reducing duplication of efforts related to hydro clearance pruning); and the service delivery model (i.e., in-house, contracted or combined). A specific pruning cycle length is not currently recommended, although a 7 or 8-year cycle is common among many municipalities and provides an acceptable cost-benefit ratio.

Young Tree Maintenance

Implementation of a young tree structural pruning program, separately from the cyclical street tree pruning program, is strongly recommended. The program may need to be delivered by developers in the years prior to Assumption of plant material and carried forward by the City in later years, unless the entire tree establishment program is wholly undertaken by the City (see Section 3.2.8).

Park and Woodland Trees

Although many municipalities implement cyclical pruning for street trees, trees in park areas and within or at the edge of municipally-owned woodlands are typically maintained on a reactive or as-needed basis; cyclical pruning for park trees is typically cost-prohibitive relative to the benefits provided. Therefore, a comprehensive inventory of trees in actively-managed, higher-use park areas should be undertaken to identify priority maintenance requirements and enable effective risk mitigation. Such an inventory will also help guide tree establishment planning and Emerald Ash Borer management in City parks. Additionally, trees with visually-observed elevated risk of tip-out from woodland edges and along trails should be inventoried and managed (see Section 3.3.4 for discussion of woodland edge/trail ash trees.)

Tree Risk Management Policy

The City's current tree risk management policy outlines the use of a points-based tree risk rating method. This method no longer conforms to industry-adopted Best Management Practices, and is known to over-exaggerate tree risk ratings. The policy should therefore be revised to include guidance provided by current industry standards and BMPs, including different risk assessment levels (Level 1: Basic Assessment through Level 3: Advanced Techniques) and the two-part likelihood/target assessment and risk rating matrix (see sidebar).

Property Standards By-law

The lack of ability by City staff to undertake tree risk inspection and compel property owners to undertake tree risk mitigation on private properties may become problematic as more of the urban forest succumbs to Emerald Ash Borer, which significantly increases the likelihood of tree failure. Provisions in the Property Standards By-law to enable such actions should be enacted. By-law revisions will need to be supported by adequate resources for enforcement and implementation.

The ISA Best Management Practice Two-part Tree Risk Assessment Matrix

(in accordance with ANSI A300 Part 9: Tree, Shrub and Other Woody Plants Management – Standard Practices (Tree Risk Assessment a. Tree Structure Assessment) and International Society of Arboriculture (ISA) Tree Risk Assessment Best Management Practices)

Part a: Likelihood/target assessment (shade one)

Likelihood of Failure	***Likelihood of Impacting Target***			
	Very Low	***Low***	***Medium***	***High***
Imminent	*Unlikely*	*Somewhat likely*	*Likely*	*Very likely*
Probable	*Unlikely*	*Unlikely*	*Somewhat likely*	*Likely*
Possible	*Unlikely*	*Unlikely*	*Unlikely*	*Somewhat likely*
Improbable	*Unlikely*	*Unlikely*	*Unlikely*	*Unlikely*

Part b: Risk Rating (shade one)

Likelihood of Failure and Impact	***Consequences***			
	Negligible	***Minor***	***Significant***	***Severe***
Very Likely	*Low*	*Moderate*	*High*	*Extreme*
Likely	*Low*	*Moderate*	*High*	*High*
Somewhat Likely	*Low*	*Low*	*Moderate*	*Moderate*
Unlikely	*Low*	*Low*	*Low*	*Low*

Recommended Actions: Tree Maintenance and Tree Risk Management

16. Utilize 2014 street tree inventory to carry out high-priority tree maintenance and address utility conflicts.

Implementation Notes: Utilize tree inventory findings to prioritize work. Consider sharing utility conflict information with Cambridge and North Dumfries Hydro to address potential utility conflicts efficiently.

17. ***Develop and phase-in implementation of a cyclical pruning program for City-owned street trees.***

    Implementation Notes: Begin phased-in implementation of pruning cycle by 2020 or following completion of all inventory-recommended tree maintenance work. Structure of pruning cycle program to be determined based upon several factors, including: current and projected resource availability, the condition and distribution of the street tree population, opportunities for interagency collaboration and resource sharing; and the service delivery model.

18. ***Develop and implement a young tree structural pruning (training) program.***

    Implementation Notes: Minimum 3 pruning rounds in first 10 years. Program to be developed and implemented separately from cyclical pruning program.

19. ***Undertake inventory of trees in high-use public park areas and along City-owned woodland edges, and carry out priority maintenance.***

    Implementation Notes: GIS-based inventory with same attributes as street tree inventory of trees in actively-managed (e.g., mowed) areas and frequently-used areas of City parks; visually-observed potential risk trees at edges of woodlands/natural areas and public trails to be included (within possible tip-out distance, or 1.5x tree height).

20. ***Update the tree risk management policy (Policy – Safety and Probability Risk Assessment) to reflect new industry standards and Best Management Practices.***

    Implementation Notes: Update internal policy and procedure to incorporate ANSI A300 Part 9 standard and ISA Best Management Practices guidance and remove points-based system.

21. ***Revise the City's Property Standards By-law (181-04) to enable the City to order risk mitigation for trees which pose potential high risk to neighbouring public or private property, on a complaints-based and proactive basis.***

    Implementation Notes: Enable staff to undertake tree risk inspection on private property on a complaints-based and/or proactive basis, and enable City to require owners to undertake necessary tree risk mitigation actions for health and safety reasons if trees pose high risk. City staff to advise property owners with dead or dying ash which may pose risk that trees require removal. Ensure adequate resources for enforcement and implementation.

3.3.3 Woodland Management

Current Practices: Woodland Management

Based on the results of the *City of Cambridge Urban Forest Canopy Assessment* (2013) and the review of the available subwatershed studies within the city (Appendix B), it is estimated that at least half of Cambridge's current canopy cover is found in wooded natural areas (i.e., at least 14% of the city). Many of these wooded natural areas are under private ownership, but some are owned by the Region, GRCA or the City. Most woodlands on private property in the city are protected through existing policies and regulation. The current Official Plan (2012) policies (see Section 3.2.1) provide a high level of protection for woodlands considered as Core Environmental Features (i.e. no development permitted within the feature, and a minimum 10 m buffer required around it), and also require special consideration for wooded areas meeting Locally Significant Natural Areas criteria. In addition, the Region's Conservation of Trees in Woodlands By-law (2008) regulates all woodlands of at least 1 ha in the city (see Section 3.2.3), providing an additional control for proposed woodland removals outside of the planning process.

Management of these privately owned woodlands is at the discretion of the landowner (as long as this management does not conflict with the applicable policies or regulations). Both the Region's and the City's Official Plans encourage maintenance of these features, and indicate the Region, GRCA and MNRF are available to provide free guidance related to land stewardship.

In terms of publicly-owned wooded natural areas, the Region owns and manages three tracts (Region of Waterloo, 2006):

- Cambridge Landfill Woodland – 39.8 ha, not open to the public, fairly degraded, unmanaged
- Hilborn Knoll Woodland – 5.5 ha, associated w Portuguese Swamp ESPA, oak dominated forest, subject to intermittent management
- Operations Centre Woodland – 7.5 ha, mainly hardwood (ranging from upland to swamp), impacts from changes in hydrology and salt, not open to the public

The GRCA owns and manages Dumfries Conservation Area (GRCA 2005), although primarily for passive recreational uses. They also own and more actively manage Shade Mills Conservation Area, which includes some wooded areas. The GRCA has also developed *A Watershed Forest Plan for the Grand River* (2004) that recognizes the benefits, as well as threats and challenges of these forested areas, and lists more than 20 management action items. These include establishing a monitoring program, using indigenous species, developing silvicultural guides for rural and urban landowners, and further integrating urban forests into municipal planning and management.

Tree risk along formal trails in woodlands is managed – trails are inspected monthly and tree removals are undertaken accordingly. However, the City of Cambridge currently does not have a city-wide inventory of its woodlands, and does not currently undertake intensive woodland management. Participants at the first public meeting for this Plan commented that they feel this presents some risk, as well as a missed opportunity for education and engagement.

Best Practices and Precedents: Woodland Management

Woodland Management Considerations

Natural wooded areas that are surrounded by urban or urbanizing lands are subject to many stressors, particularly if they are publicly accessible. Typical stressors include: impacts related to change in hydrologic regime, disturbance of plants and soils related to trail overuse, informal trail creation and off-trail activities by pedestrians, cyclists and dogs; introduction and spread of invasive species; and encroachment from adjacent land uses (e.g., dumping of waste, extending backyard activities and structures into the natural area, etc.). All of these impacts can cumulatively contribute to the overall degradation of the natural area (e.g., lower native species diversity, reduced natural regeneration, loss of habitat for specialized and forest wildlife species, etc.).

Management of publicly accessible natural areas is an ongoing exercise, and an ongoing challenge in most municipalities due to limited resources available for these types of activities. There are however, management tools that can be implemented to help manage and reduce these impacts (e.g., well-planned access points, design of trails that direct people around and away from areas most sensitive to disturbance, installation of boardwalks and lookouts over erosion prone areas, installation of educational signs and clear direction related to permitted uses, etc.). Ideally, these should be identified through site-specific management plans that consider the conditions and sensitivities of the given site, as well as the nature of the anticipated or existing external and internal uses. Examples of comprehensive and progressive management plans for wooded natural areas in urban and urbanizing settings include the Greenwood Conservation Area Management Plan (2004) in Ajax, Huron Natural Area Master Plan (2009) in Kitchener, and Crothers Wood Management Plan (2007) in Toronto. Notably, all of these were undertaken in partnership with local conservation authorities, or with the help of government grants, and in consultation with local users and stakeholders.

City-Owned Woodland Risk Considerations

Where there are insufficient resources to undertake more comprehensive management plans, municipalities should prioritize removal of high-risk trees from woodland edges and along formal trails, and undertake scheduled risk assessments in these portions of public and accessible woodlands.

Partnerships for Public Woodland Management

Alternative approaches being pursued by some municipalities to balance the desire for managed, public woodlands with the lack of resources for municipal woodland management include:

- negotiating for proponents to undertake some initial management of wooded areas prior to public assumption as part of the planning process (e.g., Milton, Guelph)
- use of community and volunteer organizations to undertake some of the resource intensive management that is low-risk and has little equipment requirements, such as invasive species control and naturalization / plantings (e.g., Mississauga, London, Toronto)

Opportunities for Improvement: Woodland Management

Inventory of City-owned Woodlands

Prior to considering management options within its woodlands, the City first requires a high level inventory and assessment of these woodlands. This inventory should confirm the extent and locations of City-owned woodlands, and also provide some basic information about each one (e.g., basic forest / woodland community type(s), whether or not the area is accessible, level and types of apparent use, identification of key management issues such as invasive species, abundance of ash trees or other high risk specimens, etc.). The information should be sufficient to allow the City to prioritize which woodlands should be targeted for management, and should consider feature sensitivities and anticipated active management needs, as well as local opportunities for building awareness and fostering stewardship.

Management of Priority Woodland(s)

Once an inventory of the City's woodlands has been completed, the City should gradually work towards undertaking targeted management in these areas, ideally with guidance from site-specific management plans that consider:

- Silvicultural management requirements
- Tree risk management
- Presence of invasive plant species and noxious/poisonous plant species
- Presence of EAB infested/susceptible trees, and other forest pests or pathogens
- Trail management (e.g. maintaining safe trails, closure of unsanctioned trails)
- Management of unsanctioned activities (e.g., encroachments, mountain bike use, vandalism)
- Naturalization / restoration opportunities
- Management of soil erosion and/or compaction
- Protection of Species at Risk or other specialized habitats, and
- Educational and stewardship opportunities.

Woodland Risk Management

If resources are insufficient to allocate towards a woodland inventory and supporting site-specific woodland management plans, the City should continue to work towards more proactive risk management of City-owned woodlands. Key aspects of this management should include continued identification and removal of high-risk trees and management of ash trees along formal trails, and inspection/monitoring and management along woodland edges where potential targets exist.

Recommended Actions: Woodland Management

22. Undertake an inventory of City-owned woodlands

Implementation Notes**:** This inventory should be at a relatively high level but provide a map of all City-owned woodland as well as sufficient guidance to prioritize areas for management.

23. Once an inventory of City-owned woodlands is complete, start to undertake management of priority woodlands

Implementation Notes**:** Site-specific woodland management should focus on balancing protection and sustainability of the woodland (and its associated ecosystem services) with appropriate use and access that can help build awareness and engagement.

3.3.4 Pest and Disease Management, including Emerald Ash Borer (EAB)

Current Practices: Pest and Disease Management

Pests and Diseases – General

The City has adopted an approach to urban forest pest and disease management program that adheres to the general principles of Plant Health Care (PHC) and Integrated Pest Management (IPM). As such, the Forestry Division attempts to correct tree disorders through the use of non-chemical control mechanisms wherever possible. The application of chemical controls is generally avoided, but may be adopted (in accordance with Provincial regulations) if pest or disease pressures surpass thresholds predetermined on the basis of "tree species, the type of pest or disease, the season and prevailing weather patterns" (*Policy and Procedures Manual*). As part of the City's pest and disease management efforts, the *Engineering Standards and Development Manual* promotes selection of a variety of species as an effective strategy to reduce the incidence of and susceptibility to pests and diseases.

Emerald Ash Borer (EAB)

One of the most pressing threats to the urban forest is Emerald Ash Borer (*Agrilus planipennis*), a non-native invasive wood-boring insect that has caused widespread mortality to ash (genus *Fraxinus*) trees across eastern North America since its discovery in 2002 in the Windsor and Detroit area. Significant financial and human resources will be required to protect selected ash trees and to remove and replace dead and dying ones.

