

# Elmira Green Infrastructure



Prepared for:  
Township of Woolwich Environmental Enhancement Committee

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**NATURAL RESOURCE SOLUTIONS INC.**  
Aquatic, Terrestrial and Wetland Biologists

# Elmira Green Infrastructure

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## Executive Summary

Township of Woolwich Environmental Enhancement Committee (TWEEEC), in cooperation with the Township of Woolwich and Region of Waterloo, retained Natural Resource Solutions Inc. (NRSI) in July 2017 to undertake a 20-year plan to “green” Elmira, Ontario. This plan addresses “Green Infrastructure”, with a focus on increasing the tree canopy in Elmira. The town of Elmira, located within the Township of Woolwich and greater Region of Waterloo, is located within the heart of southern Ontario. The Provincial Policy Statement (MMAH 2014) defines green infrastructure as the “natural and human-made elements that provide ecological and hydrological functions and processes. Green infrastructure can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs.”

This report provides recommendations to increase the tree canopy in Elmira, as well as other strategies to provide environmental benefits such as stormwater management and wildlife habitat. Increased tree canopy has many benefits, including beautification, promoting walking and cycling, cooling, mitigating climate change, and improving stormwater management, among other ecological services. This plan is to be a “living” document, to be implemented over time, by both the Township and volunteer organizations. As hard infrastructure is built and replaced, this presents an opportune time to implement greening strategies to ensure Elmira has a green infrastructure that is sustainable into the future. The Growth Plan (OMMA 2017) specifically requires upper- and single-tier municipalities to develop policies in their official plans to identify actions that will reduce greenhouse gas emissions and adapt to climate change.

The following recommendations are made for Elmira within the timeframes provided:

### 1-2 years

- update and implement Township’s Tree Planting and Landscape Design Guidelines
- replace trees along Arthur and Church Streets
- maintain downtown trees through watering and remove weeds from downtown area
- establish an annual planting program in Elmira
  - Priority areas: downtown, Bolender Park
- start fulsome tree inventory (may be completed in 5-year management blocks)

- augment tree maintenance/pruning schedule in 5-year management blocks
- enforce Township policies and standards with regards to tree compensation, tree planting and care, as well as topsoil depth
- implement a pilot project using structural cells to plant at least 2 trees on the south side of Church Street East, between Arthur Street and Memorial Avenue as part of the Church Street reconstruction in 2020
- identify canopy cover target for Elmira

#### Within 5 years

- encourage homeowners to plant trees and other native plants on their properties
- develop a tree protection by-law for individual trees on private and public land
- integrate stormwater management into parking lot design through use of Low Impact Development techniques
- develop guidance and use break-out zones where necessary to promote tree growth
- continue annual planting program in Elmira
  - Priority areas: industrial lands, plantable spots along roads and in parks, school yards
- provide additional greening opportunities in downtown Elmira through planters
- promote incorporation of Low Impact Development techniques into all new developments

#### 5-10 years

- continue tree inventory
- continue tree maintenance program
- continue tree planting program
  - Priority areas: Arthur Street South, Pentecostal Church property
- implement LID on all new development sites
- implement LID in retrofit projects
- reassess Elmira's tree canopy cover

#### 10-20 years

- continue tree inventory
- continue tree maintenance program
- continue tree planting program

- consider structural cells along Arthur Street when this street is reconstructed in the future
- implement greening strategy of the parking area along the Maple Street extension between Church Street and Wyatt Street, including structural cells for soil, tree planting, and a parkette

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## 1.0 Introduction

Township of Woolwich Environmental Enhancement Committee (TWEEC), in cooperation with the Township of Woolwich and Region of Waterloo, retained Natural Resource Solutions Inc. (NRSI) in July 2017 to undertake a 20-year plan to “green” Elmira, Ontario. This plan addresses “Green Infrastructure”, with a focus on increasing the tree canopy in Elmira. The town of Elmira, located within the Township of Woolwich and greater Region of Waterloo, is located within the heart of southern Ontario. Its population is approximately 10,900 (Township of Woolwich has a population of 26,300).

TWEEC was started in 2006 as a committee of Township of Woolwich Council, and while planting native trees and shrubs throughout Woolwich is a major part of what TWEEC does, the initiatives are wide ranging, including work on waste issues (e.g. recycling of agricultural bale wrap), leading interpretive trail walks and water walks (stormwater education), and involving school classes in clean-waterway plantings every spring. TWEEC maintains a plant nursery in Elmira, created the butterfly garden at Elmira’s library, and has a program to give away trees each year. The volunteer organization is supported by the Township’s Trails Coordinator.

The Green Infrastructure Ontario Coalition (GIOC, 2017) defines green infrastructure as the natural vegetative systems and green technologies that provide a multitude of economic, environmental, and social benefits, including:

- Urban forests and woodlots;
- Bioswales, engineered wetlands and stormwater management ponds;
- Wetlands, ravines, waterways, and riparian zones;
- Meadows and agricultural lands;
- Green roofs and green walls;
- Urban agriculture;
- Parks, gardens, turf, and landscaped areas.

Green infrastructure also includes soil volumes and qualities adequate to sustain the natural vegetation and absorb water, as well as supporting technologies like porous pavement, rain barrels, and cisterns. Green technologies replicate the functions of ecosystems, such as stormwater storage and filtration (GIOC 2017). Green



infrastructure reduces and treats stormwater at its source. It uses vegetation, soils, and other elements and practices to restore the natural processes required to manage water and create healthier urban environments (EPA 2017).

This report provides recommendations to increase the tree canopy in Elmira. Increased tree canopy has many benefits, including beautification, promoting walking and cycling, cooling, mitigating climate change, and improving stormwater management, among other ecological services. This plan is to be a “living” document, to be implemented over time, by both the Township and volunteer organizations. As hard infrastructure is built and replaced, this presents an opportune time to implement greening strategies to ensure Elmira has a green infrastructure that is sustainable into the future.

This Green Infrastructure report provides a review of the Township of Woolwich’s existing policies, by-laws, and programs dealing with urban trees and greenspaces. It also reviews what other communities across southern Ontario are doing with regards to maintaining their urban trees, replacing trees, and integrating trees into new development areas including subdivisions, commercial and industrial development, and parking lots. This report makes recommendations on how to establish trees, including appropriate tree species, minimum soil volumes, maintenance of existing and newly planted vegetation and specific technologies including structural soil cells and structural soil.

In a time when climate change is a pressing issue, the Township’s desire to become more ‘green’ is critical and an important step towards climate change mitigation. Recent updates to the Provincial Policy Statement (2014) and the Growth Plan for the Greater Golden Horseshoe (2017) have recognized key actions are necessary in addressing climate change, which include the following (MMAH 2014, OMMA 2017, Region of Peel 2017):

- Promoting intensified and compact forms of development,
- Promoting an efficient and connected transportation system by encouraging public and active transportation,
- Incorporating green infrastructure and low impact development,
- Encouraging agricultural uses and best management practices,

- Promoting the protection of water and natural heritage resources,
- Reducing water and energy use.

In fact, the Growth Plan (OMMA 2017) specifically requires upper- and single-tier municipalities to develop policies in their official plans to identify actions that will reduce greenhouse gas emissions and adapt to climate change (Policy 4.2.10.1).

Many communities have begun to realize and implement policies regarding non-treed greenspaces and habitats, such as pollinator habitats, as well other early and mid-successional vegetation communities. This report considers such habitats, and also makes recommendations with regards to appropriate low impact development approaches to deal with stormwater runoff from large paved areas.

Despite being a smaller municipality, the Township of Woolwich is following suit with larger municipalities that are following provincial directive in addressing climate change and caring for its citizens in this regard.

## 2.0 Public and Stakeholder Consultation

Following retainment, NRSI biologists met with the TWEEC representatives spearheading this project, as well as with the Township's representative on TWEEC. This meeting took place August 3, 2017 to identify project goals and share information. A public stakeholder meeting was held on September 25, 2017 to introduce the project to the public and garner feedback. NRSI biologists provided a presentation, followed up by a time of discussion. Following the meeting, members of the community were encouraged to provide additional feedback on the project through the submission of a questionnaire. In total, 20 respondents submitted comments, which are summarized in Appendix I.

Several common themes emerged from stakeholder comments:

- 1) Elmira needs more greenery; there are not enough trees or green spaces;
- 2) Planning ahead is crucial in order to design green infrastructure that will be successful in the long term; this includes a need for ongoing maintenance and professional advice;
- 3) Native plant species are vastly preferred to non-native species; and
- 4) Public outreach, educational initiatives, and community involvement in the short- and long-term will ensure the success and lasting impact of the project.

Individuals also identified a number of general areas where greening efforts should be focused, including the downtown core (the main corridors of Arthur Street and Church Street), the industrial lands to the southeast, along all trails and walkways, road medians, and vacant lots. Several specific locations were also highlighted as being priority areas for improvements or having vegetation-related issues that require attention (see Appendix I).

On October 26, 2017, NRSI biologists met with Township staff (Director of Engineering and Planning Services; staff representative on the Green Infrastructure project; staff representative of the Elmira BIA), Region of Waterloo staff (project manager for the reconstruction and resurfacing of Church and Arthur Streets), and the Elmira Business Improvement Area (BIA) Chairperson. This meeting was used to provide information on the project to Township, Regional, and BIA representatives, get a better understanding

of the planned road works in the Elmira downtown area, and share information and ideas.

Another meeting with TWEEC representatives and their Township staff support person was held November 28 to discuss the work in progress, as well as next steps, leading up to a presentation to Township Council in September 2018.

### **3.0 Existing Policies, Legislation, and Guidelines**

In the Ontario policy context, green infrastructure was first introduced in the 2014 Provincial Policy Statement (PPS). Its importance is entrenched in the 2017 Growth Plan for the Greater Golden Horseshoe, which includes the Township of Woolwich. Relevant policies are discussed below.

NRSI has reviewed the Township of Woolwich's existing policies, by-laws, guidelines, standards, and programs dealing with urban trees and greenspaces, including the Township's Landscape Design Guidelines, Tree Planting Guidelines, Site Plan / Development Approval Process document, and tree maintenance homeowner brochures (mulching, pruning, watering). NRSI staff have also reviewed what other communities across southern Ontario are doing with regards to maintaining their urban trees, replacing trees, and integrating trees into new development areas including subdivisions, commercial and industrial developments, and parking lots. In addition to the Township of Woolwich, policies and legislation from Region of Waterloo, City of Waterloo, City of Kitchener, City of London, County of Wellington, Town of Minto, Town of Bracebridge, Town of Oakville, Region of York, and City of Markham, as well as volunteer groups from across southern Ontario have been reviewed, as highlighted in the following sections. Excerpts of specific policy wording is provided in Appendix II.

#### **3.1 Provincial Policy Statement, 2014**

The PPS (MMAH 2014) defines green infrastructure as the “natural and human-made elements that provide ecological and hydrological functions and processes. Green infrastructure can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs.” Policy 1.6.2 of the PPS states that green infrastructure should be promoted by planning authorities to complement traditional forms of infrastructure (such as sewage and water systems, electrical and transportation corridors).

#### **3.2 Growth Plan, 2017**

The revised Growth Plan (OMMA 2017) provides the same definition of green infrastructure as the PPS (2014). It identifies green infrastructure as a way to become

resilient to climate change. The Growth Plan promotes green infrastructure in identifying that complete communities will integrate green infrastructure (Policy 2.2.1.4.g); large-scale development will minimize stormwater flows and reliance on stormwater ponds by including green infrastructure (Policy 3.2.7.2.b); upper- and lower-tier municipalities are to develop Official Plan policies to address climate change, including green infrastructure in stormwater management to mitigate the impacts of severe weather events (Policy 4.2.10.1.d); and in planning, green infrastructure is to be used to develop strategies to reduce greenhouse gas emissions and improve resilience (Policy 4.2.10.2.a).

### **3.3 Grand River Conservation Authority**

The Grand River Conservation Authority (GRCA) manages water and other natural resources on behalf of 39 municipalities in the Grand River watershed, which is the largest watershed in southern Ontario. The GRCA is mandated with flood control, protecting environmentally important areas, providing recreational opportunities, and promoting environmental stewardship in urban and rural areas. The latter includes a tree planting program for farm and rural landowners who have at least 1ha of land. Together with the Region of Waterloo, the GRCA administers the Rural Water Quality Program which provides grants and technical assistance to farmers for tree planting and other best management practices such as stream fencing, manure storage, and well decommissioning. The GRCA also offers tree planting consultation with a Forester as well as installation for sites greater than 2ha in size.

Ontario Regulation 150/06, *GRCA Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*, ensures public health and safety and the protection of life and property with respect to natural hazards. The GRCA regulates watercourses, floodplains, valley slopes, wetlands, and hazardous lands.

### **3.4 Township of Woolwich**

The majority of the natural environment protection policies in the Woolwich Official Plan (updated to July 31, 2012) deal with large natural areas and significant environmental features. However, in terms of urban trees and vegetation, landowner stewardship is encouraged through education and outreach, as well as publicly funded planting programs. In addition, any development subject to Site Plan Control will encourage the use of native vegetation planting along Township roads. The Official Plan also

addresses new planting in road right-of-ways, and replacement of any trees removed from construction projects or that are nearing the end of their natural life cycle. Tree Management Plans are required for new development applications.

The Official Plan states that the Township may undertake a Parks and Recreation Master Plan to encourage linked greenspace, however this has not yet been completed. In addition, the Township does not have its own tree cutting by-law, but relies on the Region's by-law to protect woodland trees.

The Township has Tree Planting Guidelines (2013) and Landscape Design Guidelines (2013) that outline technical aspects of street tree planting, maintenance, location, and preservation. Township staff implement these strategies as part of the Landscaping Plans and Engineering drawings for Site Plan applications and Plans of Subdivision. These require that 30cm of topsoil is to be provided in boulevards, as well as water bags on street trees in new developments. Occasionally the Township will advertise in the local newspapers (Woolwich Observer and Elmira Independent), encouraging property owners to maintain the tree on public property fronting their home. Door knockers are also sometimes distributed to inform homeowners on how to care for newly planted street trees. An example of such a door hanger is attached in Appendix III.

Tree pruning in Elmira is contracted out as Township staff becomes aware of pruning needs based on site visits, reconstruction preparation, or calls from residents or businesses.

### **3.5 Region of Waterloo**

The Region of Waterloo Official Plan (2015) encourages area municipalities to adopt tree preservation by-laws. The Region itself has a Conservation of Trees in Woodlands By-Law that requires permits to harvest trees in woodlots of one hectare or more. The Region also has an Environmental Sustainability Strategy (2009) which states that a priority is to improve tree canopy and monitor the percentage of land cover (no specific targets are given). There are also several past and present environmental initiatives provided by the Region, such as the Rural Water Quality Program administered in partnership with the GRCA which provides grants and technical assistance for tree planting. Another initiative are xeriscape (or "naturescape") demonstration gardens for

all Regional buildings since 2004, to illustrate how the use of appropriate native species can reduce impacts on water usage and runoff. The Region also has a policy by which every tree that is removed through a road construction project has to be replaced by two trees.

### **3.6 City of Waterloo**

The City of Waterloo's Official Plan (2016) has a section on the urban forest. This section states that the City will encourage conservation and planting of trees and hedgerows for all new development applications and municipal infrastructure projects, including the requirement for a Tree Preservation Plan. The City will also identify opportunities for tree planting on City-owned lands and encourage planting programs, public education and involvement. The Official Plan states that the City will implement urban design standards to preserve root structures and prevent soil compaction.