The presence of EAB in Cambridge was confirmed in August, 2010, and in September of that year City staff issued a status update and initial management objectives to Council. A December 2013 report to Council further recommended the undertaking of an EAB Management capital project, with the majority of the funding allocated towards an inventory of City-owned ash trees. Staff estimated that ash tree preservation, removal and replanting requirements resulting from EAB infestation would cost roughly $7.7 million over 7 years. The city-wide inventory conducted in 2014 found that, among 4,095 City-owned inventoried ash street trees, over 30% presented a Moderate or High risk, and another 30% showed positive signs and/or symptoms of EAB infestation. There is currently no inventory of ash trees in parks or along City-owned woodland edges, where dead ash trees may pose risk due to tip-out potential.

Best Practices and Precedents: Pest and Disease Management

Tree Inventory

A tree inventory is an essential tool to enable managers to effectively address urban forest pest and disease stressors. Knowledge of the location, size and condition of trees enables municipalities to prioritize management activities depending upon the distribution, condition, risk potential and/or size of vulnerable species. For example, a detailed inventory allows managers to effectively plan and budget for stem injection treatments of valuable ash trees and pre-emptive or timely removals of lower-value trees which will become infested by EAB.

Plantable Space Inventory

A GIS-based inventory of potential plantable spaces, including classification based upon the type of surface (e.g., lawn, hardscape cut-out, etc.) and potential tree size (small, medium, large) can also support the municipal response to wide-scale urban forest pest and disease outbreaks, such as EAB infestation. This highly effective tool can assist in planning and budgeting for tree establishment to improve urban forest diversity and reduce the effects of canopy loss. Communities such as Cornwall and New Tecumseth have collected plantable space inventories as part of their comprehensive EAB management programs.

Woodland Edge/Trail Inventory – Ash Trees

While street and (to a lesser extent) park ash trees may pose the most visible risk following EAB-induced mortality, ash trees located on woodland edges and along trails may pose significant risk to neighbouring properties or trail users. As such, several communities have recognized the importance of woodland ash tree inventories and risk assessments. In such inventories, all ash trees within potential tip-out distance (approximately 1.5 times tree height) of woodland edges or trails are inventoried, either individually or in groups. Because woodland ash trees will generally be removed and not treated, the inventory can be tailored to provide an understanding of potential risk exposure, budget for tree removal contracts, and assess the extent of infestation. Communities such as Cornwall and Mississauga have undertaken woodland edge/trail ash tree inventories as part of their EAB management programs, and Mississauga has undertaken the removal of many potentially hazardous and dead ash trees as informed by its inventory.

Adaptive Pest Management Strategies

Effective urban forest pest and disease management requires flexible, adaptive approaches tailored to address the specific challenges posed by different stressors. Key concepts for pest and disease management, which should be considered in all adaptive pest management strategies, include Plant Health Care (PHC) and Integrated Pest Management (IPM) (see box, page 74).

Effective pest management strategies, including a strategy to manage Emerald Ash Borer infestation, should include several components, including:

- A tree inventory, including ash trees and available potential plantable spaces
- Infestation survey methodologies
- Management zones; or areas where various types/scheduling of management may be applied
- Management strategies, including pre-emptive and reactive ash tree removals and stem-injectable insecticide treatments
- Tree replacement; considering adequate replacement ratios and suitable species
- Communication and public education
- Performance targets and monitoring framework, and
- Cost analysis and budget.

Opportunities for Improvement: Pest and Disease Management

The City's approach to pest and disease management is largely in accordance with recognized best management practices, including Integrated Pest Management and Plant Health Care. The recent street tree inventory identified EAB-infested ash trees and other urban forest pest and disease issues, which will be managed as required. With a detailed understanding of street tree species composition, the City can increase its preparedness for other pests and diseases through a basic assessment of species vulnerabilities, such as the Pest Vulnerability Matrix approach (Laćan and McBride, 2008).

The recently-collected street ash tree inventory data provides a substantial amount of information that is useful for the near to long-term planning and management of Emerald Ash Borer and ash trees in the city. Information such as location, health and condition and diameter class distribution can inform and significantly improve the City's EAB management efforts. For example, the newly-available information will enable the City to identify high preservation priority ash trees (i.e., candidates for protection through stem injection of insecticides such as IMA-Jet™ or TreeAzin™), plan reactive and pre-emptive removals and replacement plantings, and assess and mitigate risk. Perhaps most importantly, the inventory will enable the City to significantly improve its budget forecasting for the EAB management program, thereby ensuring that City Council is informed of the resources required to manage this significant threat to the urban forest. The City's EAB management strategy should be developed upon the basis of information from the street tree inventory and recommendations in this Plan, and must address near-term issues including ash tree inventory, removal, replacement planting, treatment of high-value trees, program administration, and internal/external communications. The EAB management program should include a public notification and awareness campaign regarding future extensive ash tree removals, as well as resources (e.g., web site or brochures) to help property owners identify and manage their own ash trees.

Recommended Actions: Pest and Disease Management

24. Prepare a Pest Vulnerability Matrix or similar pest and disease threat assessment and management options report utilizing 2014 street tree inventory data

Implementation Notes: Utilize Laćan and McBride (2008) Pest Vulnerability Matrix (PVM) or similar approach to assess potential threats related to pests and diseases in the street tree population. Prepare preliminary summary of control and management options as part of City's IPM program to increase readiness.

25. Develop an Emerald Ash Borer strategy, including use of data from the 2014 street tree inventory

Implementation Notes: Utilize inventory findings to update costs, overall management approach, and specific actions (e.g., tree removals, injection treatments). The EAB strategy must address near-term issues including ash tree removal, replacement planting, treatment of high-value trees, program administration, and internal/external communication.

26. Undertake an inventory of ash trees in City-owned parks (if complete park tree inventory not undertaken) and edges of City-owned woodlands

Implementation Notes: Inventory all ash trees in actively-managed/high-use and natural edge (identify tip-out potential) park areas and City-owned woodlands.

Plant Health Care (PHC)

Trees in urban areas face many stresses, making them increasingly susceptible to pests and diseases. Stressed trees are also more prone to structural problems, which may be further compounded by long intervals between inspection and maintenance, as well as inadequate cultural practices. A coordinated approach to manage pests, diseases and invasive species, maintain an optimal growing environment, and promote good tree form and structure is called Plant Health Care (PHC). PHC also recognizes the importance of other landscape plants such as shrubs and grasses, and the positive or negative influence these plants may have on tree health.

Integrated Pest Management (IPM)

Integrated Pest Management (IPM) is a similar concept, which aims to assess and control pest populations through a combination of early detection, cultural practices and pesticides, if required. The six key components of an IPM program include:

1. **Acceptable pest levels:** This principle recognizes that eradication of pest and pathogen species is generally impossible and often undesirable. An effective IPM program will establish an acceptable threshold, above and beyond which control actions will be undertaken.
2. **Preventive cultural practices:** Methods such as appropriate species selection, maintaining vitality (e.g., watering), pruning, etc. are the first step towards maintaining acceptable pest population levels and reducing pest pressure.

3. **Monitoring:** Regular and comprehensive inspection and identification of pest and pathogen pressure is a critical step of effective pest management, enabling rapid response if necessary.
4. **Mechanical controls:** Should pest and pathogen levels reach unacceptable levels, mechanical controls such as pruning, trapping, barrier installation or the like should be investigated and, if viable, implemented before resorting to other methods.
5. **Biological control:** Natural processes, such as beneficial insects or microorganisms that target the undesirable pests, should be considered prior to synthetic pesticide use.
6. **Reasonable pesticide use:** If all other methods fail to achieve acceptable pest levels, insecticides should be considered. Pesticide use should focus on targeting specific pests at the appropriate life stage; broad-spectrum pesticides should be avoided if at all possible. Furthermore, efforts should be made to reduce the likelihood of pests developing resistance to the active ingredients used in the control program.

3.3.5 Tree Establishment – Operations

Current Practices: Tree Establishment – Operations

A primary mechanism for tree planting Cambridge is development. Development approval typically requires the provision of, at minimum, street trees, and additional plantings in parklands or stormwater management facilities may also be required (depending upon the nature of the development). However, in addition to development-related tree planting, the urban forest is also enhanced through tree planting as part of Forestry operations, through resident requests, and by volunteer-based efforts.

The City plants on average 200-250 trees per year as part of its planting operations, including trees planted for the replacement of removed street and park trees, in response to resident requests, and as part of the municipal Tree Dedication Program. Newly planted municipal trees are to undergo a program of deep root watering and fertilization in June of each year. Residents can submit requests for the planting of certain tree species, and the City maintains a list of species suitable for planting in different urban growing conditions, emphasizing wherever possible the selection of Carolinian and other species that are indigenous to the area. All species requested by residents are subject to the approval of City staff. Public requests for tree planting are received until March 15th for spring planting and September 15th for fall planting, and plantings are scheduled for May and October/November of each year, unless adverse weather conditions call for rescheduling. The location of plantable spaces is determined through staff knowledge of local planting needs or through resident requests. 50-70 mm wire basket or ball-and-burlap nursery stock is planted.

Volunteer-based community groups are also involved in tree planting initiatives in and around Cambridge. Cambridge City Green, a subcommittee of the Cambridge Environmental Advisory Committee (CEAC), has driven a number of tree planting initiatives across the city. One such initiative is the Cambridge Stewardship planting project, a fifth of which is funded by the City, with the balance of funds raised from the community. Between 2007 and 2014, the group coordinated the planting of approximately 3,500 trees and 1,500 shrubs at 21 sites across the city. Among other stewardship efforts,

the group also helps in organizing TD Tree Days, fundraising, distributing the Cambridge Natural Heritage Tour and Grow Me Instead booklet (for homeowners to plant non-invasive and/or native tree species) and urban forest promotion campaigns.

Best Practices and Precedents: Tree Establishment – Operations

Comprehensive Young Tree Maintenance

Transplant failure can be greatly reduced with a dedicated program of post-planting young tree maintenance. While such a program can increase up-front costs, long-term savings are achieved as fewer trees require replacement after warranty periods expire and urban benefits are provided more quickly. York Region, which began a program of improved post-planting street tree maintenance in 2004, found that four key factors influence street tree performance. These include: 1) water availability, 2) soil quality and quantity, 3) stock quality and planting practices, and 4) environmental conditions, including salt loading. The enhanced maintenance program focused on increasing watering, enhancing species and stock selection, improving planting practices, integrating trees into site design, and monitoring.

Through program implementation, the Region has increased the proportion of good-condition young trees to 76%, up from 28% seven years earlier. The Region's comprehensive Street Tree Planting Program, which focuses on post-planting care, serves as a model for improving municipal tree planting programs. Key program components include:

- Frequent tree watering, a minimum of 14 times per year for the first three growing seasons;
- Automated Vehicle Location (AVL) systems to track watering contractors to ensure compliance;
- Funding of maintenance as part of planting cost (capital budget), rather than operations, to ensure adequate long-term funding;
- Improved site preparation prior to planting;
- Improved contract audit and inspection protocols;
- Pre-selection at nursery of every tree by trained Region staff;
- Post-planting inspection of every tree to ensure compliance;
- Minimum soil volume targets, and;
- Long-term planning for integration of trees into built sites following completion of construction.

Opportunities for Improvement: Tree Establishment – Operations

Operations-based tree establishment in Cambridge is administered in a similar manner as in most municipalities, with the majority of plantings taking place to replace removed trees or through resident requests. However, there are opportunities to improve this aspect of the urban forestry program and promote the long-term health and sustainability of the street tree population.

Species selection

Tree species selection for operations-based tree establishment is determined by the Forestry Division. As such, it is not necessary for the City to maintain an exhaustive or restrictive list of species for planting in the municipal right-of-way, and the Division should be encouraged to plant a diversity of currently underutilized or novel species. Planting such species, with a dedicated program to track their long-term performance, will help to inform future species selection and help the urban forest adapt to climate change and its associated stressors.

Nursery stock

Among the most significant causes of premature tree mortality is the establishment of poor-quality nursery stock. Poor-quality stock is characterised by features such as girdling roots, buried trunk flares, inadequately-sized root balls, co-dominant or otherwise poor branch unions, or dieback and disease. Pre-planting inspection by trained staff to ensure compliance with City specifications and Canadian Nursery Landscape Association (CNLA) standards is the only effective way to ensure poor stock is not planted by installation contractors. Ideally, staff would inspect all trees at the nursery prior to purchase and select the best specimens; however, inspection of a selection of stock (e.g., 1/4 prior to installation) and rejection of all materials if a certain proportion fails to meet standards is likely more practicable.

Planting quantity and plantable spaces

If the City's operations-based tree establishment program is to make a meaningful contribution to increasing urban forest canopy and the contribution of benefits, the number of trees planted annually must increase. Based upon modeling assumptions, approximately 128,000 trees will need to be planted by 2034 through various mechanisms to achieve this goal. Assuming that Forestry Division's operations contribute to 1/5 of the total number of plantings, approximately 1,700 trees will need to be planted annually (as of 2020) through replacement, infill and resident request-based plantings. Suitable sites for trees can identified through the Urban Forest Canopy Assessment and accompanying Priority Planting Tool. Factors such as site usage, provision of benefits such as shading or stormwater management, and promoting equitable distribution of urban forest canopy should be considered in the selection of planting sites.

Recommended Actions: Tree Establishment – Operations

27. Improve tree species and planting stock selection and establishment practices.

Implementation Notes: Increase establishment and begin long-term monitoring of Carolinian and other 'climate change-ready' species - Continue planting currently-used species (except known invasive species), but increase proportion of unutilized or underutilized species, including Carolinian trees such as sweetgum, hackberry, buckeye spp., hickory spp., redbud, Kentucky coffeetree, tulip-tree, oak spp., etc. Monitor and report on performance of various species in long-term trials in various sites with objective of informing future management decisions. Undertake pre-planting inspection of planting stock - Forestry Division technicians to inspect all stock to be planted prior to installation, either at nursery (which enables for selection) or as agreed upon with contractors. The City must reserve the right to refuse any stock which does not meet criteria. The City shold investigate opportunities to enter into long-term seed sourcing and stock growing agreement with

local nurseries - Solicit proposals from local nurseries for multi-year growing contracts, with specific provisions for high-quality nursery stock.

28. Increase the diversity and number of trees planted per year as part of Forestry operations to help attain Plan targets

Implementation Notes: The City will need to increase operations-based planting to a minimum of 1,700 caliper-size trees per year to work towards achievement of 30% urban forest canopy by 2034 (assuming 1/5 contribution toward total annual required planting to achieve goal, with the remainder through stewardship and development). Factors such as site usage, benefit provision and promoting equitable distribution of future canopy should be considered in selecting planting sites.

3.4 Outreach, Education and Stewardship

> ***"Any urban forestry program has to integrate people as part of the program itself."***
>
> The Canadian Urban Forest Network (CUFN) Compendium of Best Management Practices

Approximately 80% of the City's current urban forest canopy is found on privately-owned lands, which also contain the majority of opportunities for additional tree planting, reforestation, and stewardship. Therefore, outreach and education related to the tremendous value of the urban forest, as well as support for stewardship on private lands is critical for achieving the targets set out in this Plan.

3.4.1 Website and Social Media Outreach

Current Practices: Website and Social Media Outreach

The City of Cambridge currently has a forestry page on its website that:

- highlights current tree-related stewardship activities sponsored by the City
- lists Forestry services provided by the City
- provides the Forestry Call Centre number and hours
- describes the City's Tree Dedication Program
- links to the City's recommended species lists for residents
- lists and describes current urban forest issues and initiatives (including EAB, the Urban Canopy Assessment Report (2013), this Plan, trees and human health), and
- links to relevant assessments, reports, strategies, plans and policies.

The website pages appear to be updated on a regular basis so that they always contain current information.

Best Practices and Precedents: Website and Social Media Outreach

Websites and social media are becoming primary sources for people seeking information, as well as for outreach and awareness building. Social marketing research (Husqvarna 2013) indicates that one fundamental barrier to fostering stewardship is the growing detachment most people have from nature. Municipal websites represent a cost-effective tool for sharing a wide range of information related to a municipality's natural heritage and urban forest assets, as well as informative links to other websites. However, some websites are more user-friendly and visually appealing than others.

Municipal Urban Forestry Websites

Examples of Canadian jurisdictions with very comprehensive and user-friendly urban forestry websites include the Cities of Toronto, Ottawa and Edmonton. Other municipalities more comparable to Cambridge with engaging forestry sections on their websites include: Richmond Hill, Guelph, and Oakville. The City of Mississauga also has a well-organized and informative series of forestry web pages, as well a recently launched website for its Million Trees program that is visually attractive and engaging.

Websites can also be used, along with other forms of social media, as tools for engagement. A growing number of municipalities with active urban forestry programs are putting their municipal tree inventories on-line for use by City staff in other departments, as well as the community (typically with more limited types of information). The City of London and Town of Oakville have had their inventories on-line for several years, and the City of Ottawa recently launched their on-line tree inventory.

Leveraging Social Media

A few municipalities are starting to build social media outreach into their day to day service. The Cities of Guelph and Mississauga invite anyone to join them on Facebook, Twitter, blogs or newsfeeds. A few, such as the City of Calgary and Toronto-based non-profit organization LEAF, have developed and posted video clips on selected urban forest topics (e.g., how to plant a tree, what to do about EAB).

Finally, a few municipalities, such as Mississauga and Cambridge have their own Call Centres for inquiries about City or Regional programs or services, including Forestry.

Opportunities for Improvement: Website and Social Media Outreach

Website

Although the City of Cambridge has a dedicated Forestry webpage with current and useful information, the format of the page is not optimal (i.e., the user is required to scroll down a relatively long page to scan for topics of interest), and is not very easy to find from the main page. There are currently some limitations to re-designing this page because it must be consistent with the City's overall website format. However, the page could be more useful and engaging if, similar to the City's main page, it had a series of boxes highlighting key forestry topics (e.g., planning/policies/guidelines, management/operations,

outreach/stewardship and resources/links). These boxes would then link users to shorter pages focused on the particular topic(s) of interest.

The website should also be viewed as a platform to both inform and raise awareness. In this context, key themes to convey through the website include:

- well-established connections between the health of the urban forest and human health
- the critical role of individual private citizens, community groups and local businesses and landowners to sustaining the urban forest
- the local programs and resources that are available, and
- how the City is taking a leadership role in working towards a more proactive approach for urban forest management and planning.

The website should also include a link to the Cambridge and North Dumfries Hydro web page regarding tree pruning and planting by Hydro, and the current safety guidance for planting and pruning around utilities.

Social Media

As part of broader website updates, the City should also consider ways to raise its social media profile by setting up one or more social media accounts, and using it as a vehicle for (among other things) promoting urban forest initiatives, including stewardship activities. In the future, the City may also want to consider making components of its street tree inventory available on-line, and developing short video clips that answer frequently asked questions and/or provide key pieces of information (e.g., why the urban forest is a cornerstone of the City's infrastructure, how to plant a tree to maximize energy savings for your home, etc.).

Recommended Actions: Website and Social Media Outreach

29. Improve the format and organization of the City's Forestry webpage to make it more user-friendly and engaging.

Implementation Notes: The suggested format includes several shorter pages that include some consistent visual/graphic cues. These updates could be done independently, but might best be done as part of a City-wide website update, including the creation of one or more social media accounts.

3.4.2 Outreach and Education

Current Practices: Outreach and Education

The Forestry page on the City's website (described in Section 3.4.1) is currently the City's primary source of outreach for urban forest news and activities. However, the City has also developed or undertakren the following related to urban forest education:

- Development of a Natural Heritage Tour (developed in collaboration with the City's Environmental Advisory Committee (CEAC) with support from TD Canada Friends of the Environment) which provides a self-guided tour of representative and unique natural heritage features and areas around the city. The tour is available as a well-designed, well-written and graphically appealing guidebook available in hardcopy, as well as an associated map which is available in hardcopy and on the City's website, and developed as an online Google Map by Cambridge City Green.
- Since 2012 the City has been working with the Waterloo Region Shade Work Group which has developed A Guide for Creating Shady Outdoor Spaces (2014) and associated Shade Tree List, organized annual Shade Forums, and supported shade-supportive policy initiatives.
- As part of the development of this Plan, the City launched a "Focus on Trees" contest with the Cambridge & North Dumfries Community Foundation and Ages Foundation asking participants to submit a photo or artwork representing the urban forest. Seven finalists had their photo / artwork displayed at City Hall, and will have a tree planted on public lands with a bronze plaque in their name in the spring of 2015. One submission of these seven was selected for the cover this Plan.
- The City helps coordinate and participates in the Forest Festival (early October each year) which targets Grade 5 to Grade 7 students in the Region, and includes dozens of tree and forest-related activities ranging from biodiversity and invasive species to tree climbing demonstrations.
- Over 2013 and 2014, as part of the City's urban forest canopy assessment and plan development, as part of the stakeholder and community consultations, City staff have:
    - Developed poster boards featuring information on EAB, the Canopy Assessment and Urban Forest Plan, and current engagement intiiatives (e.g., TD Tree Day, Focus on Trees in Cambridge Contest, Public Meetings)
    - Placed displays at 20 community facilities, local libraries and TD bank branches
    - Made presentations to CEAC, the Shade Work Group, various City Departments, several local schools, the Preston Horticultural Society, the W.G. Johnston / Ted Wake Seniors Centre, Cambridge and North Dumfries Hydro Inc., the GHG Reduction / Adaptation Team, and the Waterloo Region Home Builders Association/City of Cambridge Liaison committee.
- Cambridge City Green, a subcommittee of the Cambridge Environmental Advisory Committee to Council, has obtained *Grow Me Instead* brochures from the Ontario Invasive Plant Council which raise awareness about the threats posed by invasive plant species, and presents indigenous plants readily found in garden centres that have comparable form / appearance to commonly purchased invasive species that can be selected as more sustainable and equally attractive alternatives.

The City is presently producing site-specific factsheets for schools in Cambridge to identify their current canopy and potential plantable areas as identified in the *Urban Forest Canopy Assessment* (2013). These can be used as educational and outreach tools to encourage stronger consideration of local stewardship opportunities.

Best Practices and Precedents: Outreach and Education

Municipalities are increasingly recognizing the importance of branding and marketing their messages to compete on a level playing field with the many other sources of information and imagery that people are exposed to on a daily basis. Typically, larger cities with bigger urban forestry departments offer the broadest range of educational materials and initiatives, but some smaller to mid-sized municipalities are also finding creative ways to engage their communities on limited budgets.

Examples of programs developed in municipalities of comparable size to Cambridge include:

- The City of Guelph's Healthy Landscapes program has its own logo and distinctive look that appears in newspaper advertisements as well as on resources developed for the program. The program provides up to 500 free garden assessments annually to guide residents in the planting of native trees, shrubs and herbaceous plants in their yards. It also encourages reduced reliance on water and the maintenance of attractive gardens without the use of pesticides or other chemicals. The program is complimented by a comprehensive brochure that includes recommended species for planting.
- Workshops on specific urban forest topics or technical issues (e.g., native plant selection, tree planting tips, EAB, etc.) such as those offered by the Town of Oakville and City of Brampton. In some municipalities within the Greater Toronto Area (e.g., Markham, Richmond Hill), the Toronto-based non-profit organization LEAF is available to provide workshops on backyard plantings.

Other best practice recommendations for outreach and education that could be adopted in Cambridge include:

- Providing presentations and workshops in locations where people congregate for work, academic, social or religious reasons, rather than hosting them at City Hall or comparable locations. (Cambridge City staff has already initiated this approach with their Urban Forest Canopy Assessment "road show").
- Working with the local Conservation Authority, and other community groups and local school staff / volunteers, to bringing programs that include education on natural heritage and the urban forest to local schools. The TRCA's "Watershed on Wheels" program has been designed to meet Grades 1 through 8 Ontario science and technology curriculum expectations, and is a half day program available to any school in their jurisdiction on request.
- Trying to engage with the full range of ages and backgrounds in the local community, including youth / students, businesses / corporations, local arboriculture firms and landscapers, developers and their planning consultants, and new Canadians.

Finally, a number of southern Ontario municipalities (e.g., London, Mississauga, Guelph, Hamilton) have developed jurisdiction-wide and/or area-specific brochures targeted to residents who abut wooded natural areas to educate them on being good neighbours to these features. These brochures are typically provided to new homeowners in new or infill development, but can also be provided in established neighbourhoods abutting protected natural areas. Another unique idea related to resident outreach is the use of "door hangers" in Milton to inform residents about tree removals, young tree care, or pest management in their neighbourhoods (e.g., EAB related removals) (see Figure on page 82).

Opportunities for Improvement: Outreach and Education

The activities and initiatives listed under Current Practices above show the City's growing commitment to pursuing various forms of outreach and education related to the urban forest in Cambridge, and in the broader Region. They also illustrate how the City is using the information gathered through current urban forest studies as a platform for expanding outreach and education related to the urban forest. The City should continue to engage in these educational and outreach activities, and build on the information and direction that emerge from the *Urban Forest Canopy Assessment* (2013) and this Plan.

Using the Plantable Spaces Tool for Outreach

As part of the *Urban Forest Canopy Assessment* (2013), mapping of current canopy cover and potential plantable spaces for each Ward, subwatershed and neighbourhood was provided along with an interactive tool whereby planting opportunities can be prioritized based on four distinct considerations related to urban forest contributions to community sustainability:

1. Water Quality: proximity to watercourses
2. Recreation/Public: proximity to public open space
3. Parking: proportion of pervious surface in commercial / industrial areas, or
4. Energy Conservation: residential energy conservation benefits.

This is a unique tool now owned by the City that can be used to encourage neighbourhoods, schools, businesses, etc. to think about the benefits that trees bring to their area, and to demonstrate how they could plant trees on a very site-specific basis to improve local community sustainability. City staff has recently started to develop educational packages for some schools, and should continue to do so for other sectors of the community. There is also an opportunity as part of this outreach to consider the strategic placement of trees to maximize opportunities for shade (particularly near playgrounds and in school yards) and to encourage the selection of shade trees as part of site-level assessment and species selection.

Additional Outreach

Additional items and initiatives that would help educate members of Cambridge's community about good urban forest stewardship being undertaken by the City, and that they could also undertake on their own lands include:

- Information posted on the City's website about tree species selection, planting and maintenance, as well as the numerous ecosystem services provided by Cambridge's urban forest
- Pamphlets (available in hardcopy and digitally) highlighting how to be good neighbours to protected natural areas, particularly woodlands
- Door knockers or door hangers that inform residents about forestry work being undertaken in their neighbourhood (and briefly explaining why) or promoting local stewardship events in a particular neighbourhood
- Temporary displays for local garden centres to be installed (ideally with a person knowledgeable about arboriculture and native trees) in the spring and fall to discourage purchase of invasive trees and shrubs, identify comparable non-invasive alternatives, and provide information on how best to select and situate a shade tree, and
- Annual workshops for development proponents (and their consultants and contractors) concerning the City's current regulations, policies and guidelines related to tree preservation and replacement.