The City of Waterloo's Urban Forest Policy (2001) and Urban Forestry Operation Program (2010) guide the forestry and management operations within the City. These technical documents outline maintenance and pruning standards, process for determining if a tree is on public or private land, identification of significant trees for inclusion in the maintenance schedule, tree protection and damage prevention measures, maintenance and monitoring of environmental lands.

The City of Waterloo has a tree conservation by-law that prohibits damage to or removal of any tree on public property.

### **3.7 City of Kitchener**

The City of Kitchener's Official Plan (2014) has a section dedicated to urban forests. This section encourages conservation, planting and replacement of urban trees, development of a tree inventory and tree planting and education programs. Developments subject to the Site Plan Approval process may be required to maintain and protect existing trees, and any new development applications will be required to submit a tree management plan. The City's Tree Management Policy (2002) states that a Tree Preservation/Enhancement Plan is required for subdivisions, site plan approval, and severances.



The City of Kitchener's *Developing a Sustainable Urban Forest Program* background document (2017) provides information on the urban forest to support the development of a sustainable urban forest program. It contains a summary of current urban forest cover and conditions, as well as next steps that will eventually lead to an Urban Forest Strategy, Implementation Plan, and Asset Management Plan. This process is still in the background analysis and public consultation phase, with final approval for the plans expected in late 2018.

The City of Kitchener has a tree conservation by-law for all properties 1 acre or greater and for trees larger than 10cm dbh (diameter at breast height).

### **3.8 City of London**

The City of London's Official Plan (2016) addresses the percentage of canopy tree cover within the Urban Growth Boundary, and sets out specific canopy cover targets (28% by 2035, 34% by 2065). Tree inventories and tree preservation plans are required for all planning and development applications and infrastructure projects where trees exist on the applicable lands. All trees that must be removed will be replaced on a 1:1 basis, development heights and densities may be increased to support tree conservation on restrained lots, and a water balance study may be required to ensure remaining trees retain long-term health.

The City of London's Urban Forest Strategy (2014) lists 18 future strategic goals focused on preserving and enhancing canopy cover, forest health, and natural biodiversity.

The City of London's Boulevard Tree Protection By-law (2010) and Tree Protection By-law (2016) prohibit damaging, removal or planting of trees in the public right-of-way. The newer Tree Protection By-law (2016) adds new components such as forest health, exemptions for certain activities, designation of "Tree Protection Areas," and designation and protection of "Distinctive Trees". Distinctive trees are those with a dbh of 50cm or more.

### **3.9 County of Wellington**

The County of Wellington Official Plan (2013) has a section addressing urban forests and encourages the retention of trees as well as an increase in the overall urban tree

canopy. Tools to help achieve these goals include residential intensification to preserve existing trees, requiring all Site Plans and Development Agreements address tree planting, and compensation for tree loss when a new lot is created by subdivision, consent, or part lot control. The County also enacts a Rural Water Quality Program with local Conservation Authorities which provides funding and technical advice for best management practices, including tree planting.

The County's forest conservation by-law requires a permit for destruction of more than 20 trees in a forested area 1 hectare or larger.

### **3.10 Town of Minto**

"Trees for Minto" was established in 2014 as a local initiative to increase forest cover in the Town of Minto. A grant of \$10,000 was made to the group by the Wellington County Stewardship Committee in 2015 to assist with future tree planting projects. The Town of Minto and staff make contributions to the budget.

### **3.11 Town of Bracebridge**

The Town of Bracebridge is committed to protecting its trees as it sees them as a "precious resource". Their tree cutting by-law protects trees in the urban boundary and within shoreline areas. The Town developed a Downtown Urban Tree Management Plan (NRSI 2013) that established the condition of trees on public property in the urban core with recommendations to improve tree health and manage hazards. The Town plants 30 trees a year on public property to replace fallen, hazardous, or dead trees. In addition, the Town of Bracebridge promotes memorial tree planting.

### **3.12 Town of Oakville**

The Livable Oakville Plan (Official Plan, consolidated 2017) has sections addressing landscaping, sustainability, and urban forests. The goals of these sections are maintaining and enhancing the existing tree cover to 40%, including replacing every square metre of leaf area that is removed. The Town is to develop standards for the protection and planting of trees.

The Town undertook a comprehensive study of the urban forest in 2015, as a ten-year follow-up to a 2005 study that quantified the structure of the urban forest and its

environmental benefits. It found that the urban tree canopy has increased 1.3% over ten years and the report made several recommendations to move forward.

The Town's Private Tree Protection By-Law prohibits the injury or destruction of any tree classified as endangered, threatened or at risk, as well as prohibiting the injury or destruction of 5 or more trees greater than 20cm dbh and less than 76cm dbh on private property within one calendar year, without first obtaining a permit (although there are a number of exceptions).

The North Oakville Urban Forest Strategic Management Plan (NRSI and Dillon 2012) ensures a sustainable and healthy urban forest for the Town's lands north of Dundas Street. The plan recommends a strategy that connects urban forestry best practices to existing environmental features in Oakville's Natural Heritage System. The plan identifies trees as green infrastructure and their location and suitability are now addressed at the onset of the planning process. Development applications require detailed locations and soil volume of all trees be provided in composite utility plans, ensuring the placement of trees receive equal consideration with other infrastructure services. The Town of Oakville has recently initiated a project to develop a similar urban forest plan for the entire Town.

### **3.13 Region of York**

York Region's Official Plan (2016 Office Consolidation) promotes urban greening strategies and identifies that local municipalities should develop an Urban Forest Management Plan. The Region has its own Forest Management Plan (2016) that sets a canopy target of 35% by 2031, and 40% by 2051. Woodlands are protected by the Region's Forest Conservation By-law, which applies to treed areas greater than 0.2ha.

### **3.14 City of Markham**

The City of Markham's Official Plan (2014, consolidated in 2017, appealed and not yet in force) contains policies on the urban forest, for its protection and enhancement. The City highly values trees, protecting them and requiring compensation if they are removed. The City's Trees for Tomorrow Streetscape Manual (AECOM 2009) guides development applications, as well as City boulevard tree planting. The purpose of the manual is to ensure adequate replacement and increased number of new tree plantings

occur within the City in a sustainable manner. The guideline manual provides specifications, details, and education for staff, developers, contractors and residents to guide tree planting throughout the City.

Markham's Tree Preservation By-law protects trees with a dbh of at least 20cm on private property. Trees to be removed within the City that are between 20 and 40cm dbh require replacement at a ratio of 2:1; trees with a dbh greater than 40cm require an economic appraisal as outlined in the Council of Tree and Landscape Appraisers (CTLA) Guide for Plant Appraisal (2017).

### **3.15 Volunteer Groups**

TWEEC, as mentioned above, is a volunteer organization within the Township of Woolwich. It promotes and organizes many environmental initiatives including tree and shrub planting, recycling, and nature walks. It maintains a tree nursery in Elmira with approximately 4,000 trees, that it uses in its tree planting campaigns, including school events, planting stream corridors, and free tree give-aways. This Elmira Green Infrastructure project is one of TWEEC's initiatives.

An offshoot of TWEEC, "Trees for Woolwich" was formed in 2011 to plant 23,000 trees, one for each of the Township's residents, as well as engaging the community as a whole in the joys and benefits of tree planting. It built on other tree planting efforts by groups like the Elmira Lions Club and the Woolwich Healthy Communities' Clean Waterways Group. Trees were planted on both public and private land, and emphasis was put on planting natural windbreaks along roads and between fields in order to limit erosion and soil runoff, as well as to boost crop yields. In October of this year (2017), the 23,000<sup>th</sup> tree was planted!

The Elmira Lions Club manages a Memorial Forest in Elmira along the Kissing Bridge Trail (established in 2001) and adjacent to the Lunor subdivision. Trees are planted in memory of a loved one.

The Elora Environment Centre has a volunteer group, "NeighbourWoods," which conducts multiple activities around the community to support urban tree health. These include an ongoing tree inventory of Centre Wellington since 2009, the Celebration Tree

Program in which citizens can donate money to plant 6-8 foot tall native trees in public parks, and the Citizen Pruners Program, through which arborists and volunteers prune urban trees in the Elora-Fergus area. NeighbourWoods also holds a number of public education campaigns including booths on Earth Day and a Tree Tag project that illustrates the dollar value of environmental services offered by urban trees.

Trees for Mapleton is a local initiative of landowners and technical advisors to increase the number of trees in Mapleton Township. Initiated in 2006 out of the Trees for Peel program, Trees for Mapleton's focus is on establishing windbreaks. The strategy includes planting trees around the perimeter of every 100 acres, planting the buffers of all waterways, planting up small forest fragments, planting shelterbelts around all farmsteads, linking woodlands, and planting live snow fences. The goal is 5 million trees within the Township.

Forests Ontario is a non-profit registered charity that reaches across Ontario and provides tree planting programs, education, and community outreach, relying on many volunteers. Forest Ontario is helping Ontario residents meet the province's target of planting 50 million trees by 2025, as part of the global Billion Tree Campaign. That campaign was launched in 2006 by the United Nations Environment Program in response to climate change and other sustainability issues. Forests Ontario helps landowners plant trees by reducing the costs of large-scale tree planting, covering up to 90% of the total costs through subsidies. Landowners who plant 10 acres of land with trees can participate in the Managed Forest Tax Incentive Program, thereby reducing their property taxes.

## 4.0 Urban Trees

Urban trees, found within woodlands, riparian corridors, parks, and those along streets and within parking lots, provide many benefits. These include, but are not limited to the following, many of which are related:

- Improved health (physical, emotional, mental)
- Energy savings (shading reduces the need for air conditioning, thus saving money)
- Improved water quality
- Improved air quality
- Climate change mitigation
- Increased property values
- Cancer protection (trees block UV rays)
- Stormwater management (water quantity and quality)
- Slope stabilization
- Increased crop yields through wind breaks (soil retainment)
- Traffic calming
- Increased economic growth
- Heat island mitigation
- Beautification
- Increased tourism
- Wildlife habitat
- Recreation

The economic value of trees can be calculated. i-Tree Eco is a software application that uses data collected in the field from individual trees along with local hourly air pollution and meteorological data to quantify forests, environmental impacts, and value to communities. It can provide estimates of urban forest structure, pollution reduction, public health impacts, carbon sequestration, energy impacts, avoided runoff, forecasting of tree and forest growth over time, bioemissions, compensatory value of trees, as well as potential pest impacts ([www.itreetools.org](http://www.itreetools.org)). For instance, a 40cm dbh Sugar Maple tree in southern Ontario can intercept 6,674 litres of water, raise property values by \$58, conserve 98kWh of energy, reduce carbon by 502 pounds, and provide overall benefits of \$148 per year (Schmitt 2017). Large trees provide much greater environmental

services than young trees. GreenBlue Urban (2017) reports that 60 small trees are required to achieve the same benefit as one mature tree.

Trees provide economic, environmental, and community benefits, which can be calculated in terms of dollars. As an example, Chicago's urban forest of more than 157 million trees has been calculated to be worth \$51.2 Billion, and the entire urban forest in the United States has been valued at more than \$2 Trillion (Scharenbroch 2017). Property values increase by 3-15% when they have large trees (Wolf 2010). The Toronto Star (Vendeville 2015) reported that having 10 more trees on a neighbourhood block has a self-reported health benefit similar to a \$10,000 salary raise or being 7 years younger.

The University of Washington cites the following facts related to urban trees ([https://depts.washington.edu/hhwb/Thm\\_Economics.html](https://depts.washington.edu/hhwb/Thm_Economics.html)):

- *While development costs can be greater for lots where trees were conserved (5.5% in one study), builders can recover extra costs of preserving homes through higher sales prices and faster sales for houses on wooded lots.*
- *Averaging the market effect of street trees on all house values across Portland, OR (population 590,000) yields a total value of \$1.35 billion, potentially increasing annual property tax revenues \$15.3 million.*
- *Homes that are adjacent to naturalistic parks and open spaces are valued at 8-20% higher than comparable properties, with the positive price effect declining to near zero about ½ mile away.*
- *A study found 7% higher rental rates for commercial offices having high quality landscapes.*
- *Shoppers claim that they will spend 9% to 12% more for goods and services in central business districts having high quality tree canopy.*
- *Shoppers indicate that they will travel greater distance and a longer time to visit a district having high quality trees, and spend more time there once they arrive.*



**Photo 1. Treed Business Area**

(Source: Michigan Complete Streets Coalition; <https://michigancompletestreets.wordpress.com/> )

Trees require certain elements to survive. These include sunlight, water, carbon dioxide, growing medium, and nutrients. If any of these elements is missing or limited, trees can either not grow, or cannot grow to their full maturity. As listed above, trees provide a wide range of ecological services, however, trees do not reach their full potential until they are approximately 20 years old. Trees are the only infrastructure that *appreciates* over time. Greater benefits can be received from more mature trees, than young trees, and as such, it is imperative that trees be provided the resources they need to reach maturity and to live many years.

Urban trees, especially street trees, face many harsh conditions that trees growing in natural settings do not encounter. These include limited space, limited soil volume and quality, compacted soils, not enough access to water, damage from mowers or other implements (vehicles, bikes, etc.) (Photo 2), salt from winter road maintenance, pesticides from yard maintenance, non-permeable surfaces (which reduces moisture and soil), and air pollution. Street trees that are planted in road medians and in front yards often do not survive, as roots cannot penetrate the compacted subsoils



surrounding the hole that was dug for the tree. Statistically, 50% of street trees die before they reach 10 years (GreenBlue Urban 2017). Street tree survivorship can be greatly increased by improving site conditions, selecting an appropriate species for the site, and providing sufficient maintenance. This report addresses tree requirements, which if implemented, will greatly help trees survive to maturity.



**Photo 2. Damage to the Trunk of a Street Tree**

*Note:* Newly planted trees should be surrounded by mulch. The mulch controls weed growth, retains moisture, ameliorates soil temperatures, and eliminates damage by grass trimmers. Damage done by mowers and trimmers affect the cells that transport nutrients and water between the roots and the leaves. Because these cells function as vertical tubes, once the ‘tube’ is severed at the base of the trunk it can no longer function along its length, so the overall damage is a ratio of the circumference and not the overall area of bark. In Photo 2, the damage is caused by grass trimmers, also known as weed whackers or line trimmers. Even though this looks like a relatively small wound, the tree has lost approximately 40% of its ability to convey water and nutrients. If these cells (called xylem and phloem) are damaged around the entire trunk the tree is girdled and can die. Even if the damage is not around the entire trunk, the wounded area is susceptible to wood-rotting organisms and decay fungi which will cause further damage.



**Photo 3. "Typical" Soil Conditions for Street Trees in New Subdivisions**

Beside the harsh conditions, many tree diseases are present in Ontario that affect trees, often killing them in a short period of time. Numerous tree diseases are described in Appendix IV. Notably, Emerald Ash Borer has had a significant impact on the urban streetscape in recent years by killing virtually all Ash trees, including those in downtown Elmira, that were removed in 2015. Historically Ash trees were a preferred species to plant along streets as they were hardy and tolerant to urban conditions, such as salt. Since the demise of Ash trees, it has been noted that a diversity of tree species should be planted, so no one disease can wipe out entire treed areas.

## 5.0 Elmira Tree Inventory

The Township of Woolwich originally completed a tree inventory in 1984-1985 (Hayden undated) for all communities within the Township. Within Elmira, that included 1,062 trees of 32 species on Township property.