These items would enhance the educational initiatives already underway, and are all considered to be relatively low-cost items that could be readily undertaken by the City without extensive additional effort.

Recommended Actions: Outreach and Education

30. Undertake targeted outreach to various sectors across the City, using the City's plantable spaces tool where appropriate.

Implementation Notes: The City should use the website, pamphlets, and door knockers/hangers as part of a cost-effective community outreach program related to urban forestry, along with seasonal displays at garden centres. An annual workshop for development proponents (and their consultants / contractors) is also recommended to inform them about the City's current tree-related policies and guidelines. The City also has a unique plantable spaces tool applicable on a neighbourhood or smaller scale, which can be used to help engage schools, neighbourhoods, and local businesses in urban forest stewardship and tree planting.

3.4.3 Volunteer Stewardship Programs

Current Practices: Volunteer Stewardship Programs

Cambridge Stewardship was initiated in 2007 by City Green, the Home Depot, the City of Cambridge, Our Lady of Fatima School, and the Cambridge & North Dumfries Community Foundation and Ages Foundation. Its objective was to introduce more indigenous vegetation to the City through dedicated volunteer-based initiatives. Since the inception of this umbrella organization, approximately 10 to 12 planting events have been held under its direction annually, and to date over 3,000 volunteers from more than 60 groups have planted in excess of 9,000 trees, shrubs, and wildflowers (i.e., more than 130 species) at over 20 sites across Cambridge. This has included approximately 3,500 trees (i.e., 500 large potted native trees each year on City parks and properties) over the past eight years.

The RARE charitable research reserve is also located on the edge of the city and engages in a number of ecologically-based initiatives with volunteers.

The *Urban Forest Canopy Assessment* (2013) has, as described above, identified potential plantable areas as well as potential priority areas for achieving certain urban forest benefits. The City has already begun using this tool to help target future volunteer, City, and private property planting initiatives including those undertaken by Cambridge Stewardship.

Best Practices and Precedents: Volunteer Stewardship Programs

Municipalities are increasingly recognizing that stewardship by the community and local stakeholders is critical for urban forest sustainability, since so much of the extant and potential urban forest is on private lands. In Cambridge, nearly 80% of the existing canopy cover and 80% of plantable spaces are located on private lands. Encouraging and supporting tree planting on private and public lands, and particularly site-appropriate indigenous species, is a key strategy for sustaining and enhancing the urban forest.

- The City of Guelph and the Town of Richmond Hill both have municipal programs that provide: (a) information and education on how residents can naturalize their lawns and gardens with native species, and (b) plants and/or advice at a discount or free.
- The Toronto-based non-profit organization LEAF provides a range of urban forestry services focussed on supporting tree planting and care in residential yards in the Greater Toronto Area and beyond.
- In Mississauga, there are tree planting / landscaping programs targeted to residents through the Peel Fusion Landscapes Program, Toronto Region Conservation's Healthy Yards Program and CVC's Grow Your Green Yard Program. There are also programs sponsored by the City and local Conservation Authorities that target businesses / corporate lands and schools. The City has been able to coordinate many of these programs through the One Million Trees Mississauga program.
- In the City of London, Reforest London (a local non-profit organization) worked with the City to undertake the Veteran's Parkway planting project.

Many municipalities have commemorative tree programs (e.g., Burlington, Brampton, Guelph, London, Markham, Milton, Mississauga, Oakville) that plant trees (for a set cost) in public open spaces. Many communities also have several annual tree planting events in spring and fall, often associated with Arbour Day (around April 21st) and/or National Tree Day (September 21st). A few larger municipalities have also established programs that are dedicated to encouraging broader-based tree planting, such a Markham's Trees for Tomorrow Fund, Mississauga's Million Tree program and London's Million Trees initiative led by the local non-profit group ReForest London, with support from the City.

Opportunities for Improvement: Volunteer Stewardship Programs

The City is fortunate to have a well-established umbrella group (Cambridge City Green and the Cambridge Stewardship project) to coordinate, undertake and/or assist with most of its volunteer-based tree planting events. However, in order to sustain and expand the City's urban forest to meet the objectives identified in this Plan, these efforts need to be more than quadrupled (and more than matched by other plantings in the City). To this end, the City should increase stewardship resources in the Forestry division to help coordinate and implement a wide range of stewardship activities in partnership with non-profit organizations, local businesses, community groups and others. Specifically, the City should:

- Develop a directory of local residents and community groups interested in undertaking stewardship activities
- Build on and expand current efforts to pursue funding (as listed in Appendix C) with non-profit groups, schools and others in support of tree planting and community "greening"
- Build on and expand current efforts to pursue partnerships with local school boards to bring more natural shade to school yards, and
- Work with partners to expand urban forest volunteer-based activities beyond the initial plantings to include follow-up maintenance (e.g., watering, mulching, weeding, and possibly young tree pruning as well as targeted manual invasive species control).

As indicated under Current Practices above, the City has already started to use the potential plantable areas tool provided as part of the *Urban Forest Canopy Assessment* (2013) to help target priority areas for planting in various neighbourhoods. They should continue to use this as both an outreach and a stewardship guidance tool.

Recommended Actions: Volunteer Stewardship Programs

31. Increase current efforts to coordinate and implement community-based tree planting, and other urban forest stewardship activities, across different neighbourhoods and land uses in the City.

Implementation Notes: This action will require additional resources, but by using these resources to secure more funding, broaden partnerships, and target planting where it can provide the most services / benefits, the City will be getting an excellent return on its investment. There should be consideration for planting a diversity of site-appropriate indigenous species, and for working towards more equitable distribution of canopy cover among the various neighbourhoods in the city.

3.4.4 Stewardship Incentives

Current Practices: Stewardship Incentives

As stated above, approximately 80% of the city's plantable spaces are located on private lands. Currently the City of Cambridge does not have any specific incentives for private landowners in the City to plant trees on their land. However, residents who have plantable spaces in the public boulevards in front of their lots can request that a City tree be planted there, at no extra charge.

The City has a Natural Heritage Trust Fund with the goal of providing the community with a method to make financial contributions for the purpose of purchasing and maintaining local natural areas, including wooded natural areas. This fund is administered by a subcommittee that reports annually to CEAC, but to date the fund has not been used to acquire lands.

The City has also had an Urban Design Awards program since 2000 which identifies winning candidates based on consideration for aesthetics, function and community benefits primarily related to the building itself, but with some consideration for the development in its entirety.

For landowners of relatively large forested tracts of land (at least 4 ha), the MNRF offers the Ontario Managed Forest Tax Incentive Program (MFTIP) which applies a reduced tax rate (i.e., 25% of the applicable municipal rate) to the eligible lands as long as the landowners are acting in accordance with an approved Managed Forest Plan (i.e., generally implementing good forestry practices intended to sustain the forest for the long term). While this program will not be suitable for many landowners in the city, it may be an excellent option for larger landowners who want to retain their forested lands.

Best Practices and Precedents: Stewardship Incentives

Incentives are well-recognized as a potentially useful tool to encourage the planting and maintenance of trees on private lands in both rural and urban areas. However, such incentives are not widely available or a typical component of municipal urban forestry programs, although more municipalities are considering them.

Incentives from governments in Ontario (provincial or municipal) related to the urban forest can take the form of tax credits or rebates. A tax credit, through the MFTIP (described above), is available to landowners anywhere in Ontario with at least 4 ha of woodland / forest which is being managed sustainably according to an approved plan.

With an increasing recognition of the ability of treed and permeable areas to contribute to stormwater control, a few municipalities are implementing rebates to support the retention or creation of such areas. The City of Waterloo recently launched a stormwater credit program that, among other things, provides a tax credit for residential homeowners having trees with a total dbh of at least 100 cm on their properties. The City of Mississauga is also pursuing a credit or incentive program linked to maintaining a certain proportion of residential yards as permeable surfaces. The City of Guelph, working in partnership with the non-profit organization LEAF, has offered $50 rebates on the purchase of native tree or shrubs at participating nurseries.

More conventional incentives that typically build on mechanisms already in place in municipalities include:

- Provision of recognition through awards
- Opportunities for support and/or recognition of larger scale initiatives through the naming of parklands / open space, buildings / rooms, multi-use trails, and/or gardens.

Some larger municipalities also offer the provision and installation of a free tree for homeowners, typically on front yards, on request (e.g., Toronto, Mississauga, Hamilton, Ottawa). Another indirect incentive for gaining buy-in with respect to urban forest and natural heritage policies and guidelines can be the assurance of a speedier application process, if the applicable policies and guidelines are adhered to in the application. Only a few municipalities currently engage in targeted outreach programs that focus on informing local developers, and their contractors, about the relevant urban forest and natural heritage policies, by-laws and guidelines (e.g., Town of Oakville, City of Toronto). However, it is increasingly recognized that proactive outreach can be a very effective way to ensure that natural heritage and urban forest requirements are respected through the planning process and that potential issues are identified at the outset of the process.

Opportunities for Improvement: Stewardship Incentives

In the City of Cambridge, there are a number of opportunities for providing greater incentives for private landowners to contribute towards Cambridge's urban forest targets and objectives. A few opportunities that build on existing programs and may be suitable for the City of Cambridge include:

- Revising the criteria for the City's exiting Urban Design Awards so that they specifically recognize design initiatives that support urban forest sustainability, and create a new category of award meant to recognize urban forest stewardship on existing residential or commercial properties;
- Developing and implementing a stormwater tax credit program that, among other things, provides a tax credit for eligible property owners who maintain a set percentage of urban forest canopy cover on their properties, or alternative tax incentives that encourages the retention of mature trees;
- Identifying incentives that could be implemented to encourage tree preservation and / or more investment towards sustainable tree establishment through the planning process;
- Partnering with a non-profit organization (such as LEAF) to provide subsidized indigenous trees or shrubs for planting on private properties; and
- Provision of one free front or backyard tree on request for the first 250 respondents annually, as long as the respondents have adequate space and suitable soil conditions to accommodate a medium to large-statured indigenous tree.

Recommended Actions: Stewardship Incentives

32. Identify and implement incentive programs that could be implemented to support tree planting, maintenance and / or protection on private lands.

Implementation Notes: Incentives to be considered should include developing awards and other forms of recognition for urban forest stewardship, tax and / or utility incentives to encourage the retention of mature trees, incentives through the planning process, partnering with one or more non-profit organization to subsidize trees for private properties, and / or provision of a limited number of free trees to residents.

Naturalization planting of maple, poplar and other tree species. Credit: S. Jobber.

4. Conclusion and Implementation of Recommended Actions

The urban forest in the City of Cambridge includes "the treed environment, consisting of remnant wooded areas, trees in city parks and open space, street trees and trees on private property" (*Cambridge Official Plan*, Section 3.B.4.1). The urban forest is recognized as a vital asset and an important part of a healthy and liveable community, as trees provide a wide range of environmental, economic and social benefits.

Although the City has made considerable efforts to sustain and expand the urban forest, there are numerous challenges that threaten to adversely affect its health, diversity and extent. Some of these threats, such as land use change and development or climate change may be borne out more gradually or over the long-term, while others are more immediate. For example, the current Emerald Ash Borer infestation threatens to eliminate all ash trees in the city over the next decade, and requires immediate management. Current urban forest canopy cover is approximately 27%. However, it is likely that the extent of the urban forest will decline over the next two decades unless there is substantial and sustained investment into strategic and dedicated management of Cambridge's urban forest.

Based upon extensive consultations with City staff, local agencies, members of the public and other stakeholders, the community has expressed strong support for protecting, maintaining, restoring, enhancing and expanding the urban forest in Cambridge. The vision, guiding principles, strategic objectives and targets of this 20-year Urban Forest Plan reflect this direction.

This Plan identifies 32 recommended actions intended to improve all aspects of urban forest management in Cambridge, from higher-level planning and policies to daily on-the-ground tree maintenance operations and outreach activities. These actions have been developed based on careful consideration of the state of the urban forest, the current status of the management program, best practices and precedents from other jurisdictions and the scientific and technical literature, and investigation of practical opportunities for improvement. These analyses, as well as considerable input from a diverse range of stakeholders, have ensured that recommended actions and the overall strategic direction of the Plan are practical, implementable and suitable for Cambridge.

The Plan is structured around a 20-year strategic framework, which is divided into the following four 5-year management periods:

- Management Period 1: 2015 – 2019
- Management Period 1: 2020 – 2024
- Management Period 1: 2025 – 2029
- Management Period 1: 2030 – 2034

Table 4 (below) prioritizes the implementation of the 32 recommended actions by placing each action into one or more of these management periods. The table also identifies the anticipated resource requirements and guidance for the implementation of recommended actions.

While implementation guidance is provided for all action items, resource requirements are estimated for only the first two management periods (10 years), as there is significant difficulty in accurately forecasting resource requirements beyond this horizon.

Recommendations to review the status of Plan implementation and resource requirements on a periodic basis are provided. The review process should include a review of the status, timing and anticipated budgetary requirements of each action item, as well as a review of the Criteria and Indicators for strategic urban forest planning and management. The review process is intended to inform staff about plan progress, provide an opportunity to refine or revise the next five-year management plan and associated resource requirements, and provide an opportunity to engage Council and the public about urban forestry issues.

Currently the City does not have the capacity to pursue these recommendations with its existing staffing and resources, with the exception of some less resource-intensive action items that could potentially be accommodated within existing workloads. Based on the priorities identified through this Plan, within the first two 5-year management periods the City will need to:

- Determine the human resources required to complete the tasks and recommendations detailed in Table 4 (pages 92-97). Human resources may involve a combination of existing staff, new staff or equivalent contracted services and are to be subject to the budget approval process.

- Invest approximately $5.2 million in the provision of services, including tree inventories, priority-based and cyclical tree maintenance, and tree establishment.

The urban forest is a complex and dynamic living entity. It can take many years and substantial resources to establish healthy and mature urban trees, but many threats can rapidly and adversely affect urban forest health and sustainability. Strategic planning and effective management are necessary to ensure the protection, maintenance, restoration, enhancement and expansion of the urban forest. This Urban Forest Plan provides strategic direction to enable the City of Cambridge to more effectively manage all aspects of the urban forest so that the many benefits it provides will be sustained and enhanced for current and future generations.

Table 4: Implementation table for the city of Cambridge's Urban Forest Plan

#	Action	Management Period (Years) *	Estimated Resources from 2015 to 2024 ** ("type" of resource)	Lead	Partners (Potential Funding, where applicable)	Implementation Guidance	Related Strategic Objectives
Plan Review and Monitoring							
1	**Undertake a comprehensive review of the Urban Forest Plan and report to Council.**	1 (2019) 2 (2024) 3 (2029) 4 (2034)	0.1 FTE / 175 hours ("Urban Forest Planner")	Community Services Department – Forestry Division	Sustainability Planner, Manager for Forestry	A review of the status of both the Plan recommendations and progress towards the 25 targets should be undertaken before the end of each five-year management period. This review should inform City staff responsible for and involved in implementation of the Plan, provide an opportunity for refining or revising the next five-year management plan, and provide an opportunity to engage Council and the public.	5 – Awareness and Engagement 6 – Improving Knowledge
The Urban Forest as a Shared Asset							
2	**Create an internal "Urban Forest Group" that includes key City staff involved in work related to trees.**	1 (2015 – 2019)	0.1 FTE / 175 hours ("Urban Forest Planner")	Community Services Department – Forestry Division	Staff from Community Services, Planning & Development, and Transportation & Public Works Departments	The group should be led by the City's Manager of Forestry and Horticulture, include staff from Community Services, Planning and & Development, and Transportation & Public Works, meet regularly, bring in key staff from other departments when warranted, and liaise with key agencies or organizations as needed.	2 – Proactive Management 4 – Protection and Enhancement 5 – Awareness and Engagement 6 – Improving Knowledge
3	**Establish and coordinate an external "Urban Forest Plan Steering Committee".**	1 (2015 – 2019)	0.1 FTE / 175 hours ("Urban Forest Planner")	Community Services Department – Forestry Division	Region, City, GRCA, public school boards, Cambridge Hydro, key community groups	To be composed of appropriate individuals from the Region, City, GRCA, public school boards, Cambridge Hydro, key community groups to facilitate (a) information sharing with partners and (b) implementation of this Plan.	3 – Building Resilience 4 – Protection and Enhancement 5 – Awareness and Engagement 6 – Improving Knowledge
4	**Build and expand partnerships for securing funding from a range of sources to sustain urban forest stewardship projects across the City.**	1 (2015 – 2019) 2 (2020 – 2024) 3 (2025 – 2029) 4 (3030 – 2034)	0.2 FTE / 350 hours ("Stewardship Coordinator")	Community Services Department – Forestry Division	Local community groups, local schools, universities, businesses, non-profit organizations, and others (e.g., Evergreen, TD Canada Trust, Tree Canada, Trillium Foundation, CN, Ministry of the Environment, etc.- see Appendix C)	Pursue these partnerships with local community groups, local schools, businesses, and non-profit organizations to engage a range of community sectors, land uses, and geographic areas in the City. Acknowledge the contributions and successes of these partners (e.g., through letters and/or plaques, on the City's website, possibly through awards for special or large partnerships). Create a part or full-time position in the City to help pursue, promote, develop and expand such partnerships as well as helping implement and monitor related stewardship activities.	1 – Adequate Resources 4 – Protection and Enhancement 5 – Awareness and Engagement
5	**Explore opportunities for direct and indirect support for municipally-led or supported urban forest activities from the GRCA, Region, Province and federal government.**	1 (2015 – 2019) 2 (2020 – 2024)	0.1 FTE / 175 hours ("Stewardship Coordinator")	Community Services Department – Forestry Division	Region, GRCA, and other municipalities in Ontario, and Canada, with active urban forestry programs	Explore opportunities for supporting urban forest initiatives in Cambridge through GRCA and/or regional initiatives related to human health (e.g., shade), active transportation, climate change / community sustainability, and broader forest monitoring. Coordinate with other upper and lower tier municipalities within and outside the Region to send a strong, unified message to the provincial and federal governments that this issue is a priority, including advocating for provincial and federal funds through the Association of Municipalities of Ontario and the Federation of Canadian Municipalities.	1 – Adequate Resources 5 – Awareness and Engagement
6	**Establish mechanisms for dedicated funding for urban forestry in the form of: (a) a reserve fund for tree-related disaster response on City lands and (b) a "tree account" to support tree planting and young tree maintenance.**	1 (2015 – 2019)	0.1 FTE / 175 hours ("Urban Forest Planner")	Finance Department (establish and maintain) Community Services Department – Forestry Division (manage)	Staff from Community Services, Planning & Development	The reserve fund would be dedicated to tree-related management of disaster response and mitigation in response to events such as ice storms, future invasive species or tree pests / diseases, and summer storm damage). A "tree planting account" could be supported by funds arising from tree compensation (e.g., where cash-in-lieu is provided by proponents where trees removed can't be replaced on site), donations and partnerships.	1 – Adequate Resources 2 – Proactive Management 4 – Protection and Enhancement

#	Action	Management Period (Years) *	Estimated Resources from 2015 to 2024 ** ("type" of resource)	Lead	Partners (Potential Funding, where applicable)	Implementation Guidance	Related Strategic Objectives
Planning for the Urban Forest							
7	**Explore adding policies related to tree planting and replacement as part of the next Official Plan update.**	2 (2020 – 2024)	0.1 FTE / 175 hours ("Urban Forest Planner")	Planning & Development Department	Community Services, and Transportation & Public Works Departments	Considerations should include requiring tree replacement for both public and private sector development-related removals, as well as exploring the use of "sustainability items" in lieu of payments for park / recreation land dedications, and ensuring these items include trees.	4 – Protection and Enhancement 5 – Awareness and Engagement
8	**Develop comprehensive streetscape guidelines for integration of high-quality tree growing environments and trees into urban streetscapes.**	3 (2025 – 2029)	TBD (as part of Action #15)	Community Services Department	Planning & Development, and Transportation & Public Works Departments	Guidelines should supplement existing urban design guidelines and be incorporated in/referenced by future urban design guidelines. Guidelines should provide different implementation options depending upon site specifics but should encourage consistency in approaches. Include guidelines for 'greening' of urban surface parking lots, including green infrastructure such as bioswales and trees.	3 – Building Resilience 4 – Protection and Enhancement
9	**Update the City's existing Public Tree By-law (71-06) and Grading By-law (160-09) to be more supportive of urban forestry objectives in this Plan.**	2 (2020 – 2024)	0.1 FTE / 175 hours ("Urban Forest Planner")	Planning & Development Department	Community Services / Transportation & Public Works Departments	These updates should focus on implementing broader tree replacement or compensation requirements, addressing boundary tree issues, and be implemented in conjunction with the establishment of a tree fund account for the City where cash-in-lieu related to tree removals can be placed.	4 – Protection and Enhancement 5 – Awareness and Engagement
10	**Draft and explore implementing a private tree by-law to expand the City's tool kit for achieving urban forest targets.**	4 (2030 – 2034)	TBD (as part of Action #15)	Planning & Development Department	Community Services / Transportation & Public Works Departments	Developing a private tree by-law should not be considered until the City has adequately addressed its more urgent tree maintenance and management issues on its own lands (e.g., EAB). Once these are addressed, a by-law should be drafted and subject to public consultations. Key considerations for this by-law should include: a requirement for tree replacement or compensation (ideally directed towards some kind of City tree fund or account), the City to commit some additional resources to education, administration and enforcement related to the by-law before it is passed and implemented.	4 – Protection and Enhancement 5 – Awareness and Engagement
11	**Undertake a comprehensive tree preservation planning policy and procedure review**	Review in: 1 (2015 – 2019) Implement thru: 2 (2020 – 2024) 3 (2025 – 2029) 4 (2030 – 2034)	0.1 FTE / 175 hours ("Urban Forest Planner") 0.3 FTE / 525 hours ("Arborist") 0.2 FTE / 350 hours ("Admin. Support")	Community Services Department	Planning & Development, and Transportation & Public Works Departments, Waterloo Region Home Builders Association Liaison Committee	This review should focus on streamlining the tree preservation planning and review process, providing opportunity for early-stage Forestry Division review, and providing clear and consistent guidance for tree injury and removal compensation. Options to consider include: streamlining the process by implementing a 'tree declaration' or 'tree questionnaire' form and process for development, a single-stage tree preservation plan process, and enhancement of resources for site inspection and enforcement. Toronto, Mississauga and Oakville are good examples to inform tree preservation planning policy and procedure review.	3 – Building Resilience 4 – Protection and Enhancement
12	**Review, consolidate and ensure consistency of all development-related tree establishment policies and standards**	Review in: 2 (2020 – 2024) Implement thru: 3 (2025 – 2029) 4 (2030 – 2034)	0.1 FTE / 175 hours ("Urban Forest Planner") 0.3 FTE / 525 hours ("Arborist") 0.2 FTE / 350 hours ("Admin. Support")	Community Services Department	Planning & Development, and Transportation and Public Works Departments	Review main guiding documents, including *Site Plan Approval Reference Guide* (2014), *Engineering Standards and Development Manual* (2013) and *Community Services Department Tree Planting Guidelines for Developers* (2007). Ensure planting process and specifications for various factors such as stock type, spacing, site design, etc. are internally consistent, and in line with best practices. Create one guiding document for all tree establishment-related policies and practices, with separate sections guiding development and operations, as required.	3 – Building Resilience 4 – Protection and Enhancement

#	Action	Management Period (Years) *	Estimated Resources from 2015 to 2024 ** ("type" of resource)	Lead	Partners (Potential Funding, where applicable)	Implementation Guidance	Related Strategic Objectives
13	**In new or infill developments, require (a) regular maintenance of newly-planted street trees, and (b) developers to deposit funds to cover the costs of planting, maintenance and replacement of trees by City staff or contractors**	Undertake in: 1 (2015 – 2019) Implement thru: 2 (2020 – 2024) 3 (2025 – 2029) 4 (2030 – 2034)	0.1 FTE / 175 hours ("Urban Forest Planner") 0.1 FTE / 175 hours ("Admin. Support")	Planning & Development Department	Community Services Department	Trees in new developments to be planted by City forces or contractors, supported by adequate funds deposited by developers to cover cost of planting and maintenance. Newly-planted trees should be watered on a regular basis during the establishment period, and other maintenance such as mulching and young tree pruning/training should be undertaken, as required.	2 – Proactive Management 3 – Building Resilience 4 – Protection and Enhancement
14	**Compile a 'master' planting list to guide tree establishment on both public and private lands across the city.**	3 (2025 – 2029)	TBD (as part of Action #15)	Community Services Department - Forestry Division	CEAC, Region, GRCA	This list should contain enough information to make it equally usable by City staff, contractors for public and private projects, stewardship activities and request-based plantings from homeowners. This information should include: indigenous versus non-native species (invasive species should be excluded), site tolerances, habitat requirements (e.g., full sun, partial shade), size class at maturity (e.g., "small", medium" or "large"), and time of year when best planted. The list should also include species that do, or could, occur in Cambridge but are at or close to the northern limit of their range (i.e., as a climate change consideration).	2 – Proactive Management 3 – Building Resilience 4 – Protection and Enhancement
Managing the Urban Forest							
15	**Undertake a comprehensive review of Forestry Division workload and service levels to determine appropriate staffing levels to ensure adequate service provision**	2 (2024)	Existing Resources (Manager of Forestry)	Community Services Department - Forestry Division	Not applicable	This review should be undertaken before the end of the second five-year management period (i.e., in 2024) to assess how well the priorities identified in the Plan are being addressed with the additional resources approved up to that point, and what additional resources may still be required.	1 – Adequate Resources
16	**Utilize 2014 street tree inventory to carry out high-priority tree maintenance and address utility conflicts.**	1 (2015 – 2019) 2 (2020 – 2024)	1 FTE / 1,750 hours ("Arborist") $100,000 (Contracted)	Community Services Department - Forestry Division	Cambridge and North Dumfries Hydro	Utilize tree inventory findings to prioritize work. Consider sharing utility conflict information with Cambridge and North Dumfries Hydro to address potential utility conflicts efficiently. Combined in-house and contracted maintenance provision.	2 – Proactive Management 3 – Building Resilience
17	**Develop and phase-in implementation of a cyclical pruning program for City-owned street trees.**	Develop in: 2 (2020 – 2024), Implement thru: 3 (2025 – 2029) 4 (2030 – 2034)	0.3 FTE / 525 hours ("Arborist") $1.55 million (2020-2024, Contracted)	Community Services Department - Forestry Division	Not applicable	Begin phased-in implementation of pruning cycle by 2020 or following completion of all inventory-recommended tree maintenance work. Structure of pruning cycle program to be determined based upon several factors, including: current and projected resource availability, the condition and distribution of the street tree population, opportunities for interagency collaboration and resource sharing; and the service delivery model. Cost based on $310,000 annually at full implementation of 8-year cycle @ $45/tree, contracted pruning.	2 – Proactive Management 3 – Building Resilience
18	**Develop and implement a young tree structural pruning (training) program.**	Develop in: 2 (2020 – 2024), Implement thru: 3 (2025 – 2029) 4 (2030 – 2034)	0.5 FTE / 875 hours ("Arborist")	Community Services Department - Forestry Division	Not applicable	Minimum 3 pruning rounds in first 10 years. Program to be developed and implemented separately from cyclical pruning program.	2 – Proactive Management 3 – Building Resilience