In the summer of 2017, the Township of Woolwich retained a college student to undertake a street tree inventory. In total, 1,204 trees were inventoried in Elmira, comprised of 33 different species, including some shrubs. Approximately half the streets west of Arthur Street were inventoried, but were not surveyed. Appendix V contains a map showing the streets in Elmira where the street trees were inventoried<sup>1</sup>. The inventory focused on newer subdivisions, where public trees could more easily be identified. Data collected included tree species, location (property address), and health. Additional notes were made with regards to whether the tree should be pruned or removed, and the condition of mulch around the base of the tree. Data was not recorded consistently, however, as no categorized responses were recorded or no data was entered, making analysis difficult.

Table 1 provides collected data on tree health. Where data was recorded on a tree's health (1,103 out of 1,204 trees), most were in 'good', 'fair', or 'okay' condition (note: there is no glossary of terms defining how 'okay' differs from 'good' or 'fair'). In reviewing the data, where information was not entered, the vast majority of the trees were either dead or in 'poor' condition, as they were predominantly infected White Ash. As such, the data in Table 1 is misrepresentative, identifying that only slightly over 8% of surveyed trees in Elmira are in poor condition or dead. In reality, it is closer to 18% (based on the 2017 tree inventory).

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<sup>1</sup> The map is *approximate*. Roads were highlighted as accurately as possible based on the Excel data provided (addresses).

**Table 1. Elmira Tree Inventory - Tree Health**

Condition	#	%	Synonymous Condition
Good	479	43.4	
Fair	425	38.5	green canopy
Okay	108	9.8	
Poor	88	8.0	hazard, not planted deep, 1/2 dead, bad, complaint, shoots, dying, diseased
Dead	3	0.3	dead, remove
	1103	100	

Similarly, Table 2 identifies the maintenance recommendation for the inventoried trees. Data was recorded in 105 different ways, making analysis difficult. However, for the purposes of this report, it was identified as either 1 of 3 recommendations: prune, remove, or no maintenance required. The vast majority of street trees (82%) require pruning. 16% of trees were recommended for removal, either because they were dead, in poor or very poor condition, or were infected Ash trees (most in poor condition or already dead). Very few trees do not require maintenance. To the extent possible, it is recommended that trees that have to be removed are replaced the same year they are removed.

**Table 2. Elmira Tree Inventory - Maintenance Recommendation**

Maintenance	#	%
Prune	990	82.2
Remove	198	16.4
No Maintenance	16	1.3
	1204	100.0

It is recommended that all street trees in Elmira be inventoried, as they form a part of the urban forest, an important asset within the Township. It is best to manage a street tree inventory as a GIS or AutoCAD layer, similar to other infrastructure (e.g. utilities). This layer can be maintained with updates whenever new street tree plantings or removals are undertaken, and is not an onerous task once a fulsome tree inventory is completed. A schedule to re-inventory street trees can be established to keep the data up to date at

10-year intervals. Elmira can be subdivided into management blocks such that the inventory work can be done over several years. The management blocks will allow the required work and budget to be split up into manageable amounts over several years.

A standard inventory method and trained arborist is recommended. Appendix V includes an example data sheet that can be used or digitized, outlining the information that should be collected. It is imperative that data be collected in a standard way, using accepted terms. The following data is typically collected during street tree inventories:

- Species
- Municipal street address as applicable
- UTM survey point
- DBH (diameter at breast height, cm)
- Number of stems
- Crown radius (m)
- Potential for structural failure (as improbable, possible, probable, or imminent)
- Overall condition (as excellent, good, fair, poor, very poor, or snag/dead)
- Maintenance recommendation (such as prune, remove/replace, no maintenance required)
- Other comments (such as regarding disease, damage, aesthetics, mulch, suckers, use by wildlife including woodpecker cavities, comments from homeowner)

Criteria for how to assess and determine potential for structural failure and overall condition is outlined in Tables A and B within Appendix V. Each tree location is typically surveyed along with areas that could have a street tree planted. Notes on each “plantable” spot are recorded including the following information:

- Approximate size of plantable area
- Restrictions (e.g. overhead wires, hydro pole, utility box, mail box)
- Location with UTM and municipal address (e.g. boulevard, front yard)
- Recommendation for size of tree (large or small stature tree)

The Township may tender the tree inventory work. This will give Township staff a competitive price on having the work completed by a third party and will provide

information that the Township will find informative, such as time involved to conduct the inventory, equipment required, and best time of year to conduct the inventory.



**Photo 4. Street Trees in Elmira**

## 6.0 Township of Woolwich Guidance Documents

The Township has several guidelines related to trees and green infrastructure. There are many good guidelines contained within these documents that should be implemented, along with the following suggestions.

### 6.1 Tree Planting Guidelines

The Township of Woolwich's Tree Planting Guidelines (2013) were reviewed. The following suggestions are made to improve upon these guidelines:

- Insert tree stakes outside the root ball instead of in the root ball to avoid damaging the roots and to give the tree more stability (p. 2).
- Update the recommended tree list from Appendix A with species listed in Section 7 of this report (p. 4).
- Balled and burlapped stock should be used for street tree planting instead of bare root or container stock (p. 5).
- Consider cul-de-sac islands for tree planting (p. 7).
- Stake all newly planted trees for 2 years, after which time the stakes should be removed (p. 17).
- The tree planting guidelines should consider mandating at least 40cm topsoil be placed on boulevards and residential yards to promote tree and other vegetation growth.

A list of suitable trees for planting in Elmira is attached in Appendix VI. The table identifies where each species can be planted. In and adjacent to natural areas (e.g. woodlands), only *native* species should be planted, no cultivars or varieties. Non-native species may be planted as street trees where necessary, although native trees are preferred. Always avoid invasive species near woodlands and other natural features.

## 6.2 Landscape Design Guidelines

The Township of Woolwich's Landscape Design Guidelines (2013) were reviewed. The following suggestions are made to improve upon these guidelines. Under Section 1, Site Plan, the following bullets are recommended to be added below each sub-heading:

### Plant Material

- Consider shape and size to appropriately fit the space

### Lighting

- Be directed downward to minimize light pollution and impacts to migratory birds

### Existing Landscaping

- Retain existing landscaping through the completion of a Tree Preservation Plan or Environmental Impact Study

### Parking Areas

- Consider a minimum tree to parking stall ratio of 1:5

### Plant Material

- Consider proximity to natural areas and opportunities to support pollinators in species selection

Under "Site Plan Submission & Approval Process, Plant Material" (p. 15), the following suggestions are made:

- Under 'Plant Material Specifications,' deciduous trees are to have a caliper of at least 60mm, which contradicts the 50mm specified in the Township's Tree Planting Guidelines. 50mm is considered adequate.
- Add Ash (*Fraxinus*) species to the list of trees not acceptable for planting along roads.
- Plant buffers with native species only. Add Eastern Hemlock (*Tsuga canadensis*), Red Cedar (*Juniperus virginiana*), White Cedar (*Thuja occidentalis*), and White Pine (*Pinus strobus*) to the list of acceptable species.

Under "Drawing Submission Requirements, Tree Preservation Plan" (p. 17), that the following suggestions are made:

- The Plan is to be prepared by a Certified Arborist.
- Add scale and include crown radius with tree size.



Under “Tree Preservation” (p. 19), it is unnecessary to plant trees spaced on mature width, as tree width is variable and a product of its growing area. Under “Existing trees should be assessed for the following” (p. 20), trees with splitting potential should be managed for the hazard, such as pruned, and not necessarily removed. It is recommended that trees are assessed by a Certified Arborist.

The species lists appended to the Landscape Design Guidelines with regard to stormwater management facilities are not entirely appropriate. New species lists should be prepared specifically for Waterloo Region, with a strong preference to native species. Native species provide habitat for wildlife that non-natives species do not. For instance, birds will forage within native trees, as they harbor insects, whereas non-native trees will not provide the insect diversity or quantity, providing little foraging habitat for birds. The following documents can be reviewed for their guidance on appropriate species for stormwater management facilities, including various environmental tolerances (e.g. salt):

- City of Toronto. 2015. Landscape Design Guidelines for Stormwater Management Ponds. September 2015. See especially Appendix A, Acceptable Plant Species for Stormwater Management Ponds.  
[https://www1.toronto.ca/City%20of%20Toronto/Engineering%20and%20Construction%20Services/Standards%20and%20Specifications/Files/pdf/Landscape%20Design%20Guidelines/Landscape\\_Design\\_Guidelines\\_SWM\\_Ponds\\_Sep2015\\_AODA.pdf](https://www1.toronto.ca/City%20of%20Toronto/Engineering%20and%20Construction%20Services/Standards%20and%20Specifications/Files/pdf/Landscape%20Design%20Guidelines/Landscape_Design_Guidelines_SWM_Ponds_Sep2015_AODA.pdf)
- Credit Valley Conservation (CVC). 2012. Stormwater Management Criteria. August 2012. See especially Appendix D, Stormwater Management Pond Planting Guidelines.  
<http://www.creditvalleyca.ca/wp-content/uploads/2014/09/cvc-swm-criteria-appendices-Aug12-D-july14.pdf>
- Conservation Halton. 2010. Landscaping and Tree Preservation Guidelines. April 2010. Appendices current to December 2014. See especially Appendix 1, Native Species List (Herbaceous and Woody)  
<http://www.conservationhalton.ca/policies-and-guidelines>
- Ministry of the Environment (MOE). 2003. Stormwater Management Planning and Design Manual. See especially Section 4.6.1, SWMP Vegetation, and Appendix E, plant species. Note that a revised Manual is expected out very soon.  
<https://dr6j45jk9xcmk.cloudfront.net/documents/1757/195-stormwater-planning-and-design-en.pdf>

Tree species for landscaping along streets, within parks, natural areas and buffers, are addressed in the next section.

## 7.0 Tree Species

The Township Tree Planting Guidelines (2013) contain a list of preferred species for street trees in Appendix A. It is recommended that list be updated and replaced by the one attached in Appendix VI. Generally, native species should be planted wherever possible. However, some urban conditions are very difficult and native species may not thrive. In such cases, non-native cultivars may be better suited to the site-specific conditions. A local nursery can be consulted for the most appropriate species. Some of the hardiest trees for difficult situations are Ohio Buckeye (*Aesculus glabra*), Kentucky Coffee Tree (*Gymnocladus dioicus*), and Lilac (*Syringa vulgaris*), with the two former species being the most “bullet proof” (Gynan 2017). Suitable species lists from other jurisdictions are attached in Appendix VI as well, and can be consulted with regards to suitability for site conditions, such as salt tolerance.

Within natural areas and any areas bordering natural features, only native species should be planted (no cultivars or varieties). The tree list provided in Appendix VI identifies native species that are suitable for these areas. Trees that provide food for wildlife should be considered, especially Basswood (*Tilia americana*), Hickory (*Carya* spp.), Ironwood (*Ostrya virginiana*), Oak (*Quercus* spp.), and White Cedar (*Thuja occidentalis*) (Wu-Winter 2017).

## **8.0 Greening Areas**

Various areas in Elmira are highlighted within this section to focus greening efforts, especially tree planting.

### **8.1 Downtown**

The two main roads in Elmira, Arthur Street and Church Street, are both Regional roads. Church Street East, between Arthur Street and Spruce Lane, is to be reconstructed in 2020. This reconstruction will not widen the road, but is to widen sidewalks to 1.8m. The road corridor is extremely tight, leaving no room for boulevards. There are no plans for any reconstruction on Church Street West in the near future.

Arthur Street is to be resurfaced in 2021, between South Street to just beyond the Canagagigue Creek bridge north of Riverside Drive. This will include a 'shave and pave' of the road, as well as repairs to lighting, sidewalks, and spot repairs to curbs. It does not, however, include a full reconstruction. Arthur Street was last reconstructed in 1991, which is when the downtown trees were planted. These were mostly Ash, which died because of infestation by Emerald Ash Borer, and so were removed in 2015 (see Photos 5 and 6). The tree beds have been covered with concrete to prevent trips, while a solution to the downtown tree area could be found (Photo 7).

The Region is responsible for the road works; however, the Township is responsible for sidewalks, lighting, and trees, partially through Regional funding. In partnership with the Elmira BIA and Region of Waterloo, the Township will upgrade the existing decorative lighting along Church and Arthur Streets. The Township will also plant trees or other vegetation along the roads, with guidance from this Green Infrastructure document.



**Photo 5. Arthur Street Prior to 2015**



**Photo 6. Arthur Street in 2017**

The BIA currently arranges for the decorative hanging flower baskets in the downtown area each summer (Photo 8). These are watered and fertilized regularly, which causes unsightly weeds to grow underneath the baskets (Photo 8). Some business owners in the downtown area have expressed concern with certain issues trees along the main streets cause, including blocking advertising and signs, interfering with delivery trucks,

maintenance issues such as falling branches and leaves, and impacts of tree roots on basements and underground utilities. On the other hand, residents and other business owners have expressed concern and frustration by an unfriendly downtown area denude of trees and vegetation. Residents have noted that the heat island created in the downtown core is very difficult and unhealthy for elderly residents in the summer. Downtown areas with trees and other vegetation have been shown to increase economic revenue by being an inviting place and encouraging visitors to spend more time downtown, spending money, as well as providing cooling, shade, beautification, and calming traffic. In short, treed downtown areas are much more welcoming and encourage people to stop and stay (compare Photos 5 and 6 of the Elmira downtown area, before and after the trees were removed).



**Photo 7. Downtown Former Tree Bed**



**Photo 8. Hanging Basket and Weeds**

Most of the concerns business owners have can be addressed by pruning trees so that they do not block signage. Appropriate species selection and pruning can address issues with delivery trucks.

According to the Township's Landscape Design Guidelines (2013), 'gateway roads,' such as Arthur Street, are prominent areas that require additional landscaping to soften parking and building features. In keeping with this guidance, it is strongly recommended that the trees along Arthur Street and Church Street be replaced. According to Google Earth images from 2006, it appears that there were 51 trees along Arthur Street between William Street to the north and Park Street to the south. Along Church Street, between Walker Street to the west and Memorial Avenue to the east, there were 11 trees (with only 1 tree being located east of Arthur Street). The most effective way to grow mature street trees in downtown areas is by using enhanced rooting environments, also referred to as structural cells for soil. Numerous companies sell these products, such as the following:

- **Deep Root Canada Corp.** (Silva Cell product)  
Suite 341 – 550 West Broadway  
Vancouver, BC V5Z 0E9  
1-800-561-3883  
[www.deeproot.com](http://www.deeproot.com)
  
- **GreenBlue Urban**  
71 Bysham Park Drive  
Woodstock, ON N4T 1P1  
1-866-282-2743  
[www.greenblue.com](http://www.greenblue.com)

Structural cells are generally modular plastic frames that are used in urban environments to provide sufficient rooting area for trees. These products can be integrated with other underground infrastructure (e.g. pipes) to provide soil volumes necessary for large tree growth. These systems also provide an array of other environmental benefits, such as stormwater management through absorption, evapotranspiration, and interception. They have been proven to improve stormwater quality significantly (reduce total suspended solids, reduce heavy metals and other contaminants, reduce temperature), reduce peak flows, and require low or no maintenance. Structural soil cells are installed in the ground around other infrastructure, filled with topsoil, and covered with a variety of surface treatments, which include roads, walkways, and parking lots. Stormwater is directed to these systems for treatment before discharging into natural systems. The downtown Elmira core receives no stormwater treatment, so installing these systems would be very beneficial for many reasons. However, since the proposed work on Arthur Street in the near future is solely resurfacing, installing these underground cells is not feasible at this

time. It is highly recommended that this infrastructure be considered for the future, at whatever time Arthur Street is reconstructed.

On Church Street East, as this is a reconstruction project to be completed in 2020, this infrastructure can be considered, especially as a pilot project for the Township. The south side of the road, between Arthur Street and Memorial Avenue could be identified for this project. Local banks may have funding opportunities that can be applied for this greening project or others. Local businesses may also be interested in supporting such an initiative. As the road corridor is very tight along Church Street East, almost the entire stretch of reconstruction will be enveloped by road or sidewalk, with no boulevards. As such, there is no room for tree planting on Township property without the use of structural soil cells. Private homeowners adjacent to the reconstruction may be approached to see if they are willing to accept one or more trees on their property. It is suggested the Township provide and plant the trees, educating homeowners how to maintain the trees (e.g. frequency of watering). It is estimated that approximately 20-24 trees could be planted this way, offsetting the trees that have to be removed as part of the reconstruction. In addition, the embankments to the north and south of the road can be planted with trees, especially east of Canagagigue Creek.

Along Arthur Street, in the absence of a full reconstruction, it is recommended that a mini-excavator be used to re-dig the tree holes where trees once were. Hand digging will also have to be used (or used exclusively) to remove excess material, making the holes as large as possible. Suitable tree species should be planted and the hole filled with high quality topsoil. It is imperative the trees be watered regularly (as needed) for the first 2 -3 years at least. It is suggested that the trees be given water bags, which can be filled as needed (usually once per week, twice per week if there is no rain) by the same contractor who is watering the hanging baskets. Tree pruning every 5 years along the gateway roads is recommended.

Township staff recommendation to plant the downtown trees over 4 years is endorsed. It is recommended that 15 trees be replanted in 2018, 17 trees in 2019, 15 trees in 2020, and another 15 trees in 2021. In 2021, following the Arthur Street repaving, it is recommended additional greening strategies be implemented, including planters of flowers and grasses. These should be maintained by the Township. Weeds in the

downtown core have been noted as a concern and should also be removed through a Township contract, without the use of pesticides. Weeds can be pulled, cut, or removed by spraying them with boiling water.

The following tree species are recommended for downtown Elmira:

Large stature trees:

- Chinquapin Oak (*Quercus muhlenbergii*)
- Common Hackberry (*Celtis occidentalis*)
- Elm species (*Ulmus* sp.; Dutch Elm disease resistant cultivar)
- Honey Locust (thornless variety, *Gleditsia triacanthos* var. *inermis*)
- Kentucky Coffee Tree (*Gymnocladus dioica*)

Small stature trees (only on sites with overhead restrictions):

- Ivory Silk Lilac (*Syringa reticulata*)
- Serviceberry (*Amerlanchier canadensis*)

#### **Recommendations for Elmira:**

- Consider a pilot project implementing structural cells to plant at least 2 trees on the south side of Church Street East, between Arthur Street and Memorial Avenue
- Plant trees on private property along Church Street East where permissible
- Replace the trees along Arthur Street and Church Street West starting in 2018
- Provide additional greening in the downtown core with flower and glass planters; promote native species which provide pollinator habitat
- Watering of trees and weeding should be included in a contract to maintain the downtown area, along with planters, decorative hanging baskets, and garbage clean up
- Consider structural cells along Arthur Street when this street is reconstructed in the future



## 8.2 Parking Lots

The Township's Landscape Design Guidelines (2013) already provide guidelines for parking lot design, which include the following, related to greening:

- *Reduce visual impact and massing of parking areas where possible.*
- *Provide shaded areas and windbreaks to improve microclimate.*
- *Parking islands should be planted with trees, shrubs, ground covers and/or turf and landscaping must be of suitable height and hardiness for the use of the area.*
- *It is recommended that traffic safety islands be provided at the ends of all bays of parking to separate parking areas from driveways, aisles or other areas. These safety islands should be planted with appropriate shade trees and/or other plantings.*
- *Should be dispersed with visual relief with vertical landscape elements, and physical relief with seasonal tree shading to improve parking lots.*

These guidelines are not necessarily implemented, as evidenced recently in a large retail parking lot on Arthur Street South, which opened in March 2017. Many attendees at the public stakeholder meeting, as well as respondents to the questionnaire, explained their disappointment that the new parking lot does not contain enough trees. Large paved surfaces are detrimental to the environment as they produce heat islands and do not allow water to infiltrate into the ground. Planting trees in parking lots can help with both issues.

Some municipalities are providing specific guidelines with regards to trees in parking areas. The City of London's Official Plan, London Plan (2016), contains the following policies:

*277\_ Surface parking lots should be designed to include a sustainable tree canopy with a target of 30% canopy coverage at 20 years of anticipated tree growth.*

*282\_ Surface parking areas will be designed to incorporate landscape/tree islands for visual amenity and to help convey stormwater and reduce the heat island effect.*

401\_ 14. *A minimum tree canopy cover of 30% should be achieved for parking lots. Appropriate soil volume, drainage, and appropriate technology will be used to ensure the long-term sustainability of these trees.*

An objective of the Town of Oakville's Official Plan (2017) is "to progressively increase the urban forest to achieve a canopy cover of 40% Town-wide". In order to meet this goal, the North Oakville Urban Forest Strategic Management Plan (NRSI and Dillon 2012) recommends implementing design guidelines for greening parking lots and amending the Town's zoning by-law to require trees within parking lots. Relevant sections of the North Oakville Plan (NRSI and Dillon 2012) are copied below:

#### **7.4.3.7 Surface Parking Lots**

##### *7.4.3.7.1 Tree Planting Requirements*

- *Minimum one (1) 60 millimetre caliper deciduous tree planting for every five (5) parking spaces.*
- *Minimum two (2) trees per parking lot island.*
- *All required trees must be in or within 5.0 metres of surface parking area in parking lot with 76 or more parking spaces.*
- *Distribute shade tree planting such that no parking space is no more than 30 metres from a tree.*
- *When necessary, small-statured trees (3 metre spread and less) will be accepted to meet these requirements.*

##### *7.4.3.7.2 Landscape Buffer Strip Requirement*

- *Provide a minimum 3.0 metre wide landscape buffer from inside the property line, between the parking lot and the municipal right-of-way.*
- *Provide for a minimum 3.0 metre wide landscape strip not abutting a street in 5 to 75 space parking lot.*
- *Provide for a minimum 4.5 metre wide landscape strip not abutting a street in parking lot with 76 or more parking spaces.*
- *Provide a minimum 4.5 metre soft landscape area as setback when abutting a residential zone. If other zoning setbacks apply, the greater setback shall be required.*

#### 7.4.3.7.3 Landscape Buffer Strip Planting Requirements

*For landscape buffer abutting the municipal right-of-way, the buffer shall include:*

- *One (1) deciduous tree for every 12 metres of street fronting the parking lot; arrangement of trees in clusters or groupings is encouraged, but in no case shall trees be more than 15 metres apart. Site trees must be sufficiently set back to avoid overlap with any municipal street tree.*

*For landscape buffer not abutting a street, the buffer shall include:*

- *Deciduous tree plantings meeting parking lot tree spacing and minimum tree planting requirements.*

#### 7.4.3.7.4 Internal Landscape Area / Parking Lot Islands

- *Minimum two (2) shade trees per parking lot island. Provide ground cover planting.*

#### 7.4.3.7.5 Parking Lot Tree Spacing Requirements

- *Small stature tree (3 metre spread) = min 5 metre spacing*
- *Medium stature tree (10 metre spread) = min 10 metre spacing*
- *Large stature tree (14 metre spread and greater) = min 14 metre spacing*

The City of Toronto has adopted Design Guidelines for 'Greening' Surface Parking Lots (2013). These discuss parking lot location and layout, including lighting requirements; vehicle and pedestrian access and circulation; landscaping; and stormwater management. Relevant sections are copied below:

#### 4.4.2. Streetscape and Perimeter Landscaping

*c. For parking lot edges adjacent to streets, parks or other public open space, provide the following:*

- *at least one row of shade trees, spaced evenly at 5m to 6m intervals (or as appropriate to the selected species) for the length of the parking lot edge*
- *screening, consisting of continuous planting, alone or in combination with a low decorative fence/wall or a landscaped berm. Typically, keep shrubs, fences or walls to a maximum height of 1m.*

#### 4.4.3 Internal Landscaping

d. *Plant high-branching deciduous trees throughout the parking lot interior to provide shade for pedestrians, vehicles and surfaces:*

- *provide internal shade trees at a minimum ratio of one tree planted for every five parking spaces supplied*
- *distribute internal shade tree planting such that no parking space is more than 30m from a tree*

*Note: On small or narrow sites, shade trees provided in non-street facing perimeter planting areas can be counted toward the internal tree requirement, provided that the maximum distance from a parking space (30m) is met.*

e. *Include landscaped islands at the beginning and end of each parking row and to break up longer rows or highlight special features:*

- *provide a minimum growing environment of 30m<sup>3</sup> (at 0.9m depth) of good quality soil*

*Note: This typically results in a landscaped area at least 3.5m wide for end-of-row islands and 3m wide for mid-row islands*

- *plant at least 1 high-branching deciduous shade tree (2 preferred) in each island*
- *include understory planting, such as shrubs, perennials, ornamental grasses and groundcover*

f. *Provide continuous landscaped medians every 3 (or fewer) banks of parking.*

*Note: a “bank” of parking consists of 2 parking rows and a drive aisle.*

g. *Medians should have a landscaped area at least 3m in width and combine with shade tree planting requirements, pedestrian pathways and/or stormwater management as appropriate.*

### Recommendations for Elmira:

- Implement Township's Landscape Design Guidelines (with revisions as per Section 6.1)
- Specify 1 tree for every 5 parking stalls, or best efforts as determined by Township staff
- Specify 2 trees for every parking lot island, depending on size (design parking lot islands to be large enough for 2 or more trees)
- Specify requirement for landscape buffer strips surrounding parking lot and within parking lot
- Integrate stormwater management into parking lot design through use of Low Impact Development techniques (e.g. rainwater harvesting, infiltration galleries, bioretention areas, permeable pavement, use of CB Shield units)
- Priority parking lot areas in Elmira are the parking lots in these areas: large retail parking lots along Arthur Street South (south of Southfield Drive), large parking area on south side of William Street between Maple Street and Arthur Street North, and Maple Street extension to Wyatt Street.



**Photo 9. Parking Lot South of William Street Near Arthur Street**

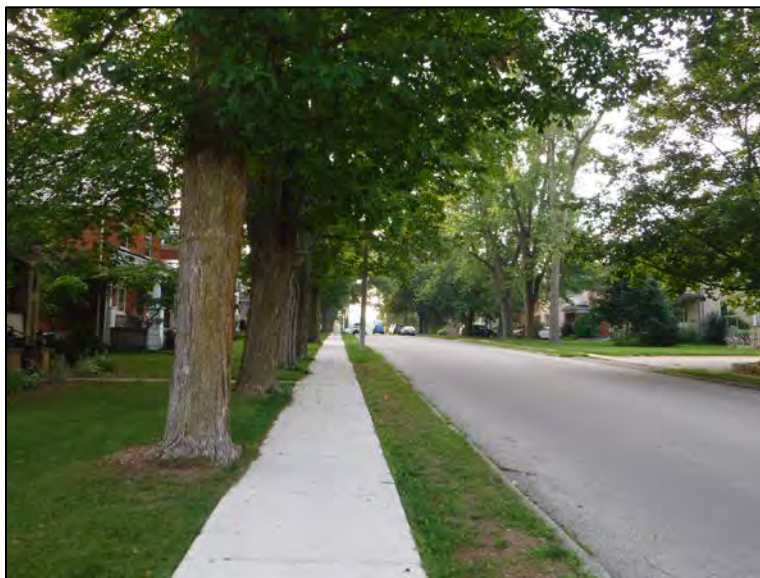
## 8.3 Residential Areas

### 8.3.1 Established Neighbourhoods

Older neighbourhoods in Elmira contain some very large, mature trees. These trees obtained their stature because either the houses were built within former woodlands, or because home building was conducted differently in the past than it is now.

Unfortunately, street trees planted today will struggle to reach maturity under today's planting practices. When new homes are built today, they are usually part of a large subdivision, where the entire land is stripped and cleared. Subsoils are compacted through the use of heavy machinery. Topsoil is often reapplied at a minimal depth, as current guidelines are not necessarily adhered to and the Township lacks enforcement capabilities. In the past, homes were built on an individual basis, and typically left native soils in place. As such, planted trees had access to higher quality and quantities of soil.

Street trees in older neighbourhoods in Elmira are declining because of their age. The trees should be pruned as required to manage for hazards and to extend their life as long as possible. Even though many of the trees are in decline, they still provide an incredible amount of environmental, social, and economic benefits. Where possible, it is recommended that young trees be inter-planted, so they can become established before the large trees have to be removed. Where this is not possible, large trees that have had to be removed should be replaced by caliper trees in close proximity.



**Photo 10. Park Street in Elmira**

### 8.3.2 New Neighbourhoods

When new development occurs, large areas get stripped of their topsoil. Generally, less than 30% of the topsoil is reapplied following construction, usually to a depth of 10 to 15cm, with 1-2% organic content (TRCA 2012, Young 2016). Planting of street trees in Elmira is required in new subdivisions through the Draft Plan of Subdivision approval process with the Township. The Township currently requires 15cm topsoil depth in yards, and 30cm topsoil depth in boulevards. The *Preserving and Restoring Healthy Soil: Best Practices for Urban Construction* document (TRCA 2012) makes the following recommendations:

Areas of turf (i.e. yards):

- 5-10% organic matter (by dry weight)
- pH of 6 – 8
- subsoil should be scarified by at least 10cm and some topsoil should be incorporated into this lower layer
- topsoil depth at least 20cm

Planting beds:

- 10-15% organic matter (by dry weight)
- pH of 6 – 8
- subsoil should be scarified by at least 10cm and some topsoil should be incorporated into this lower layer
- topsoil depth at least 20cm

Tree pits:

- 10-15% organic matter (by dry weight)
- pH of 6 – 8
- subsoil should be scarified by at least 30cm and some topsoil should be incorporated into this lower layer
- topsoil depth at least 60cm
- tree pits should provide at least 30m<sup>3</sup> soil for single trees. Multiple trees can share soil volumes provided the minimum of 30m<sup>3</sup> is satisfied (e.g. parking lot island for 2 trees)

The Credit Valley Conservation's *Healthy Soils Guideline* (CVC 2017) goes further, by recommending the following for development sites:

- 10-13% organic matter (by dry weight)
- pH of 6 – 7.5
- subsoil should be scarified by at least 45cm and some topsoil should be incorporated into this lower layer
- topsoil depth at least 30-45cm; topsoil should be placed in lifts of 15cm

The TRCA's guide (2012) is expected to be updated in the near future, and may incorporate some of the newer recommendations.

For Elmira, it is recommended that the depth of topsoil be increased to a minimum of 40cm. To retain the health of the soil, it is best practice to store only the first stripping of topsoil, and maximize stock pile height at 2m. Higher piles ruin the soil quality by killing soil organisms and microbes. Before it is reapplied, the subsoils should be scarified to 45cm. If possible, the topsoil should be amended with compost (10-15%; in tree pits 25% compost is recommended, Henry 2106). This will not only improve tree growth and health, but will improve all other plantings, including turf. Stormwater benefits will also be realized, as topsoil will retain and infiltrate stormwater. Studies have shown that where these best management practices are not implemented, landscaped areas constructed on compacted soils act more like impervious areas, with 40-60% total runoff (TRCA 2012).