#	Action	Management Period (Years) *	Estimated Resources from 2015 to 2024 ** ("type" of resource)	Lead	Partners (Potential Funding, where applicable)	Implementation Guidance	Related Strategic Objectives
19	**Undertake inventory of trees in high-use public park areas and along City-owned woodland edges, and carry out priority maintenance.**	1 (2015 – 2019)	0.5 FTE / 875 hours ("Arborist") $75,000 (Contracted)	Community Services Department - Forestry Division	Not applicable	GIS-based inventory with same attributes as street tree inventory of trees in actively-managed (e.g., mowed) areas and frequently-used areas of City parks; visually-observed potential risk trees at edges of woodlots/natural areas and public trails to be included (within possible tip-out distance, or 1.5x tree height).	1 – Adequate Resources 2 – Proactive Management 3 – Building Resilience 4 – Protection and Enhancement
20	**Update the tree risk management policy (Policy – Safety and Probability Risk Assessment) to reflect new industry standards and Best Management Practices.**	1 (2015 – 2019)	Existing Resources (Manager of Forestry)	Community Services Department - Forestry Division	Legal Services	Update internal policy and procedure to incorporate ANSI A300 Part 9 standard and ISA Best Management Practices guidance and remove points-based system.	2 – Proactive Management
21	**Revise the City's Property Standards By-law (181-04) to enable the City to order risk mitigation for trees which pose potential high risk to neighbouring public or private property, on a complaints-based and proactive basis.**	1 (2015 – 2019)	0.1 FTE / 175 hours ("Urban Forest Planner") 0.1 FTE / 175 hours ("Arborist") 0.1 FTE / 175 hours ("Admin. Support")	Community Services Department - Forestry Division	Legal Services (review), and Planning & Development (enforcement)	Enable staff to undertake tree risk inspection on private property and compel owners to undertake necessary tree risk mitigation actions. Ensure adequate resources for enforcement and implementation. The City's Legal Services should review the by-law for liability implications to the City.	2 – Proactive Management 5 – Awareness and Engagement
22	**Undertake an inventory of City-owned woodlands**	3 (2025 – 2029)	TBD (as part of Action #15)	Community Services Department - Forestry Division	Not applicable	This inventory should be at a relatively high level but provide a map of all City-owned woodlands as well as sufficient guidance to prioritize areas for management.	2 – Proactive Management 6 – Improving Knowledge
23	**Once an inventory of City-owned woodlands is complete, start to undertake management of priority woodlands**	4 (2030 – 2034)	TBD (as part of Action #15)	Community Services Department - Forestry Division	Some limited support by community groups, local schools, neighbourhood groups	Site-specific woodland management should focus on balancing protection and sustainability of the woodland (and its associated ecosystem services) with appropriate use and access that can help build awareness and engagement.	2 – Proactive Management 3 – Building Resilience 4 – Protection and Enhancement
24	**Prepare a Pest Vulnerability Matrix or similar pest and disease threat assessment and management options report utilizing 2014 street tree inventory data**	2 (2020 – 2024)	$6,000 (Contracted)	Community Services Department - Forestry Division	Not applicable	Utilize Laćan and McBride (2008) Pest Vulnerability Matrix (PVM) or similar approach to assess potential threats related to pests and diseases in the street tree population. Prepare preliminary summary of control and management options as part of City's IPM program to increase readiness.	3 – Building Resilience 6 – Improving Knowledge
25	**Develop Emerald Ash Borer strategy, including use of data from the 2014 street tree inventory**	Develop in: 1 (2015) Implement thru: 2 (2020 – 2024) 3 (2025 – 2029)	Existing Resources (Manager of Forestry)	Community Services Department - Forestry Division	Not applicable	Utilize inventory findings to update costs, overall management approach, and specific actions (e.g., tree removals, injection treatments). Use EAB Capital Project budget to fund cost of required maintenance (TBD).	2 – Proactive Management 3 – Building Resilience 6 – Improving Knowledge
26	**Undertake an inventory of ash trees in City-owned parks (if complete park tree inventory not undertaken) and edges of City-owned woodlands**	1 (2015-2019)	0.1 FTE / 175 hours ("Admin Support") $30,000 (Contracted)	Community Services Department - Forestry Division	Not applicable	Inventory all ash trees in actively-managed/high-use and natural edge (tip-out potential) areas.	2 – Proactive Management

#	Action	Management Period (Years) *	Estimated Resources from 2015 to 2024 ** ("type" of resource)	Lead	Partners (Potential Funding, where applicable)	Implementation Guidance	Related Strategic Objectives
27	**Improve tree species and planting stock selection and establishment practices.**	Develop in: 3 (2025 – 2029) Implement thru: 4 (2030 – 2034)	TBD (as part of Action #15)	Community Services Department	Planning & Development, and Transportation and Public Works Departments	Increase establishment and begin long-term monitoring of Carolinian and other 'climate change-ready' species - Continue planting currently-used species (except known invasive species), but increase proportion of unutilized or underutilized species, including Carolinian trees such as sweetgum, hackberry, buckeye spp., hickory spp., redbud, Kentucky coffee tree, tulip-tree, oak spp., etc. Monitor and report on performance of various species in long-term trials in various sites with objective of informing future management decisions. Undertake pre-planting inspection of planting stock - Forestry Division technicians to inspect all stock to be planted prior to installation, either at nursery (which enables for selection) or as agreed upon with contractors. City to reserve right to refuse any stock which does not meet criteria. Investigate opportunities to enter into long-term seed sourcing and stock growing agreement with local nurseries. Solicit proposals from local nurseries for multi-year growing contracts, with specific provisions for high-quality nursery stock.	2 – Proactive Management 3 – Building Resilience 4 – Protection and Enhancement 6 – Improving Knowledge
28	**Increase the diversity and number of trees planted per year as part of Forestry operations to help attain Plan targets**	2 (2020 – 2024) 3 (2025 – 2029) 4 (2030 – 2034)	1 FTE / 1750 hours ("Arborist") $3.4 million (2020-2024)	Community Services Department	Local community groups (e.g., City Green, local schools, businesses, non-profit organizations, and others (e.g., Evergreen, TD Canada Trust, Tree Canada, Trillium Foundation, CN, Ministry of the Environment, etc.- see Appendix C)	Increase operations-based planting to minimum of 1,700 trees per year to work towards achievement of 3% UTC canopy increase by 2034 (assuming 1/5 City contribution toward total annual required planting to achieve goal, with the remainder through stewardship and development). Assumes establishment cost of $400/tree.	2 – Proactive Management 3 – Building Resilience 4 – Protection and Enhancement 5 – Awareness and Engagement
Outreach, Education and Stewardship							
29	**Improve the format and organization of the City's Forestry webpage to make it more user-friendly and engaging.**	3 (2025 – 2029)	TBD (as part of Action #15)	Community Services Department	Not applicable	The suggested format includes several shorter pages that include some consistent visual/graphic cues. These updates could be done independently, but might best be done as part of a City-wide website update, including the creation of one or more social media accounts.	5 – Awareness and Engagement 6 – Improving Knowledge
30	**Undertake targeted outreach to various sectors across the City, using the City's plantable spaces tool where appropriate.**	1 (2015 – 2019) 2 (2020 – 2024) 3 (2025 – 2029) 4 (3030 – 2034)	0.3 FTE / 525 hours ("Stewardship Coordinator") 0.1 FTE ("Admin. Support")	Community Services Department - Forestry Division	Local neighbourhoods, local schools, business parks, City Green, and others (e.g., Evergreen, TD Canada Trust, Tree Canada, Trillium Foundation, CN, Ministry of the Environment, etc.- see Appendix C)	The City should use the website, pamphlets, and door knockers as part of a cost-effective community outreach program related to urban forestry, along with seasonal displays at garden centres. An annual workshop for development proponents (and their consultants / contractors) is also recommended to educate them about the City's current tree-related policies and guidelines. The City has a unique tree planting tool, applicable on a neighbourhood or even smaller scale, which can be used to help engage schools, neighbourhoods, and local businesses to think about the benefits that trees bring to their area, and how they could plant trees to improve local community sustainability	5 – Awareness and Engagement 6 – Improving Knowledge

#	Action	Management Period (Years) *	Estimated Resources from 2015 to 2024 ** ("type" of resource)	Lead	Partners (Potential Funding, where applicable)	Implementation Guidance	Related Strategic Objectives
31	**Increase current efforts to coordinate and implement community-based tree planting, and other urban forest stewardship activities, across different neighbourhoods and land uses in the City.**	1 (2015 – 2019) 2 (2020 – 2024) 3 (2025 – 2029) 4 (3030 – 2034)	0.4 FTE / 700 hours ("Stewardship Coordinator) 0.1 FTE / 175 hours ("Admin. Support")	Community Services Department	Local community groups (e.g., City Green, RARE Charitable Research Reserve), local schools, businesses, non-profit organizations, and others (e.g., Evergreen, TD Canada Trust, Tree Canada, Trillium Foundation, CN, Ministry of the Environment, etc.- see Appendix C)	This action will require additional City staff and resources, but by using these resources to secure more funding, broaden partnerships, and target planting where they can provide the most services / benefits, the City will be getting an excellent return on its investment. There should be consideration for planting a diversity of site-appropriate indigenous species, as well as for trying to work towards a more or less equitable distribution of canopy cover among the various neighbourhoods in the city.	3 – Building Resilience 4 – Protection and Enhancement 5 – Awareness and Engagement 6 – Improving Knowledge
32	**Identify and implement incentive programs that could be implemented to support tree planting, maintenance and / or protection on private lands.**	3 (2025 – 2029)	TBD (as part of Action #15)	Community Services Department	Planning & Development, and Transportation and Public Works Departments	Incentives to be considered should include developing awards and other forms of recognition for urban forest stewardship, tax and / or utility incentives to encourage the retention of mature trees, incentives through the planning process, partnering with one or more non-profit organizations to subsidize trees for private properties, and / or provision of a limited number of free trees to residents.	2 – Proactive Management 3 – Building Resilience 4 – Protection and Enhancement 5 – Awareness and Engagement

* "Management Period" denotes the 5-year management cycle associated with the Urban Forest Plan framework: 1: 2015-2019, 2: 2020-2024, 3: 2025-2029, and 4: 2030-2034. In some cases the relative priority within that period is indicated in brackets with a specific year. In addition, in some cases, the recommended action will need to be implemented over more than a five year period. In these cases successive management periods are shown.

** Anticipated new resource requirements have only been identified for the first two Management Periods (i.e., 10 years) of this Plan, with any additional resources needs to be identified as part of the 10 year review process. "Type" of resource refers generically to the types of job titles (in other municipalities, Community Services Departments, Forestry Services Departments, etc.) that normally are associated with the task identified and recommended action.

Glossary of Terms

Adaptive Management: A systematic process for continuously improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, management is treated as a deliberate experiment for the purpose of learning.

Aggregate Caliper: A method for assessing tree removal compensation planting, whereby the combined caliper (diameter) of trees to be planted meets or exceed the diameter at breast-height (dbh) of the tree removed. The adequacy of this method is debatable, as it is argued that the leaf area and benefits provided by the removed tree are not adequately replaced by new trees. Conversely, benefits may be increased over time if the planted trees grow to maturity.

Buffer: Areas between protected natural areas and the surrounding landscape or seascape which help protect the network from potentially damaging external influences and which are essentially transitional areas.

Canopy Cover: A measurement of the areal extent of vegetation foliage, typically measured in percentage of total land area. It can include both trees and shrubs, or just trees. For example, the City of Cambridge's tree canopy cover is estimated at 27% of the total land area of the city.

Carbon sequestration: Carbon sequestration is a biochemical process by which atmospheric carbon is absorbed by living organisms, including trees, soil microorganisms, and crops, and involving the storage of carbon in soils, with the potential to reduce atmospheric carbon dioxide levels.

Ecosystem services: A term used to describe the processes of nature needed to support the health and survival of humans. While ecological goods and services are required and used by all living organisms, they are primarily considered in terms of their value (quantified or not) to humans. Ecological services include processes such as air and water purification, flood and drought mitigation, waste detoxification and decomposition, pollination of crops and other vegetation, carbon storage and sequestration, and maintenance of biodiversity. The products generated by these services include fundamental items like clean air, fresh water, food, fiber, timber, and medicines, as well as less tangible items like mental health and spiritual well-being.

Family: For plants, the family includes plants with many botanical features in common and is the highest classification normally used. Modern botanical classification assigns a type plant to each family, which has the distinguishing characteristics of this group of plants, and names the family after this plant.

Genus: For plants, the genus is the taxonomic group containing one or more species. For example, all maples are part of the genus called "*Acer*" and their Latin or scientific names reflect this (e.g. Sugar maple is called *Acer saccharum*, while Black maple is called *Acer nigrum*).

Geographic Information System (GIS): An organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.

Greenhouse gases (GHG): Gases that contribute to the greenhouse effect (i.e., hinder heat radiation from escaping through the atmosphere). Atmospheric carbon dioxide gas is a major GHG.

Green Infrastructure: A concept originating in the mid-1990s that highlights the contributions made by natural areas to providing important municipal services that would cost money to replace. These include storm water management, filtration of air pollution and provision of shade. The Green Infrastructure Ontario Coalition has defined this term as "natural vegetation, vegetative systems, soil in volumes, and qualities adequate to sustain vegetation and absorb water, and supportive green technologies that replicate ecosystem functions".