The Township's Tree Planting Guidelines (2013) provide guidance with regards to where trees should be planted within new subdivisions.

Where trees are planted in boulevards, it is recommended the Township stipulate that structural soil or equivalent (e.g. unwashed ¾ inch crushed aggregate) be placed under the 2 sidewalk squares adjacent to the tree, to create a "break-out zone". Structural soil is a mixture of crushed stone, clay loam, and a hydrogel stabilization agent that supports the weight of pavement (sidewalks, driveways, roads), without compacting the soil. The medium contains pore spaces to allow root growth, while providing some water and nutrients for trees. As such, roots can grow through the structural soil, accessing additional high quality soils in areas on the other side of the pavement, such as front yards. Structural soil was developed by Cornell University. "CU-Structural Soil" is produced by a network of qualified companies and is sold for \$35-42/ton. Structural soil must be installed by licensed contractors, as it requires special handling. Local contracts that install CU-Structural Soil include the following:

- **Earthco Soil Mixtures**  
401 Bowes Road  
Concord, ON L4K 1J4  
905-761-6599  
sales@earthcosoils.com  
www.earthcosoils.com



- **Hermanns Contracting Limited**

1510 Hwy 27, PO Box 369  
Schomberg, ON L0G 1T0  
905-939-1230  
general@hermanns.ca  
www.hermanns.ca

**Recommendations for Elmira:**

- Retain mature trees for as long as possible; pruning for hazards and to prolong life
- Inter-plant in established neighbourhoods to start new tree growth where old trees will eventually have to be removed
- In new neighbourhoods, implement the following as minimum soil standards:
  - 10-15% organic matter (by dry weight)
  - pH of 6 – 7.5
  - scarify subsoils to 45cm or greater if possible, or to at least 15cm and incorporate some topsoil into this lower layer
  - topsoil depth at least 40cm; topsoil should be placed in lifts of 15cm
- Mandate 30m<sup>3</sup> of topsoil per tree, which may be shared by other trees
- Encourage topsoil stockpiling in accordance with best practices (see TRCA 2012)
- Where necessary (to meet soil requirements per tree), create break-out zones
- Encourage homeowners to plant trees on their properties and educate them on how best to maintain trees
- Encourage homeowners to plant native flowers and shrubs to provide pollinator habitat as well as other wildlife habitat
- Encourage homeowners to disconnect downspouts where they are currently connected to storm sewers and encourage the use rain barrels
- Implement Low Impact Development techniques wherever possible to manage stormwater (e.g. permeable driveways, rain gardens, bioretention facilities, CB Shield units)



**Photo 11. Perennial Garden With Many Native Species**

#### **8.4 Industrial Areas**

Industrial areas within Elmira contain very little tree cover, which is quite evident on aerial photography (see Figure 1 in Section 10), especially in the southeast portion of Elmira, which is heavily industrialized (south of First Street, east of Arthur Street South) (Photo 12). Business owners should be encouraged to plant trees on their properties. They may need to be educated on the environmental, social, and economic benefits trees provide. The Township should consider an incentive program to encourage tree planting on industrial properties. This could be in the form of public recognition within local newspapers or other means. Many properties are large and contain large areas of mowed grass, which are very suitable for tree planting. It is recommended that vacant lots be left to naturalize in order to provide habitat while the property is not in use.



**Photo 12. Industrial Lands** (Google Earth image, 2016)

Where industries have planted trees, but in the future need to expand their building or parking area, they should be allowed to do so, without having to compensate for the removal of trees they may have planted years earlier. Of course, tree removal should be discouraged wherever possible.

The implementation of Low Impact Development scenarios on industrial lands should be highly encouraged for their benefit to stormwater and stormwater management.

**Recommendations for Elmira:**

- Encourage more tree planting and naturalization of industrial lands
- Integrate Low Impact Development techniques wherever possible (e.g. green roofs, rainwater harvesting, disconnect downspouts, increase topsoil depth, bioretention facilities, vegetated swales)
- See Section 8.2 for recommendations with regards to parking lots

## 8.5 Parks

Individual trees within parks should be managed as street trees; trees within naturalized wooded areas should be managed as part of the natural feature. It is recommended that trees within woodlands only be pruned as necessary to manage for hazards, such as those in close proximity to private property or trails. Individual park trees should be inventoried and plantable spots within parks identified so more trees can be planted.

### Recommendations for Elmira:

- Individual trees in parks should be inventoried and maintained as street trees
- Additional tree planting in parks where possible

## 8.6 Schools

The tarmac around schools can become extremely hot in the spring and fall while school is running, creating a heat hazard for children. Sun and heat is a health and safety concern that schools need to be concerned about and which they have an obligation to protect children from. Tree planting should be encouraged on school grounds, which have a lot of opportunity because of their large size. Besides protecting children from sun burn and severe heat, trees provide psychological benefits to children, reducing stress and providing relaxation.

The Evergreen Foundation provides many resources to promote the greening of school yards (see <https://www.evergreen.ca/our-projects/planning-design/> ). Strategies include the following:

- Tree planting, especially in clusters
- Pollinator gardens
- Food gardens
- Naturalization areas

### Recommendations for Elmira:

- Promote tree planting on school grounds
- Encourage schools to create school yard greening strategies and implement these

- Integrate Low Impact Development techniques wherever possible (e.g. associated with parking lots; green roofs)
- See Section 8.2 for recommendations with regards to parking lots

## 8.7 Other Areas

The following areas within Elmira were specifically recommended for tree planting, most as identified by members of the community who submitted questionnaires.

- Arthur Street South, especially between Listowel Road / Union Street and Whippoorwill Drive / Southfield Drive
  - Especially on east side of road within vacant lots and in areas of manicured lawn (e.g. site immediately north of Voisin Chrysler Ltd.)
  - Large stature trees preferred, including Sugar Maple, as Elmira is home of the world's largest Maple Syrup Festival (particularly to be considered near the sign for Elmira, noting the Maple Syrup Festival)
- Arthur Street South, between Southfield Drive and Oriole Parkway
  - Tree planting on Home Furniture/PIB property and along Industrial Drive
- Bolender Park
  - Shade tree planting around the new splash pad
- Elmira Pentecostal Church
  - Tree planting along sidewalk and drainage ditch

The extension of Maple Street to Wyatt Street in downtown Elmira is discussed here as well. This area is comprised mostly of parking areas for the stores along Arthur Street and Church Street. As such, this area is heavily paved, with only 2 trees in one parking lot island. Whenever reconstruction is necessary in this area, it is highly recommended that this area be 'greened' through structural cells for soil to manage and clean stormwater and to promote tree growth. A small parkette in this area with trees and benches would enhance the downtown area, providing beauty and a spot to rest and socialize.

It is recommended that trees planted in the Memorial Forest in Elmira be comprised of native species only, especially since the Memorial Forest is adjacent to natural areas.

## 9.0 Soil Volume

Mature trees, those at least 20 years old, provide the greatest environmental and stormwater benefits. Important is providing trees with the elements they need so that they can reach maturity; key to this, is sufficient soil volume. Trees need at least  $0.625\text{m}^3$  of soil for every square metre of tree canopy (Blakelock and Maynes 2016). Toronto and Oakville have mandated  $30\text{m}^3$  of good quality soil for tree planting (City of Toronto 2013; NRSI and Dillon 2012); whereas the City of Markham (AECOM 2009) specifies  $15\text{m}^3$  for small stature trees and  $30\text{m}^3$  for large stature trees. It should be noted that trees can share this soil volume, so 2 trees will not require  $60\text{m}^3$  of soil, but can share the  $30\text{m}^3$ . Of course, additional trees will require additional soil volume to some extent. It is a best management practice that topsoil in tree pits be provided to a depth of at least 90cm (TRCA 2012). It is beneficial to tree growth and health to scarify the surrounding subsoils to a depth of 45cm. Topsoil must be high quality to provide the best medium for tree growth (see above).

### Recommendations for Elmira:

- As above, implement the following as minimum soil standards in all planting locations:
  - 10-15% organic matter (by dry weight)
  - pH of 6 – 7.5
  - Scarify subsoils to at least 45cm and incorporate some topsoil into this lower layer
  - topsoil depth at least 40cm; topsoil should be placed in lifts of 15cm
- Mandate  $30\text{m}^3$  of good quality topsoil for tree planting

## 10.0 Tree Management and Maintenance

Both young and old trees need to be pruned to obtain the maximum utility from each tree. Pruning will ensure good growth and structure of young trees, while managing liability in old trees. Pruning should be done on a rotational basis, such as recommended for the tree inventory in Section 5. Trees in high profile areas, such as along the main roads, should be pruned every 5 years. It is encouraged that pruning work is documented in the tree inventory database so that there is an overlay that will record pruning events (dates) by tree or street. Tree removals also need to be recorded in the overlay both as risk management but also in identifying new plantable spots.

Dead or nearly dead trees should be removed and replaced throughout the town. Planting beds should be maintained regularly. This includes pruning trees, replacing mulch as needed, and weeding. Tree maintenance is an investment. A special report put out by the TD Bank (Alexander and DePratto 2014) noted that “the return on trees is significant: for each dollar spent on maintenance, between \$1.88 and \$12.70 in benefits are realized each year, depending on the city.”

It is recommended that the Township identify an urban forest canopy target and establish a planting program to work towards this goal. A target of 30% forest cover by watershed was identified by Environment Canada (2013) as a minimum threshold, that has often been identified as a canopy cover target by municipalities, which others are surpassing. In York Region, canopy cover targets range between 20 and 47% for member municipalities (York Region 2016). An estimate of current canopy cover within Elmira’s urban area<sup>2</sup> has been identified as 16.3% (Seery 2018; see report in Appendix VII). This is above the 12% tree canopy of the Upper Middle Grand subwatershed within which Elmira is located, based on mapping from the Grand River Conservation Authority.

Based on rough GIS mapping of the woodlands in Elmira, the town has a woodland canopy cover of just under 5%. Figure 1 shows the woodlands within Elmira, based on Land Information Ontario mapping within the Elmira Ward boundary. Based on these numbers, it is estimated that the existing urban forest canopy cover within the town

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<sup>2</sup> Seery 2018 does not include a map identifying the assessed area that makes up Elmira’s urban area.

(Ward boundary) is between 10 and 15%. The canopy cover should be reassessed every 5 to 10 years to identify how it has changed and in order to assess progress in reaching the canopy target.



**Figure 1. Elmira Woodlands**

In order to increase tree canopy cover to 20% in 20 years (an increase of approximately 4% over current conditions), an estimated 6,470 large stature trees would have to be planted. In order to increase canopy cover to 30% in Elmira in 20 years (an increase of 14%), 22,650 trees would have to be planted. This assumes an existing tree canopy of  $1\text{m}^2$  at the time of planting, and a canopy of  $78.5\text{m}^2$  after 20 years, based on a 5m crown radius, which is achievable for large stature trees. These calculations have been made for the town of Elmira as show on Figure 1, with an area of 1,270ha. This also assumes that *all* planted trees survive and thrive, which points to the necessity of providing the



best growing conditions for each tree, as well as proper maintenance. It should be noted that in the short term, increases in canopy cover are mostly realized through the growth of existing, large trees; but in the long term, increases in canopy cover will come from the trees that are planted today and tomorrow. Newly planted trees will not contribute greatly to canopy cover until they are well established and actively growing (exponential growth rates are typically seen after 10 years of age). It is vital that existing trees be protected and maintained in good health.

It is also recommended that the Township enforce its tree compensation policy, as well as monitor compliance with its tree planting guidelines and topsoil depth requirements. This will address common problems including improper staking and mulching, ensure that water bags are provided, and that topsoil depths adhere to Township standards.

**Recommendations for Elmira:**

- Create regular pruning program for all trees (young and old)
- Identify canopy cover target for Elmira; suggestion: minimum 30%
- Establish an annual planting program
- Enforce Township policies and standards with regards to tree compensation, tree planting and care, as well as topsoil depth

## 11.0 Low Impact Development

Low impact development, referenced several times in this report and often referred to as LID, are techniques used to manage stormwater at its source, rather than through end-of-pipe facilities such as stormwater management ponds. LID measures are considered green infrastructure, as they promote clean water and the greening of the landscape.

LID techniques include the following:

- Green roofs
- Disconnected downspouts
- Rain barrels
- Increased topsoil depths
- Permeable pavement
- Rain gardens
- Bioretention facilities
- Underground stormwater tanks
- Rainwater harvesting
- Infiltration trenches

There are other methods as well, including a combination of approaches that can be used and tailored to specific site needs. A combination of techniques is recommended as a 'treatment train' approach in order to provide the greatest environmental benefit, which includes maintaining the water budget, both in the ground and in the natural watercourses through treated, clean stormwater. New development in Elmira is required to integrate stormwater management into its design, however older neighbourhoods and industrial lands do not manage stormwater. It is recommended that new developments in Elmira be required to implement several LID measures, and that LID be incorporated into existing neighbourhoods and industrial lands as much as possible through retrofits. This includes the structural cells for soil recommended for downtown Elmira, which will treat stormwater, while also providing the soil requirements for trees. The Toronto and Region Conservation Authority and Credit Valley Conservation are on the forefront of promoting LID. More information can be obtained from the following websites:

<https://sustainabletechnologies.ca/>

<https://www.creditvalleyca.ca/low-impact-development/>

The Ministry of Environment and Climate Change (MOECC) is in the process of developing a Low Impact Development Stormwater Management Guidance Manual, which is expected to be posted on Ontario's Environmental Registry later in 2018 for final review. This document is to be a companion report to the 2003 Ministry of Environment Stormwater Manual. The new manual will prescribe specific runoff volume control targets for new development, redevelopment, linear development, and stormwater retrofits. The targets are to be met using a control hierarchy which will require the application of green infrastructure and LID techniques.

An easy and cost effective way to provide stormwater improvements is by installing a CB Shield unit ([www.cbshield.com](http://www.cbshield.com)) in each catch basin, whether old or new. These are small units that can be installed into any catch basin to capture sediment and phosphorus before it is discharged into natural watercourses or stormwater management ponds. These units will mitigate impact from urban development on watercourses and can extend the life of stormwater management ponds significantly. These units can be installed in all areas of Elmira, including parking lots, residential neighbourhoods, and industrial areas.

## 12.0 Summary of Recommendations, Timeframe, and Costs

The following recommendations are made in the report and summarized here, divided by recommendations that are easy to implement in the short term, those that will have a maximum impact with some additional resources (short and long term), and that that will require longer term planning but are also critical for the greening of Elmira. Cost estimates are provided as well, although these are approximate and may vary considerably depending on whether they can be completed by Township staff, require a new position, or are tendered. Tendering work does not necessarily result in additional costs, as the work is competitive. Some costs may be reduced, for example, tree planting costs can be reduced to the cost of the tree if volunteers are available for the planting.