Heat Island Effect: The urban heat island effect describes the documented phenomenon of urban areas being significantly warmer than the surrounding rural areas largely due to the extent of built structures and paved areas. The temperature difference usually is larger at night than during the day, is most apparent when winds are weak, and is noticeable during the summer and the winter.

Invasive Species: A plant, animal or pathogen that has been introduced to an environment where it is not native may become a nuisance through rapid spread and increase in numbers, generally to the detriment of native species.

Mitigation: Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards

Monitoring: Regular measurement and/or evaluation of an area, ecosystem, habitat, community, species, etc. to identify changes in abundance and/or quality, usually in response to a management action or a predicted impact (e.g. development).

Indigenous Species: A species that occurs naturally in a given geographic region that is present only through natural processes. Often also referred to as "native" species.

Naturalization: The change from a managed landscape (e.g., mown lawn) to a more natural plant and animal community. This may occur as a result of the abandonment of management practice without human assistance, as a result of a management prescription that involves cessation or reduction of deliberate intervention, or as a result of planned landscaping with site-appropriate indigenous species.

Qualified Arborist: A person who maintains his or her certification through the International Society of Arboriculture and/or the American Society of Consulting Arborists as a competent practitioner of the art and science of arboriculture.

Resilience: In ecology, resilience is the capacity of an ecosystem to respond to a perturbation or disturbance by resisting damage and recovering quickly. Such perturbations and disturbances including random variable

events such as drought, flooding, windstorms, insect population explosions, and the introduction of invasive plant or animal species.

Right-of-Way: A portion of land granted through an easement or other legal mechanism for transportation purposes, such as for a rail line, highway or roadway. A right-of-way is reserved for the purposes of maintenance or expansion of existing services. Rights-of-way may also be granted to utility companies to permit the laying of utilities such as electric power transmission lines (hydro wires) or natural gas pipelines.

Significant Woodland: In the City of Cambridge (and the Region of Waterloo) this term is defined as wooded areas that (a) are greater than four hectares in size, (b) consist primarily of indigenous species of trees; and (c) meet all criteria of a woodland in accordance with the provisions of the Regional Woodland Conservation By-law. The Regional Woodland Conservation By-law specifies that in order to be a woodland the area must meet certain tree stem densities (i.e., at least (i) 1,000 trees of any size per ha, (ii) 750 tree more than five cm diameter per ha, (iii) 500 trees more than 12 cm diameter per ha, or (iv) 250 trees more than 20 cm diameter per ha excluding cultivated fruit or nut orchards, or Christmas tree plantations.

Street Trees: Municipally owned trees, typically found within the road right-of-way along roadsides and in boulevards, tree planters (pits) and front yards.

Sustainability: Refers to the adequate access, use and management of the natural resources, to ensure that the people of present and future generations are able to meet their basic needs on an uninterrupted basis. Pattern of behaviour that guarantees for each of the future generations, the option to enjoy, at the very least, the same level of welfare enjoyed by the preceding generation. Emphasis is placed on the intergenerational equity of development.

Urban Forest: The urban forest in Cambridge is the treed environment, consisting of remnant wooded areas, trees in city parks and open space, street trees and trees on private property (City of Cambridge Official Plan, 2012).

Watershed: An area of land that feeds water to a river, draining through the landscape into tributaries and main river channels. Also called “catchments”, “drainage basins” or “river basins”.

Woodland: In both the City of Cambridge and Region of Waterloo Official Plans, woodlands are defined broadly as treed areas that provide environmental and economic benefits to both the private landowner and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products.

Woodlot: For the purpose of this Urban Forest Plan (and the related Urban Forest Canopy Assessment, 2013), “woodlot” has been used to refer to areas in the City of Cambridge with contiguous canopy cover of at least 0.5 ha. This captures contiguous tree cover associated with natural areas, as well as contiguous tree cover over manicured landscapes and the built environment.

References Cited

Akbari, H. 2002. Shade trees reduce building energy use and CO_2 emissions from power plants. Environmental Pollution 116, 119-126.

Akbari, H., Pomerantz, M. and H. Taha. 2001. Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. Solar Energy 70, 295-310.

American National Standards Institute (ANSI) Standard A300 Part 9: Tree, Shrub and Other Woody Plant Management – Standard Practices (Tree Risk Assessment a. Tree Structure Assessment).

Bowler, D., Buyung-Ali, L., Knight, T., and A.S. Pullin. 2010. How effective is 'greening' of urban areas in reducing human exposure to ground level ozone concentrations, UV exposure and the 'urban heat island effect'. CEE Review 08-004. Environmental Evidence.

Bray Heritage with ERA Architects Inc., Archaeological Services Inc., Maltby & Associates Inc. and the Tourism Company. Cambridge Heritage Master Plan - Final Report. 2008. Prepared for the City of Cambridge.

Cambridge, City of. 2007. Community Services Department Tree Planting Guidelines for Developers (2007).

Cambridge, City of. 2009. Growth Management Strategy. Planning and Development Department. Policy Planning Division.

Cambridge, City of. 2011. Corporate Sustainability Plan. Office of the Chief Administrative Officer.

Cambridge, City of. 2012a. Official Plan. Planning and Development Department. Policy Planning Division.

Cambridge, City of. 2012b. Report to General Committee No. CSD/12-78 on the Public Consultation Process on the Proposed Tree Preservation By-law.

Cambridge, City of. 2013a. Engineering Standards and Development Manual. Planning and Development Department. Planning Operations.

Cambridge, City of. 2013b. GHG Reduction (Energy Management) Plan. Office of the Chief Administrative Officer. Energy Conservation & Demand Management Planning Division.

Cambridge, City of. 2013c. Main Street Urban Design Guidelines. Planning and Development Department. Policy Planning Division.

Cambridge, City of. 2013d. Urban Forest Canopy Assessment. Community Services Department. Forestry Division.

Cambridge, City of. 2014a. Downtown Urban Design Guidelines. Planning and Development Department. Policy Planning Division.

Cambridge, City of. 2014b. Hespeler Streetscape Plan & Urban Design Guidelines. Planning and Development Department. Policy Planning Division.

Cambridge, City of. 2014c. Preston Streetscape Plan & Urban Design Guidelines. Planning and Development Department. Policy Planning Division.

Cambridge, City of. 2014d. Site Plan Approval Reference Guide. Planning and Development Department. Development Planning Division.

Cavanagh, J.E., Zawar-Reza, P., Gaines and J. Wilson. 2009. Spatial attenuation of ambient particulate matter air pollution within an urbanized native forest patch. Urban Forestry and Urban Greening 8, 21-30.

Clark, J.R., N.P. Matheny, G. Cross and V. Wake. 1997. A Model of Urban Forest Sustainability. Journal of Arboriculture 23, 1:17-30.

Coley, R.L., Kuo, F.E. and W.C. Sullivan. 1997. Where does community grow? The social context created by nature in urban public housing. Environment and Behavior 29, 4:468-492.

Dearlove, K. 2012. Active History on the Grand: Heritage Tree in Ontario. Available online at: http://activehistory.ca/2012/01/active-history-on-the-grand-heritage-trees-in-ontario/. Last accessed December 22, 2014.

Donovan, G.H, and J.P. Prestemon. 2012. The effect of trees on crime in Portland, Oregon. Environment and Behavior 44, 3-30.

Endreny, T.A., 2005. Land Use and Land Cover Effects on Runoff Processes: Urban and Suburban Development. In Anderson, M.G., ed., 2005. Encyclopedia of Hydrological Sciences. Chichester, UK: Wiley, 1775-1804.

Faeth, S.H., Bang, C. and S. Saari. 2011. Urban biodiversity: patterns and mechanisms. Annals of the New York Academy of Sciences, 69-81.

Green Infrastructure Ontario Coalition. Website. Available online at: http://www.greeninfrastructureontario.org/. Last accessed December 22, 2014.

Grand River Conservation Authority. 2004. A Watershed Forest Plan for the Grand River.

Grand River Conservation Authority. 2005. Dumfries Conservation Area Master Plan.

Guelph, City of. 2014. Streetscape Manual, Built Form Standards, & Conceptual Design for St. George's Square.

Husqvarna. 2013. Global Green Space Report. Available online at: http://greenspacereport.com/. Last accessed December 22, 2014.

Inkiläinen, E.N.M, McHale, M.R., Blank, G.B., James, A.L. and E. Nikinmaa. 2013. The role of the residential urban forest in regulating throughfall: A case study in Raleigh, North Carolina, USA. Landscape and Urban Planning 119, 91-103.

International Society of Arboriculture. 2011. Best Management Practices – Tree Risk Assessment. Smiley, E.T., N. Matheny and S. Lilly, eds. Champaign, IL.

Johnston, M. 2004. Impacts and adaptation for climate change in urban forests. Proceedings of the 6th Canadian urban forest conference, Kelowna, BC, October 19-23, 2004. Canadian Urban Forest Association (CUFA). p. 1-14. (Available at: www.treecanada.ca/cufc6/proceedings/, retrieved September 2012).

Kenney, W.A., van Wassenaer, P.J. and A. Satel. 2011. Criteria and Indicators for Strategic Urban Forest Planning and Management. Arboriculture & Urban Forestry 37, 108-117.

Laćan,I. and J.R. McBride. 2008. Pest Vulnerability Matrix (PVM): A graphic model for assessing the interaction between tree species diversity and urban forest susceptibility to insects and diseases. Urban Forestry & Urban Greening 7, 4:291-300.

Lovasi, G. S., Quinn, J. W., Neckerman, K. M., Perzanowski, M. S., and A. Rundle. 2008. Children living in areas with more street trees have lower prevalence of asthma. Journal of Epidemiology and Community Health 62, 647-649.

Markham, Town of. Trees for Tomorrow Streetscape Manual.

McHale, M.R., McPherson, E.G. and I.C. Burke. 2007. The potential of urban tree plantings to be cost effective in carbon credit markets. Urban Forestry and Urban Greening 6, 49-60.

McKenney, D.W., J. P. Pedlar, L. R. Iverson LR, M. F. Hutchinson, K. Lawrence and K. Campbell. 2007. Potential impacts of climate change on the distribution of North American trees. Bioscience 57(11): 939-948.

Moka, J., Landphair, H.C., amd J.R. Nederi. 2006. Landscape improvement impacts on roadside safety in Texas. Landscape and Urban Planning 78: 263-274.

Müller, N., Kuttler, W., and A.B. Barlag. 2014. Counteracting urban climate change: adaptation measures and their effect on thermal comfort. Theoretical and Applied Climatology 115, 243-257.

Nowak, D.J. 1993. Atmospheric carbon reduction by urban trees. Journal of Environmental Management, 207-217.

Nowak, D.J., Crane, D.E. and J.C. Stevens. 2006. Air pollution removal by urban trees and shrubs in the United States. Urban Forestry and Urban Greening 4, 115-123.

Ontario, Province of. 2007. Go Green: Ontario's Action Plan on Climate Change. Toronto: Queen's Printer for Ontario.

Ontario, Province of. 2012. Ontario Invasive Species Strategic Plan. Toronto: Queen's Printer for Ontario.

Ontario, Province of. 2011. Ontario's Biodiversity Strategy: Protecting What Sustains Us. Toronto: Queen's Printer for Ontario.

Santamour, F.S. 1990. Trees for Urban Planting: Diversity, Uniformity and Common Sense. Proceedings of the 7th Conference of METRIA: Metropolitan Tree Improvement Alliance 7:57-65.

TD Economics. 2014. Special Report: The Value of Urban Forests in Cities across Canada.

Thompson Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., and M.H. Depledge. 2011. Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review. Environmental Science and Technology 45, 1761-1772.

Toronto, City of. 2013. Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual.

Toronto, City of. 2013. Design Guidelines for 'Greening' Surface Parking Lots. City Planning Department.

Toronto, City of. No Date. Streetscape Manual: Online Tool. Available online at: http://bit.ly/1rditK6. Last accessed December 22, 2014.

United Nations. 2005. Millennium Ecosystem Assessment.

Waterloo, Region of. 2006. Regional Forest Management Plans: Forest Tract Summary Sheets. Approved by Regional Council August 30, 2006.

Waterloo, Region of. 2008. By-Law No. 08-026 - Conservation of Trees in Woodlands.

Waterloo, Region of. 2010. Regional Official Plan. As approved, with modifications, by the Minister of Municipal Affairs and Housing on December 22, 2010.

Waterloo Region Shade Work Group. 2014. Shade Audit Information Guide + Tool: A Guide for Creating Shady Outdoor Spaces. Available online at: http://chd.region.waterloo.on.ca/en/healthyLivingHealthProtection/resources/ShadeAudit_GuideTool.pdf. Last accessed December 22, 2014.

Wolf, K.L. 2003. Public response to the urban forest in inner-city business districts. Journal of Arboriculture 29, 117-126.

Wolf, K.L. 2005. Business district streetscapes, trees and consumer response. Journal of Forestry 103, 396-400.

Wolf, K.L. 2007. City trees and property values. Arborist News 16, 34-36.

Appendices

- **Appendix A: Baseline Criteria and Indicators Assessment of City of Cambridge Urban Forestry Program, 2014**

- **Appendix B: Overview of Subwatershed Forest Cover, Dominant Forest Types and Forest Tree Species**

- **Appendix C: Overview of Funding Opportunities (listed alphabetically by program name)**

Appendix A: Baseline Criteria and Indicators Assessment of City of Cambridge Urban Forestry Program, 2014

Criteria and Indicators for Strategic Urban Forest Planning and Management

The following tables are extracts from *Kenney, W.A., van Wassenaer, P. and Satel, A. 2011. Criteria and Indicators for Strategic Urban Forest Planning and Management. Arboriculture & Urban Forestry. 37(3): 108–117.*

Assessment conducted by City of Cambridge staff, November 2014.