### A. Short term recommendations

	Recommendation	Report Section	Estimated Cost (\$)
1	Update the Tree Planting Guidelines	6.1	In-house
2	Update the Landscape Design Guidelines	6.2	In-house
3	Use the recommended tree species list for Elmira	7	0
4	Replace the trees along Arthur Street and Church Street West starting in 2018	8.1	2018: \$9,000 2019: \$10,200 2020: \$9,000 2021: \$9,000
5	Watering of trees and weeding should be included in a contract to maintain the downtown area, along with planters, decorative hanging baskets, and garbage clean up	8.1	5K/year
6	Implement Township's Landscape Design Guidelines (with recommended revisions)	8.2	0
7	Specify 1 tree for every 5 parking stalls or best efforts as determined by Township staff	8.2	Part of #2
8	Specify 2 trees for every parking lot island	8.2	Part of #2
9	Specify requirement for landscape buffer strips surrounding parking lot and within parking lot	8.2	Part of #2
10	Retain mature trees for as long as possible; pruning for hazards and to prolong life	8.3	0
11	Implement the following as minimum soil standards: <ul style="list-style-type: none"> <li>▪ topsoil depth at least 40cm; topsoil should be placed in lifts of 15cm</li> <li>▪ 10-15% organic matter (by dry weight)</li> <li>▪ Scarify subsoil (to 45cm if possible, but no less than 15cm) and incorporate some topsoil into this lower layer</li> <li>▪ pH of 6 – 7.5</li> </ul>	8.3	Part of #2
12	Encourage topsoil stockpiling in accordance with best practices	8.3	Part of #2

	<b>Recommendation</b>	<b>Report Section</b>	<b>Estimated Cost (\$)</b>
13	Inter-plant in established neighbourhoods to start new tree growth where old trees will eventually have to be removed	8.3	500/tree
14	Homeowners should be encouraged to plant trees on their properties and educated on how best to maintain trees	8.3	1K
15	Homeowners should be encouraged to plant native flowers and shrubs to provide pollinator habitat as well as other wildlife habitat	8.3	Included in #14
16	Encourage homeowners to disconnect downspouts and use rain barrels	8.3	Included in #14 (Cost to homeowner: \$0-200)
17	Mandate 30m <sup>3</sup> of topsoil per tree, which can be shared	8.3, 9	Part of #2
18	Additional tree planting in parks where possible	8.5	600/tree <sup>3</sup>
19	Tree planting along Arthur Street South, south of Oriole Parkway	8.7	600/tree <sup>2</sup>
20	Tree planting in Bolender Park, especially around the splash pad	8.7	600/tree <sup>2</sup>
21	Tree planting on the Pentecostal Church property, especially along sidewalk	8.7	600/tree <sup>2</sup>
22	Enforce Township policies and standards with regards to tree compensation, tree planting and care, as well as topsoil depth	10	May require additional position at Township. 80K

## B. Recommendations with maximum impact

	<b>Recommendation</b>	<b>Report Section</b>	<b>Estimated Cost (\$)</b>
23	Develop a tree protection by-law for individual trees on private and public land	3.4	In-house
24	Complete the tree inventory	5	30K
25	Integrate stormwater management into parking lot design through use of Low Impact Development techniques	8.2	Part of #2
26	Where necessary (to meet soil requirements per tree), create break-out zones under sidewalk squares	8.3	Part of #2
27	Integrate Low Impact Development techniques wherever possible, in residential neighbourhoods, industrial areas, and on school grounds.	8.3, 8.4, 8.6	Part of #2
28	Encourage more tree planting on industrial lands	8.4	In-house; volunteers; tie into #21

<sup>3</sup> \$600 is a fairly typical cost to plant 1 caliper tree (50mm or smaller), with mulch, stakes, and a water bag. Costs can be reduced by using volunteer labour, or may increase with larger trees, additional soil amendments or structural soil.

	<b>Recommendation</b>	<b>Report Section</b>	<b>Estimated Cost (\$)</b>
29	Individual trees in parks should be inventoried and maintained as street trees	8.5	Part of #23
30	Promote tree planting on school grounds	8.6	In-house; volunteers; tie into #21
31	Schools should be encouraged to create and implement school yard greening strategies	8.6	Part of #28
32	Create regular pruning program for all trees (young and old)	10	25K/year
33	Identify canopy cover target for Elmira; suggestion: minimum 30%	10	0-5K
34	Establish an annual planting program	10	0-5K

### **C. Recommendations that require longer term planning, but are very important**

	<b>Recommendation</b>	<b>Report Section</b>	<b>Estimated Cost (\$)</b>
35	Reassess tree canopy cover in Elmira every 5 – 10 years	10	5K
36	Plant trees on private property along Church Street East where permissible	8.1	600/tree <sup>2</sup>
37	Consider a pilot project implementing structural cells to plant at least 2 trees on the south side of Church Street East, between Arthur Street and Memorial Avenue	8.1	15K
38	Provide additional greening in the downtown core with flower and glass planters; promote native species which provide pollinator habitat	8.1	10-20K
39	Consider structural cells along Arthur Street when this street is reconstructed in the future to promote tree growth and manage stormwater	8.1	To be determined in future with prices of the day.
40	Future greening of the parking area along the Maple Street extension between Church Street and Wyatt Street, including structural cells for soil, tree planting, and a parkette	8.7	100K

Many of the recommendations may be incorporated into the Township's Tree Planting and Landscape Design Guidelines as they are updated. Others may be best addressed through a by-law or amendments to the Official Plan.

The recommendations made in this report are intended to be implemented within the next 20 years, with many of them to be implemented within the next 5 years. Certainly the recommendations included in Table A, above, can be implemented within the next 1 to 2 years. It is suggested that this Plan be reviewed every 5 years to assess what recommendations have been achieved, which have not been, and adapting the Plan and

recommendations as necessary at the time. The following provides a rough guideline on the timing of implementation:

### 1-2 years

- update and implement Township's Tree Planting and Landscape Design Guidelines
- replace trees along Arthur and Church Streets
- maintain downtown trees through watering and remove weeds from downtown area
- establish an annual planting program in Elmira
  - Priority areas: downtown, Bolender Park
- start fulsome tree inventory (may be completed in 5-year management blocks)
- augment tree maintenance/pruning schedule in 5-year management blocks
- enforce Township policies and standards with regards to tree compensation, tree planting and care, as well as topsoil depth
- implement a pilot project using structural cells to plant at least 2 trees on the south side of Church Street East, between Arthur Street and Memorial Avenue as part of the Church Street reconstruction in 2020
- identify canopy cover target for Elmira
- only native trees to be planted in Memorial Forest, moving forward

### Within 5 years

- encourage homeowners to plant trees and other native plants on their properties
- develop a tree protection by-law for individual trees on private and public land
  - integrate stormwater management into parking lot design through use of Low Impact Development techniques
- develop guidance and use break-out zones where necessary to promote tree growth
- continue annual planting program in Elmira
  - Priority areas: industrial lands, plantable spots along roads and in parks, school yards
- provide additional greening opportunities in downtown Elmira through planters
- promote incorporation of Low Impact Development techniques into all new developments

### 5-10 years

- continue tree inventory
- continue tree maintenance program
- continue tree planting program
  - Priority areas: Arthur Street South, Pentecostal Church property
- implement LID on all new development sites
- implement LID in retrofit projects
- reassess Elmira's tree canopy cover

### 10-20 years

- continue tree inventory
- continue tree maintenance program
- continue tree planting program
- consider structural cells along Arthur Street when this street is reconstructed in the future
- implement greening strategy of the parking area along the Maple Street extension between Church Street and Wyatt Street, including structural cells for soil, tree planting, and a parkette



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**APPENDIX I**  
Summary of Comments on Project

## APPENDIX I

### Questionnaire and Summary of Public Comments on the Elmira Green Infrastructure Project

Following a public stakeholder meeting held on September 25, 2017, members of the community were encouraged to provide feedback by completing a questionnaire on the Elmira Green Infrastructure Project. In total, 20 individuals replied with comments made in response to 5 general questions. Comments are summarized below.

#### **Question 1: What are your concerns with regards to trees and green space?**

- There are not enough trees or green spaces in Elmira
- There are not enough trees being planted in new subdivisions, especially in parks and playgrounds
- There is a need for more trees and green space for social, economic, and environmental reasons, e.g. pollution mitigation, hydrological function, food and habitat for wildlife, cooling effect in hot weather, climate change mitigation
- Many storefronts and sidewalks (particularly in the downtown core) are overgrown with weeds, making these areas unattractive
- The denuded downtown core creates a heat island during the summer months that is unsafe for children and seniors, raises utility bills for lower-income residents living above commercial establishments, increases the cost of replacing the asphalt, and produces more CO<sub>2</sub> from increased utility use
- Mature trees should not be cut down without serious thought being given to alternative options
- Planning ahead is crucial to ensure that appropriate varieties are chosen for longevity and size at maturity, and ease of maintenance and growth
- Maintenance of trees and green spaces in public areas is often lacking
- Plant species chosen for greening initiatives and tree replacements should be native varieties, and should be long-lasting (e.g. 20 years or more)
- Trees, shrubs, and other greenery should be planted in clusters, rather than in isolation
- Homeowners should have a say as to which tree species are planted on or near their property
- Greening and naturalization should be done in consideration of the public health risks associated with Lyme disease and West Nile Virus, to ensure that any implemented changes do not provide increased habitat for ticks and mosquitos
- When possible, stormwater management and servicing is to be integrated with habitat for wildlife and plants

***Hydrogeological Concerns:***

- More education is needed to communicate the importance of keeping swales and proper drainage systems away from house foundations on immediate and adjacent properties
- Large open spaces within the industrial lands in the southeast presents the risk for erosion and wash-outs, and impacts the conditions of the soil and aquifer; more trees are needed to prevent these issues

**Question 2: What are the benefits of trees specific to your point of view?**

Trees:

- Are aesthetically pleasing and visually interesting (particularly when a variety of species are planted)
- Provide habitat and movement corridors for wildlife
- Are integral to the ecosystem as a whole
- Produce oxygen
- Improve air quality by reducing pollution and allergens
- Absorb CO<sub>2</sub>, thereby fighting climate change
- Offer shade and temperature regulation in hot weather
- Provide wind protection in winter (particularly evergreens)
- Extend the life of asphalt
- Stabilize the soil
- Improve topsoil quality through the decomposition of fallen leaves
- Help retain moisture
- Filter and sequester water
- Can be harvested for wood at the end of their lifecycle, thereby providing building material
- Calm traffic
- Increase economic activity in a town core by making it a more attractive place to stop and shop
- Provide people with places to explore and a way to connect with nature
- Encourage cycling and walking along trails and sidewalks
- Are therapeutic, calming, and provide mental relaxation

### **Question 3: What topics should this study address / focus on?**

- Public outreach, education, and community involvement\*
- Providing trees and green spaces, but also ensuring that these spaces are maintained in the long-term
- Addressing the need for ongoing, professional help for the tree population of Woolwich Township
- Developing a plan to increase the percent canopy cover in the Elmira
- Conducting an inventory of all trees in Elmira
- Identifying trees that will be susceptible to disease over the next 20 years to understand specific areas that may be devoid of trees in the future
- Recommending new bylaws for minimum numbers/size of trees and required soil conditions in parking lots and new developments
- Recommending new policies that prioritize the establishment and maintenance of green spaces
- Developing methods to ensure ongoing greening measures for established, but particularly new, developments
- Advocating for the retention of more topsoil in new developments to ensure suitable soil depths for trees and plants (Elmira has lots of topsoil that is often sold by the developer), and recommending policies to ensure minimum topsoil thickness in new developments
- Encouraging developers to consider long-term neighbourhood aesthetics and greening, and not only building activities
- Exploring options such as permaculture neighbourhoods, 'living'/grass driveways and parking lots, home water cisterns to reduce the demand on stormwater systems (and the demand on the water supply for irrigation and watering when weather is hot and dry), and planting grasses and trees in large existing parking lots
- Developing guidelines for where to plant, what species to use, and how to ensure the successful establishment and long-term survival of trees and other plants
- Determining how to get stakeholders to "buy in" and commit to the long-term maintenance of the trees and other plants on their properties; ideas include incentives for the installation of water cisterns to mitigate water costs under ongoing water use restrictions and increasing awareness of the Region's water barrel program
- Determining how the Region and Township can encourage more tree-planting, especially through the use of "structural soils" in new developments
- Identifying short-term, small-scale improvement goals as part of the long-term plan so that success can be observed and documented over time, and so that advances can be directly observed by the volunteer groups and individuals involved in these efforts

***Public Outreach, Education, and Community Involvement Suggestions:***

- Educational materials should be made available (online and in print) with information about the native species that will thrive in Elmira; information about the size at maturity of trees is particularly important to include to ensure residents can make appropriate decisions about what to plant depending on the size of their lot
- Provide education about the benefits and possibilities of greening initiatives now and in the future
- Publicize all greening initiatives through well-written articles in The Observer and The Record
- Find ways to encourage the participation from people of all ages
- Enlist school groups of all ages to participate in planting projects; this can result in a sense of ownership for those involved that can be a catalyst for long-term stewardship
- Implement community projects that help to maintain green spaces
- Conduct public relations campaigns (for example, the tree cutting guide provided in a recent edition of the newspaper) that inform the community about how to care for plants and green spaces
- Implement a monthly meeting to track progress and solve issues
- Create a calendar and a weekly newsletter to highlight planting events
- Have a specific community area where everyone can participate
- Implement an Adopt-a-Tree Program
- Educational plaques beneath trees in prominent locations (e.g. Gibson Park, Bolender Park), potentially tied in to school programs to encourage learning about different species
- Placing an emphasis on the practical usefulness of trees during public outreach will help to get everyone on board

**Question 4: What are your priorities with regards to trees in Elmira?**

- The beautification of Elmira
- The restoration of unwanted swaths of asphalt back to a greener state
- Community health and socioeconomic issues, including the heat island effect downtown, food security, and the health of the creek
- Minimizing community costs for utilities and stormwater management
- Encouraging home- and business-owners to plant trees on their properties through education about the care and maintenance of trees, support from experts, and incentive programs
- Better methods for successfully establishing additional green space
- Planting of a wide variety of native species should be encouraged

- Planting native food-bearing species on both public and private property can contribute to local food security
- In many spaces that are already naturalized, more trees are still needed to create a more visually appealing effect
- Replacing trees that have been cut down and then some
- Trees should be planted in areas where they will thrive, and there must be a plan for maintaining the health of these trees in the long-term
- To “get them (trees/plants) in the ground” as soon as possible, but following a plan so that time, effort, and money is not wasted
- If a forest canopy within Elmira is the end goal, there needs to be a commitment to education and a devotion of resources that will permit the canopy to grow to the most healthy and complex state
- In the small lots mandated in recent developments, trees that will not overwhelm the lots should be planted rather than larger varieties
- Low-maintenance species should be planted in road medians
- Replacement of deceased and diseased ash trees affected by Emerald Ash Borer before they fall and injure people or property
  - Hazard trees on private property are less likely to be managed properly by homeowners, and increased awareness about the risks and financial incentives for safe removal are necessary
- Dead trees within woodlots should be harvested or removed, or at least only a percentage of deadfall should be allowed to remain as compost
- Harvested trees should be replaced, and an overlap between harvesting and planting is key
- Having more shade in the downtown core would attract visitors to linger and enjoy the scenery

***General areas within Elmira that respondents have identified as priorities for greening:***

- Downtown core (main corridors of Arthur Street and Church Street)
  - As a short-term solution, large concrete planters with trees or evergreen shrubs could be placed downtown
  - Store owners should be encouraged to add more planters and benches outside their stores
- Industrial lands in the southeast
  - Liaising with business owners to increase awareness and provide education and support for planting native trees and shrubs on their properties, especially in the large, unattractive parking lots
- Along footpaths and trails
- Road medians