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 0-25% of the potential, **or 0-13%.**	The existing canopy cover equals 25-50% of the potential, **or 13.1-26%.**	The existing canopy cover equals 50-75% of the potential, **or 26.1-39%**	The existing canopy cover equals 75-100% of the potential, **or 39.1-52%**	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	Less than 50% of trees are of species considered suitable for the area.	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 level.
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

Table A1-2. Criteria and performance indicators for the Community Framework.

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)**	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.

Table A1-3 (cont'd). Criteria and performance indicators for the Resource Management Approach.

Resource Management Approach					
Criteria	**Performance Indicators**				**Key Objectives**
	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.

Appendix B: Overview of Subwatershed Forest Cover, Dominant Forest Types and Forest Tree Species

Appendix B. Overview of Subwatershed Forest Cover, Dominant Forest Types and Forest Tree Species

ID #	Subwatershed (SWS) Name	SWS Area (ha)	Predominant Land Use	Current Canopy Cover*	Proportion of SWS Forested (ha)	Proportion of SWS Forested (%)	Summary of Forest Types in SWS**	Notes on Dominant Forest Species / Communities and Ash	Comments
1	Bauman Creek	7	forested, urban	6 ha (92%)	Not Available	Not Available	Not Available	Not Available	SWS completed in 1996, but did not include details of forest communities.
2	Bechtel Creek	76	forested, agricultural, urban	40 ha (53%)	Not Available	Not Available	Not Available	Not Available	SWS completed in 1996, but did not include details of forest communities.
3	Blair Creek	337	agricultural, urban	106 ha (31%)	Not Available	Not Available	Not Available	Not Available	SWS completed in 1996, but did not include details of forest communities.
4	Chilligo (Ellis) Creek	1091	agricultural, urban	318 ha (29%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
5	Confluence of the Speed and Grand Rivers Drainage	533	agricultural, urban	144 ha (27%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
6	Cruickston Creek	58	agricultural	5 ha (8%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
7	Devils Creek	264	urban, forested	105 ha (40%)	56 ha	21%	4% of SWS in FOD 2% of SWS in FOD/CUP 5% of SWS in FOD/SWM 1% of SWS in FOD/SWT 1% of SWS in SWD/SWT 7% of SWS in SWD/SWT/FOD	Not Available	Recent (2013) ELC data provided by City only partially within the Devil's Creek SWS, therefore direct comparisons to the canopy assessment are not appropriate. Environmental Assessment completed in 1992 and Watershed Enhancement Program completed in 1997 did not include details of forested communities.
8	East Hespeler	549	urban	127 ha (23%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
9	Fairchild Creek	72	agricultural	24 ha (33%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
10	Forbes Creek	350	agricultural, urban	88 ha (25%)	70 ha	20%	9% of SWS in FO 9% of SWS in SW 2% of SWS in Hedgerow	Uplands: Sugar Maple, Beech, White Ash; Lowlands: White Cedar, Green Ash, Sassafras, White Birch, Aspen, Poplar, Basswood. Buckthorn in many areas. Ash was identified as a dominant, co-dominant or common species in 3 of the 7 forest, swamp or hedgerow communities identified within the SWS.	Data from SWS completed in 2002.
11	Freeport Creek	319	agricultural	33 ha (10%)	16 ha	5%	<1% of SWS in CUT <1% of SWS in CUP <1% of SWS in CUW 2% of SWS in FOD <1% of SWS in SWD	Uplands: Sugar Maple, White Ash, Beech, Basswood, Ironwood, Black Cherry; Lowlands: Black/Green Ash, Bur Oak, Freeman's/Red Maple, White Elm. Buckthorn in many areas. Ash was identified as a dominant, co-dominant or common species in all of the 13 thicket, plantation, woodland, forest and swamp communities identified within the SWS.	Data from Master Environmental Services Plan and Community Plan completed in 2013.
12	Glenchristie	218	agricultural, forested	92 ha (42%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
13	Grand River Drainage Area	1356	urban	398 ha (29%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.

14	Groff Mill Creek	964	urban	135 ha (14%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
15	Hespeler West	964	agricultural, urban	236 ha (25%)	204 ha	21%	2% of SWS in CUT<1% of SWS in CUW<1% of SWS in FOC<1% in FOM2% of SWS in FOD1% of SWS in SWC 3% of SWS in SWM9% of SWS in SWD1% of SWS in SWT	Uplands: Sugar Maple dominated deciduous forests dominate. One Hemlock mixed forest unit documented. Lowlands: White Cedar coniferous swamp, Maple (Silver/ Freeman) deciduous swamp with Willows and Poplars. Buckthorn in many areas. Ash was identified as a dominant, co-dominant or common species in 2 of the 8 thicket, woodland, forest and swamp communities identified within the SWS.	Data from SWS completed in 2004+J3.
16	Irish Creek	14	urban, forested	6 ha (43%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
17	Mill Creek	1260	urban	403 ha (32%)	Not Available	Not Available	FOC2-2, FOM1 to FOM8, FOD1 to FOD9, FOC4, SWT, CUT1, CUP3	Uplands: White Cedar, Sugar Maple, White Birch, Eastern Hemlock, White Pine. Lowlands: White Cedar, Balsam Fir, Eastern Hemlock, Tamarack, Red Maple, Yellow Birch, Black Ash, Balsam Poplar, Silver Maple, Crack Willow. Buckthorn in many areas. Plantations: Red / Scots / White Pine (in Shade's Mill Reservoir).	Limited information pertaining to the forested communities in the SWS is provided in the GRCA Mill Creek SWS. Small proportion of SWS in City of Cambridge.
18	Moffat Creek	1164	urban, agricultural	341 ha (29%)	Not Available	Not Available	CUT, CUP, FOM, FOD, SWC, SWM, SWD and SWT communities were all identified within the SWS	Uplands: Sugar Maple, White/Red Pine, White/Red/Bur Oak, Black Walnut, Birch, Willow, Aspen, White Cedar, White Ash, Hickory, Basswood, Beech, Cherry; Lowlands: Green Ash, Hawthorn, Aspen, Manitoba Maple, Elm, Willow, Basswood, Silver/Red Maple, White Cedar, Yellow Birch, Tamarack, Poplar Ash was identified as a dominant, co-dominant or common species in 7 of the 8 thicket, woodland, forest and swamp communities identified within the SWS.	Data from Moffat Creek Watershed and Comprehensive Environmental Impact Statement completed in 1996.
19	Newman Creek	21	urban, agricultural	5 ha (22%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
20	Portuguese Swamp Drainage Area	396	urban	97 ha (25%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
21	Randall Drainage Area	250	agricultural	58 ha (23%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data..
22	Speed River Drainage Area	902	urban	240 ha (27%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
23	Toyota Drainage Area	224	urban	26 ha (12%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.
24	Tributaries of the Grand River	181	agricultural	48 ha (27%)	Not Available	Not Available	Not Available	Not Available	No SWS-scale studies available/located with forest community data.

* Based on assessments conducted as part of the *City of Cambridge Urban Forest Canopy Assessment* (2013) **As per the Ecological Land Classification (ELC) System for Southern Ontario (1998)

SOURCES

Aquafor Beech Limited. 2013. East Side Lands (Stage 1) Master Environmental Services Plan and Community Plan - Appendix B1 - Final Draft - Freeport Creek and Tributary to the Grand Subwatershed Study.

Cambridge Engineering and Planning Consultants Limited. 1996. Moffat Creek Watershed and Comprehensive Environmental Impact Statement.

Ch2M Gore & Storrie Limited, Gartner Lee Ltd., Mark L. Dorfman, Planner Inc., Schroeter and Associates. 1996. Blair, Bechtel, and Bauman Creeks Subwatershed Study.

Planning & Engineering Initiatives Ltd., C. Port and Associates, Dougan and Associates, Naylor Engineering Associates, Schroeter and Associates and Ag Plan. 2003 (Revised September 2004). The Corporation of the City of Cambridge Hespler West Subwatershed Study.

Planning & Engineering Initiatives Ltd., C. Portt and Associates, Dougan and Associates, Naylor Engineering Associates , Schroeter and Associates, Ag Plan and Paradigm Transportation Ltd. 2002. The Corporation of the City of Cambridge Forbes Creek Subwatershed Study.

Appendix C: Overview of Funding Opportunities (listed alphabetically by program name)

APPENDIX C: OVERVIEW OF FUNDING OPPORTUNITIES (LISTED ALPHABETICALLY BY PROGRAM NAME)

Program Name	Program Sponsor	Target Group(s)	Required Lead for Application	Brief Program Description	Funding / Incentive(s) Offered	Contact / More Information
CN EcoConnexions From the Ground Up	CN with Tree Canada	Community and Schools	Municipalities or First Nations	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	http://www.tcf-fca.ca/cnfromtheground up/
Community Greening	Evergreen	Community or School	Non-profit community group	Evergreen works with community organizations, local volunteers, urban planners, park managers and other land use professionals to restore, design, maintain and steward public open spaces and school grounds. In addition to funding, they also provide training, design and maintenance advice, and a range of resources.	Since 1991 Evergreen has provided over $7.6 million to more than 4,000 projects across Canada. Grants vary but typically range from of $1,000 to $12,000.	http://www.evergreen.ca/get-involved/funding-opportunities grants@evergreen.ca Tel. (888) 426-3138 x310
Community Grants Program	Ontario Trillium Foundation	Community	Non-profit or charitable organization	Provides grants 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.	http://otf.ca/
Corporate Greening for Carbon Credits	Tree Canada	Corporation	Local Businesses	Tree Canada estimates the amount of carbon potentially sequestered by the number of trees planted. Useful to businesses who wish to enter their carbon credits on to the Voluntary Challenge Registry.	Businesses are required to plant and maintain the trees themselves, but are provided with a "Carbon Certificate" at no cost.	https://treecanada.ca/en/programs/ https://treecanada.ca/files/2313/4880/1893/Carbon_Protocol_English.pdf

Program Name	Program Sponsor	Target Group(s)	Required Lead for Application	Brief Program Description	Funding / Incentive(s) Offered	Contact / More Information
EcoAction Community Funding Program	Environment Canada	Community	Non-profit community group	Program supports projects that address clean air, clean water, reducing greenhouse gas emissions that contribute to climate change and nature.	Grant (values vary)	http://www.ec.gc.ca/ecoaction/
Edible Trees	Tree Canada	Community	Non-profit community group	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.	Grant (values vary)	https://treecanada.ca/en/programs/
Greening Canada's School Grounds	Tree Canada	Schools / Youth	School	Provides to the selected schools: educational information, technical advice and financial support towards the transformation of their school grounds into environmentally enriched learning landscapes.	Grants up to $10,000	https://treecanada.ca/en/programs/
Jack Kimmel Grants	Canadian Tree Fund		Most suited for an academic institution	Could be pursued in partnership with someone at a local college or university (e.g., to explore success of different species in streetscapes, or success of trees in streetscapes using different soil amendments).	Grant (values vary)	http://www.canadiantreefund.org/site/index.php?option=com_content&view=category&layout=blog&id=35&Itemid=68
In-Store Native Tree/Shrub Rebates	LEAF	Community	Would need to be coordinated by City	LEAF offers a wide range of programs in support of urban forestry, but does not provide its full range of programs outside the GTA. This incentive program has been piloted in Kitchener , Guelph and Cambridge previously and could be pursued for longer term implementation.	Rebates (up to $100) for the purchase of a native tree or shrub at partner local nurseries	http// www.your**leaf**.org/

Program Name	Program Sponsor	Target Group(s)	Required Lead for Application	Brief Program Description	Funding / Incentive(s) Offered	Contact / More Information
ISO 14064-2 Carbon Credit acquisition and sale	Canadian Standards Association Group's GHG Clean Projects	Corporation	Most suited to a corporation	Provides specifications at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements. After implementation, the carbon reductions gained through urban tree planting would have to be verified by an accredited third-party ISO 14064-2 verifier. carbon credit retailers.	Verified emission reduction credits could be sold through one of a number of carbon credit retailers.	http://www.csaregistries.ca/cleanprojects/masterprojectdetails_e.cfm?pid=65 Carbon credits may be sold through Zerofootprint: http://zerofootprintcarbon.com/projects-new/forest-new-4/
Managed Forest Tax Incentive Program (MFTIP)	Province of Ontario (OMNR)	Private Landowners	Private Landowner	The Managed Forest Tax Incentive Program is a voluntary program administered by the MNR to provide lower property taxes to participating landowners who agree to conserve and actively manage their forests. Under MFTIP, participating landowners have their property reassessed and classified as Managed Forest and are taxed at 25 percent of the municipal tax rate set for residential properties.	Property tax relief for qualifying landowners	http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_166346.html
TD Green Streets Program	Tree Canada (with TD Canada Trust)	Community	Municipality	TD Green Streets encourages and supports the adoption of leading-edge practices in municipal forestry.	Grants up to $15,000	Requires 50% matching funds from the municipality http://treecanada.ca/en/programs/
Toyota Learning School Grounds Greening	Evergreen	Students / Youth	Public School	Helps schools create outdoor classrooms to provide students with a healthy place to play, learn and develop genuine respect for nature.	Grants of $500 to $3500 for schools, $500 to $2000 for daycares	http://www.evergreen.ca/get-involved/funding-opportunities/school-ground-grants/
50 Million Tree Program	Trees Ontario	Private Landowners	Private Landowners (at least 1 ha)	The program is designed to significantly reduce landowner's costs of large-scale tree planting and thereby increase the number of trees planted.	Agencies work directly with landowners to allocate funding and coordinate planting.	http://www.treesontario.ca/programs/index.php/fifty_million