- In general, these are initially planted by developers but are not being maintained afterwards, resulting in an overgrowth of weed species; the survival of trees to maturity within these medians is often questionable due to the poor condition of these medians
- Vacant lots

***Specific locations within Elmira that respondents have highlighted as being priority areas for improvements or having vegetation-related issues that require attention:***

- Grasses planted as part of greening enhancements along the front of St. Teresa of Avila Catholic Elementary School on First Street cascade over the sidewalk, effectively impeding use of half of the sidewalk
- Diseased ash trees along First Street past St. Teresa of Avila Catholic Elementary School need to be removed
- The road median west of Elmira Mennonite Church has become overgrown with weeds and requires more regular maintenance
- Sumacs planted when the Raceway Lands were developed are starting to become overgrown; and ditches are overwhelmed by Common Reed (*Phragmites australis*)
- The woodland off of Whippoorwill Drive is not currently being managed, and the space taken up by fallen or cut trees should be put to better use by clearing the deadfall and planting new seedlings in the resulting space
- Trees and greenery are urgently needed to be planted along Arthur Street South, especially following redevelopment in 2020
- Shade trees are needed to provide cover for children and families over the new splash pad in Bolender Park
- The Home Furniture/PIB property could benefit from greening along the trail
- The boulevard and ditch along Industrial Drive needs bushes and greenery that are sensitive to vehicle sight lines on all intersecting streets
- The church at Whippoorwill Drive and Arthur Street should be encouraged to place greenery along the walking path
- The drainage ditch beside the Pentecostal Church would benefit from tree planting and a “greenery treatment”
- Potentially a walkway could be created behind McDonald’s, tying in with an existing trail between Oriole Parkway and Howard Avenue
- The creation of a trail system along the creek, as well as a path to the Woolwich Dam, would be welcome
- Leafy walkways between the original downtown core and the attached bedroom communities nearby are suggested
- More trees are needed along the biking/walking path along the creek in the new subdivision in the south

### **Question 5: Other comments and suggestions**

- “We are citizens who care about our community and see nothing but positive things when we have lots of healthy trees around”
- Snow removal issues are a poor argument against the greening of the downtown core; in December 2016, there was a “rocky mountain range” of snow banks between the road and sidewalk downtown, and the Township should be managing snow removal differently
- Consider the inclusion of specialty gardens (e.g. butterfly, water, bird, arboretum) in the greening plan
- Consider installing rooftop gardens on large buildings within the downtown core
- Consider establishing several paid summer internships for students to beautify and maintain public areas (e.g. downtown core) during the summer months
- Consider establishing a position within Woolwich Township devoted to both consulting with new homeowners about the trees they would like to encourage on their property to ensure long-term success, and overseeing all forest reserves within the Township
- Have a part-time forester/arborist on Township staff to assist locals with tree-related issues
- Consider a tax reduction incentive for homeowners who plant trees on their own property
- Wherever possible, trees should be used for phytoremediation purposes
- While trees seem to be the current focus of greening initiatives, open green space (i.e. natural grassland) is also necessary to provide habitat for the widest variety of wildlife species possible; an approach to greening Elmira that considers the big picture and the ecosystem as a whole is needed
- In new subdivisions, the parks are not large enough; more trees and park benches are needed in these areas
- In new subdivisions, builders should be encouraged to place small cisterns underground during lot constructions, thereby enabling new homeowners to gather water for gardens and trees for use during dry periods without having to install the cisterns themselves
- Solar panels should be placed on all south-facing roofs in new subdivisions
- Many individuals feel as though these initiatives are Township-led and paid for; helping the public to understand the costs so they help, rather than complain about inaction, would be beneficial
- By beautifying public areas with trees and other plants, homeowners are more likely to engage in similar projects on their own properties
- TWEEC and the Elmira District Horticultural Society could consider joining forces in being resources/advisors for residents that want to plant native species
- Local nurseries should be encouraged to stock native plant species
- Local fundraisers aimed at raising money to help Foodland, Canadian Tire, and Home Hardware create rooftop gardens for public enjoyment

**APPENDIX II**  
Specific Policy Excerpts

## **Township of Woolwich Official Plan consolidated version (updated to July 31, 2012)**

### **Chapter 13 Environmental Stewardship**

13.1.1 Council shall support private landowners in their efforts to manage property in a way which maintains or enhances the natural environment, by encouraging publicly-funded programs, such as reforestation and stream improvement, to focus on measures which enhance the natural environment system including:

- increasing connectivity between natural habitat areas;
- increasing native vegetative cover within and around significant natural areas, on steep slopes and adjacent to watercourses;
- encouraging initiatives in the agricultural community to develop environmental farm plans and other programs to support farming practices which maintain or enhance environmental quality;
- making available information to landowners on environmental issues;
- pursuing opportunities to combine education and communication on environmental issues with other Township activities.

13.12.4 The Township will promote the use of native trees, shrubs and herbaceous vegetation for plantings along Township Roads and for new development subject to Site Plan Control.

### **13.13 TREE MANAGEMENT**

13.13.1 The Township recognizes the environmental, aesthetic and heritage values of trees lining urban streets and rural roads.

13.13.2 The Township shall protect and preserve trees located within road rights of way wherever practical. Trees removed from a road right of way due to development or public utilities projects shall be required to be replaced wherever possible with native species by the individual or body responsible for their removal, to the satisfaction of the Township.

13.13.3 The Township shall implement a program of planting native trees within the boulevards on Township roadways where appropriate.

13.13.4 The Township shall implement a program of planting native trees where appropriate along streets where the existing trees in those areas are mature and are close to the end of their natural life cycles.

13.13.5 The Township encourages private landowners to protect and preserve street trees located outside of road rights of way.

13.13.6 The Township shall require, as necessary, the preparation of a Tree Management Plan prior to consideration of a development application, with an aim to preserve and protect significant individual trees, tree stands, hedgerows, woodlots and forested areas within the municipality.

#### 13.14 OTHER NATURAL AREAS AND FEATURES

It is recognized that some environmental areas and features in the Township may not meet the criteria as components of the Natural Habitat Network as identified in Policy 13.2.2.

Notwithstanding this, the Township recognizes that these areas and features contribute to the environmental health of the Township and the Township shall require, as necessary, the preparation of a Tree Management Plan prior to consideration of a development application, with an aim to preserve and protect significant individual trees, tree stands, hedgerows, woodlots and forested areas within the municipality

#### Chapter 10 Open Space Policies

10.1.3 The Township may undertake a parks and recreation master plan on a Township-wide basis to inventory existing parkland, open space, and recreational facilities, identify deficiencies, and provide recommendations for future acquisition/development of parkland, open space and facilities.

10.1.5 The Township will encourage the development of a system of linked green space, open space and trails throughout the Township relying on existing parklands, watercourses, utilities corridors, conservation areas, schools and the co-operation of private landowners.

### **Region of Waterloo Conservation of Trees in Woodlands By-Law**

By-law number 08-026 of the Regional Municipality of Waterloo

A By-law Respecting the Conservation of Trees in Woodlands

Under this By-Law, a permit is needed from the Region to harvest trees in woodlots of one hectare or more.

### **Region of Waterloo Official Plan (as approved June 18, 2015)**

7.1.7 Area Municipalities are encouraged to adopt a Tree Preservation By-law to prohibit or regulate the destruction or injuring of trees in woodlands less than four hectares in area.

### **Region of Waterloo Past and Present Environmental Initiatives (May 2008)**

#### **2.5.1 Facility and Road Construction (Corporate)**

In road construction projects that require landscaping, anytime one tree is removed, two are replanted where feasible. Where landscape buffers are provided for noise attenuation, enhanced landscaping beyond the 2-for-1 tree planting practice is implemented within the road allowance where feasible.

**City of Waterloo. Official Plan. Office Consolidation Nov. 2016**

8.2.9 Urban Forest

(1) The City recognizes the urban forest as providing significant ecological, social, and economic benefits. The City will encourage the protection, restoration, wise management, and expansion of the urban forest.

(2) It is the City's intent to protect existing trees and plant new ones where feasible and appropriate. When considering development applications and site alteration permit applications, the City will require that only the trees that directly impede the proposed work be removed and that the applicant replace them in reasonable amount, with trees of sufficient maturity. The amount and maturity of replacement trees will be determined based on the amount, maturity, species, and health of the trees to be removed. A Tree Preservation Plan may be required to provide an inventory of all trees on the site, an assessment of their health and condition, recommendations regarding which trees should be saved and which will be removed, tree protection measures, and replacement trees. As part of any Tree Preservation Plan, the City may require tree loss totals and corresponding compensation estimates. Tree Preservation Plans must be prepared by qualified professionals.

(3) When considering development applications and site alteration permit applications, the City may require the protection and enhancement of hedgerows, especially where:

- (a) they link other elements of the Natural System;
- (b) wildlife regularly use them as habitat or movement corridors;
- (c) they are composed of mature, healthy trees;
- (d) they contain trees that are rare, unique, culturally important, or over 100 years in age; or
- (e) they contribute to the aesthetics of the landscape.

(4) Where the City is undertaking infrastructure work, the urban forest will be protected and preserved, where feasible. If it is necessary for infrastructure work to remove any trees, the City will compensate by replanting in reasonable amount on or off-site, with trees of sufficient maturity. The amount and maturity of replacement trees will be determined based on the amount, maturity, species, and health of the trees to be removed. A Tree Preservation Plan may be required to provide an inventory of all trees on the site, an assessment of their health and

condition, recommendations regarding which trees should be saved and which will be removed, tree protection measures, and replacement trees.

(5) Opportunities for tree planting on City-owned lands will be identified and implemented in coordination with other public agencies and local interest groups, as required. The City will plant native species that are ecologically appropriate and suitable for site conditions, where feasible.

(6) The City will implement planting programs of desired and compatible species, with preference given to native species, on public lands or, in conjunction with landowners, on private lands.

(7) To generate appreciation and stewardship towards the urban forest, the City will encourage public education and involvement.

(8) The City will support and enhance the urban forest by implementing urban design standards that protect street trees, in particular in terms of preservation of existing root structures and preventing soil compaction.

**City of Waterloo BY-LAW NO. 2014 078 BY-LAW FOR THE PROTECTION OF TREES ON CITY PROPERTY WITHIN THE CITY OF WATERLOO**

Provides for the prohibition of damage or removal to any trees on public property.



**City of Kitchener. Official Plan. (Approved Nov. 19, 2014)**

8.C.2 Urban Forests

8.C.2.1. The City will preserve, protect, manage, replace and where appropriate acquire significant tree stands, hedgerows, woodlands and forested areas within the city boundaries.

8.C.2.2. The City, in accordance with the Parks Strategic Plan, will develop an Urban Forest Management Strategy including a tree inventory and an update of the Woodland Management Program.

8.C.2.3. The City, in accordance with the Parks Strategic Plan, will protect the natural environment through greening and naturalization initiatives and policies, restoration and management of City-owned natural areas and the urban forest, and natural areas stewardship and education programs.

8.C.2.4. The City, in accordance with the Parks Strategic Plan, will implement a tree planting and replacement program and support natural area and urban woodland retention and maintenance.

8.C.2.5. The City will encourage landscaping on public and private lands to preserve and complement the existing natural landscape. The City will direct the use of a mix of indigenous plant species and trees having historic or cultural significance in these landscape areas.

8.C.2.6. The City will incorporate existing and/or new trees into the streetscape or road right-of-way and encourage new development or redevelopment to incorporate, protect and conserve existing healthy trees and woodlands in accordance with the Urban Design Policies in Section 11, the Urban Design Manual and the Development Manual

Trees and Natural Areas on Public Property

8.C.2.7. The City will, where appropriate, reforest and naturalize parks, open space and stormwater management areas.

8.C.2.8. Wherever feasible and appropriate, species native to the region will be used in roadside plantings, stormwater management facilities and park naturalization projects.

8.C.2.9. The City will promote and encourage the protection and wise management of trees located within and outside a road right-of-way and encourage public authorities to give due

consideration to their preservation when undertaking infrastructure projects and regular maintenance.

8.C.2.10. The City will require the replacement of any trees damaged or removed from an existing road right-of-way due to a development or infrastructure project.

8.C.2.11. By-laws enacted under the Municipal Act will contain details and regulations pertaining to protection, planting, care and maintenance of City trees within a public right-of-way and regulate and ensure the appropriate use of the City's natural areas including parks.

#### Trees on Private Property

8.C.2.12. The City will encourage the reforestation, wise management and improvement of privately owned trees and woodlands within the City.

8-11 8.C.2.13. Tree removal on private property will be subject to the City Tree Conservation By-law where applicable.

8.C.2.14. The City will, whenever possible, provide guidance and advice for the reforestation, wise management and improvement of privately owned trees and woodlands within the city.

8.C.2.15. The City may require existing trees and vegetation to be retained through the Site Plan Approval process to act as buffers to minimize potential adverse effects to sensitive natural areas.

#### Development or Site Alteration

8.C.2.16. The City will require the preparation and submission of a tree management plan in accordance with the City's Tree Management Policy, where applicable, as a condition of a development application. Any tree management plan must identify the trees proposed to be removed, justify the need for removal, identify the methods of removal and specify an ecologically sound tree replacement scheme and any mitigative measures to be taken to prevent detrimental impacts on remaining trees.

8.C.2.19. When considering development, redevelopment or site alteration proposals, the City may require the protection and enhancement of hedgerows, especially where: a) they link other elements of the Natural Heritage System; b) wildlife regularly use them as habitat or movement corridors; c) they are composed of mature, healthy trees; d) they contain trees that are rare,

unique, culturally important or over 100 years in age; or, e) they contribute to the aesthetics of the landscape.

**City of Kitchener. Tree Management Policy (Policy no. I-1160). Feb. 28, 2002**

<http://www.kitchener.ca/en/businessinkitchener/resources/Treemanagementpolicy.pdf>

A consistent tree management process will ensure that:

1. An inventory and analysis of existing natural characteristics of a site are undertaken, so that both opportunities and constraints for tree management in the natural environment are identified.
2. An assessment of proposed development impact on trees and vegetation communities is undertaken, so that adverse impacts are minimized while potential benefits of remaining tree and vegetation communities are optimized.
3. Tree removal and tree protection responsibilities are implemented prior to the grading and construction stages of development.
4. Initial and continual compliance with approved tree protection measures including tree replacement are achieved.
5. Rationale is presented to justify tree removal i.e. layout, grading, servicing constraints. Section 51(2)(g) of the Planning Act requires the location of natural features to be shown on any Draft Plan of Subdivision. The lack of specific information at an early stage often results in poor tree management. This policy requires a General Vegetation Overview be submitted by the Subdivider and approved by the Development and Technical Services Department and the Department of Community Services prior to draft approval to optimize tree management potential.

The Tree Management Policy consists of three key steps within which data collection and analysis is to be sequentially undertaken. These are:

- 1) A General Vegetation Overview (part of the subdivision approval process)
- 2) A Detailed Vegetation Plan (part of the subdivision registration process)
- 3) A Tree Preservation/Enhancement Plan

A Tree Preservation/Enhancement Plan is required for subdivisions, site plan approval, and consents

**City of Kitchener – Tree Conservation By-Law** (property maintenance Chapter 692 trees - protection destruction – injury)

A tree conservation permit is required for all properties 0.405 hectares (1.0 acre) or greater.

A permit is not required for:

- Trees that are less than 10 cm, in diameter at breast height (DBH).
- The removal of a dead, diseased or hazardous tree when certified as such by an individual designated or approved by the director of planning.

**City of London. The London Plan (Official Plan). Approved Dec. 28, 2016**

Section 389 explicitly states the goal is to have no net loss of urban tree cover through protection, monitoring, and additional planting.

393\_ It is a target of this Plan to achieve a tree canopy cover of 28% within the Urban Growth Boundary by 2035.

394\_ The 20-year target identified above is intended help us to achieve a long-term tree canopy cover of 34% within the Urban Growth Boundary by 2065.

395\_ Specific tree canopy cover and other targets for specific place types will be developed through the Urban Forest Strategy Implementation Plan and implemented through the Zoning Bylaw and other by-laws and guideline documents.

396\_ Progress toward meeting these targets will be monitored as follows:

1. A tree canopy cover analysis will be prepared every five years to determine if tree canopy targets are being achieved.
2. An analysis of the structure, function, and value of the Urban Forest will be prepared at least once every ten years.
3. An inventory update and analysis of trees in boulevards, rural streets, manicured portions of parks and municipal properties will be completed at least once every ten years.

399\_ The following policies will be applied to support the strategy of protecting trees:

Tree inventories and tree preservation plans will be required for all planning and development applications and infrastructure projects where trees exist on the applicable lands.

All trees that must be removed will be replaced on a one-to-one basis, development heights and densities may be increased to support tree conservation on restrained lots, and a water balance study may be required to ensure remaining trees retain long-term health.

### **City of London Urban Forest Strategy. June 2014.**

<https://www.london.ca/residents/Environment/Trees-Forests/Documents/London%20Urban%20Forestry%20Strategy%20Final.pdf>

The strategy lists 18 future strategic goals:

1. Achieve appropriate canopy cover across the community.
2. Develop a tree establishment program driven by canopy cover targets, maintenance capacity, and “right tree, right place” principles.
3. Establish a diverse tree population city-wide as well as at the neighbourhood level.
4. Preserve and enhance local natural biodiversity.
5. Enhance and enforce municipal policies.
6. Improve urban forest health.
7. Ensure City departments operate with common goals and objectives and adequate staffing.
8. Maintain publicly owned trees to maximize current and future benefits provided to the site.
9. Increase funding to support and sustain urban forest management.
10. Complete a comprehensive urban forest inventory and apply to management decision making.
11. Monitor existing and potential canopy cover.
12. Undertake research to improve urban forest performance and encourage adaptive management.
13. Consult and cooperate with large private landholders to embrace city-wide urban forest goals and objectives.
14. Consult and cooperate with local nurseries, arborists, landscapers, etc. (urban forestry services) to embrace city-wide urban forest goals and objectives.
15. Consult and cooperate with citizens at the neighbourhood level to embrace city-wide urban forest goals and objectives.
16. Consult and cooperate with the business community to embrace city-wide urban forest goals and objectives.
17. Facilitate public understanding of urban forest management.
18. Consult and cooperate with neighbouring communities on regional urban forest management issues.

Table 1 Suggested canopy cover goals by current land use types.

<u>Land Use Type</u>	<u>Target Canopy Cover by 2035</u>	<u>Target Canopy Cover by 2065</u>
Agriculture	13%	15%
Commercial	10%	15%
Institutional	18%	20%
Industrial	12%	15%
Low density residential	27%	35%
Medium and high density residential	19%	25%
Natural area and open space	55%	60%
City-wide	25%	32%

**City of London. Boulevard Tree Protection By-law P.-69 – Consolidated May 3, 2010**

Damaging, removal, or planting of trees in any boulevard is prohibited. “Boulevard” means that portion of every road allowance within the limits of the City of London which is not used as a sidewalk, driveway, travelled roadway or shoulder.

**City of London. Tree Protection By-law C.P.-1515-228 – Enacted August 30, 2016**

The new Tree Protection By-law includes:

- a new Forest Health component, allowing the City to respond quickly to any serious threats to our forests;
- exemptions for certain activities, such as pruning a tree, from requiring a permit;
- designated 'Tree Protection Areas', and;
- protection for 'Distinctive Trees'.



## **County of Wellington. Official Plan. Consolidated version updated to Sept. 1, 2016**

Good forestry practices will be encouraged and tree removal shall be subject to the Wellington County Forest Conservation By-law.

The County has developed a Rural Water Quality Program with Conservation Authorities to encourage farm stewardship initiatives to improve water quality. The County also has a Green Legacy Program that supports community and private planting activities which include an educational and advisory component. Both programs are stewardship initiatives that restore and enhance the County's natural heritage. Examples include projects to: tree planting to prevent or reduce water and wind erosion or to restore fragile lands.

### 7.5.14 Urban Forests

Urban forests are made up of trees in a range of environments from downtowns to rural fringes, including: trees in planters on main streets; street trees; trees in yards; park trees; interspersed woodlots or hedgerows in greenfield areas; and trees in hazardous lands, wetlands and significant woodlands referred to above that are protected in the Greenlands System of this Plan. Collectively, these trees make important economic, visual and environmental contributions to the quality of life in Wellington's small towns and hamlets. The County will encourage the retention of trees where practical and will encourage increases in the overall urban tree canopy.

### 8.3.12 Intensification Criteria

Intensification within all residential land use designations shall be evaluated using the following criteria: e) the impact of the development on the streetscape including, where feasible, the protection of municipal street trees;

Under Development Agreements and Site Plans, the developer must address preparation and implementation of a landscaping plan to cover tree planting, sodding and buffering;

10.1.3 The County will consider the following when considering new lot creation by subdivision, consent or part lot control: g) that tree loss related to anticipated development be kept to a minimum and, wherever reasonable, be compensated for by new tree planting;

**County of Wellington. Forest Conservation By-Law 5115-009**

A County permit is required prior to the cutting or destruction of more than 20 trees in a "woodlands" [i.e. a forested area 1 hectare or larger].

**Town of Oakville. The Livable Oakville Plan (2009 Town of Oakville Official Plan).**  
**Consolidated to April 4, 2017.**

6.10 Landscaping

6.10.2 Development should preserve and enhance the urban forest by: a) maintaining existing healthy trees, where possible; b) providing suitable growing environments; c) increasing tree canopy coverage; d) incorporating trees with historic or cultural significance; and, e) integrating a diverse mix of native plant species

10. Sustainability

10.1.1 Objectives - The general objectives for sustainability are:

e) to maintain the existing urban forest; and,

f) to progressively increase the urban forest to achieve a canopy cover of 40% Town-wide beyond the life of this Plan.

10.12 Urban Forests - The Town considers its municipally-owned urban forest as green infrastructure.

10.12.1 For every square metre of leaf area that is removed from Town property or from Town road rights-of-way, sufficient trees will be replanted to replace the lost square metres of leaf area.

10.12.2 The Town shall ensure that appropriate space for tree protection and tree planting within road rights-of-way are included in the design of new roads or road improvements.

10.12.3 The Town shall develop standards for the protection of trees to assist with the review of planning applications and municipal consents by utilities.

10.12.4 The Town shall develop standards for the planting of new trees to assist with the review of planning applications.

10.12.5 Tree removal on private property shall be subject to the Town's private tree protection by-law.

**Town of Oakville. Growing Livability – A Comprehensive Study of Oakville’s Urban Forest. 2016.** <http://www.oakville.ca/assets/general%20-%20culture%20recreation/itree-growing-livability-report.pdf>

In 2005, Oakville was one of a number of Canadian municipalities to complete an Urban Forest Effect Model (UFORE) study, now known as i-Tree, to quantify the structure of the urban forest and its environmental benefits. In 2015, Oakville became the first municipality in Canada to conduct a ten-year follow-up survey to track the changes to the urban forest since the initial study. The results of the 2015 survey show that Oakville has increased its tree canopy by 1.3 per cent in the last ten years to a total canopy coverage of 27.8 per cent.

Highlights of the report include:

- Oakville’s urban forest canopy cover in 2015: 27.8 per cent
- Total number of trees: 2,016,500
- The structural value of Oakville's urban forest is \$1.04 billion
- Oakville’s tree canopy is estimated to provide \$2.93 million in environmental benefits each year
- The total value of home energy savings provided by Oakville’s trees is approximately \$1.8 million per year
- Oakville’s urban forest removed 113 tonnes of pollutants and 7,586 tonnes of carbon dioxide from Oakville's air in 2015
- Oakville’s top three species by leaf area are Sugar maple, Norway maple and Northern red oak

Recommendations focus on several key areas:

Communication: Building & strengthening partnerships across departments and sectors

Management: Enhancing and adapting management practices to address pertinent issues, like invasive species and enhancing urban forest health

Planning: Developing tools for improved procedures and supporting urban forest management with current, high-quality data

Planting: Re-evaluate and refine planting strategies to maximize the ecological services of Town-owned trees

**York Region – Official Plan (2010, April 2016 Office Consolidation)**

2.2.50 That local municipalities shall develop an Urban Forest Management Plan, together with York Region, that may include additional locally significant woodlands.

5.4.6. ... These secondary plans shall include:

- i. policies that establish urban greening targets, which may be achieved through urban forest canopy, green walls, requirements for on-site greening

## **City of Markham – Official Plan (2014, April 21 Office Consolidation)**

### 3.2 Urban Forest System

The Urban Forest System comprises all woodlands, hedgerows and small woodlots, individual trees and shrubs, understory and soils that grow on public and private property in Markham. The urban forest provides various benefits to Markham including reduction in air pollution, moderation of urban heat island effect, energy savings, mitigating climate change effects, habitat for urban adapted wildlife, stormwater management, recreation and opportunities for physical activity, biodiversity, improving mental wellbeing and contributing to the quality and character of the urban environment and supporting Markham's Greenway System. It is the policy of Council:

3.2.1 To protect, expand and integrate the urban forest in existing and new communities.

3.2.2 To develop in cooperation with York Region an Urban Forest Management Plan to address local tree canopy targets, tree species diversity, invasive species management, soil conservation strategies to implement tree canopy targets and provide for the long-term maintenance of Markham's urban forest.

3.2.3 To encourage the enhancement of the urban forest through tree planting and restoration of public and private lands in the urban area. Restoration sites may include hydro corridors, municipal parks, schools, stormwater management ponds and other public infrastructure sites. Diversity of tree species shall be encouraged to ensure a resilient and healthy urban forest.

3.2.4 To require appropriate compensation in the form of rehabilitation and enhancement of the urban forest where the urban forest has been impacted by the provision of infrastructure.

3.2.5 To maintain and update the Tree Preservation By-law to manage the preservation of trees on private property and cooperate with the York Region in the implementation of the Regional Tree By-law.

3.2.6 To protect and enhance the urban forest, including hedgerows and small woodlots identified for protection by an environmental impact study, and integrate the urban forest

into development, redevelopment and site alteration where possible, particularly where it provides a linkage to other natural areas, provides for wildlife habitat and movement, and is composed of healthy and mature trees.

3.2.7 To increase awareness of the benefits of the urban forest and promote public education and involvement in the stewardship of Markham's urban forest.

3.2.8 To work in cooperation with York Region to track and measure the health and environmental benefits of the urban forest.

## **Provincial Policy Statement 2014**

1.6.2 Planning authorities should promote *green infrastructure* to complement *infrastructure*.

**Green infrastructure:** means natural and human-made elements that provide ecological and hydrological functions and processes. *Green infrastructure* can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs.



## **Growth Plan 2017**

2.2.1.4. Applying the policies of this Plan will support the achievement of complete communities that:

- g) integrate green infrastructure and low impact development.

3.2.7.2. Proposals for large-scale development proceeding by way of a secondary plan, plan of subdivision, vacant land plan of condominium or site plan will be supported by a stormwater management plan or equivalent, that:

- b) incorporates an integrated treatment approach to minimize stormwater flows and reliance on stormwater ponds, which includes appropriate low impact development and green infrastructure;

4.2.10.1. Upper- and single-tier municipalities will develop policies in their official plans to identify actions that will reduce greenhouse gas emissions and address climate change adaptation goals, aligned with the Ontario Climate Change Strategy, 2015 and the Climate Change Action Plan, 2016 that will include:

- d) undertaking stormwater management planning in a manner that assesses the impacts of extreme weather events and incorporates appropriate green infrastructure and low impact development;

4.2.10.2. In planning to reduce greenhouse gas emissions and address the impacts of climate change, municipalities are encouraged to:

- a) develop strategies to reduce greenhouse gas emissions and improve resilience through the identification of vulnerabilities to climate change, land use planning, planning for infrastructure, including transit and energy, green infrastructure, and low impact development, and the conservation objectives in policy 4.2.9.1;

## **APPENDIX III**

Township of Woolwich Documents:

Door Hanger

Tree Planting Guidelines

Landscape Design Guidelines



## HOW TO CARE FOR YOUR NEW BOULEVARD TREE:

## HOW TO CARE FOR YOUR NEW BOULEVARD TREE:

### **PLEASE DO:**

- Water the soil around the base of the trees at least once every ten days to help establish roots
- Soak the soil around your trees slowly
- If your tree appears to be dead, is damaged or requires pruning please contact Engineering & Planning Services at 519-669-6041 or 519-664-2613 ext. 6041

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- Soak the soil around your trees slowly
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### **PLEASE AVOID:**

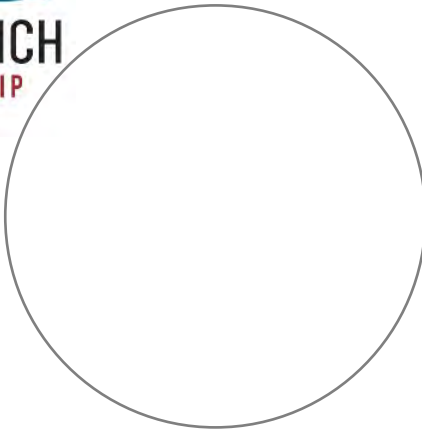
- Watering every day since roots can become waterlogged
- Mounding up the mulch or soil around the base of the tree. While it may look aesthetically pleasing, it causes the water to run away from the roots, starves the surface roots of oxygen and may encourage mould and pests to invade the bark
- Cultivating, digging, planting or constructing borders around the mulched area as this may damage the newly forming roots. Also do not tie anything to the tree that could restrict its growth
- Using a trimmer close to the bark of the tree

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Thank you for your cooperation and assistance in helping to create a more beautiful and healthy environment in the Township of Woolwich and helping to ensure we will all enjoy these trees for many years to come.

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## CARING FOR YOUR BOULEVARD TREE

### TREE SPECIES PLANTED:

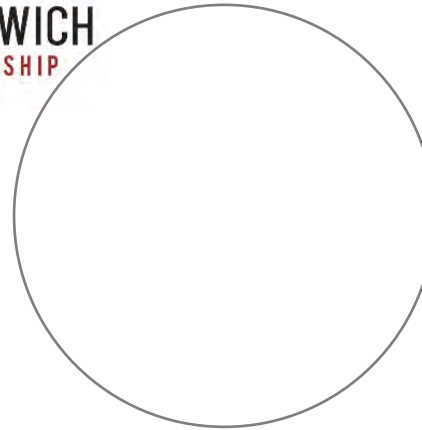
#### PLEASE DO:

- Water the soil slowly around the base of the tree or fill the supplied water bag, should one be provided, at least once every ten days, to help establish roots.
- Leave mulch around the tree to minimize weed and grass growth and reduce soil moisture loss.
- If your tree appears to be dead, is damaged or requires pruning, please contact Engineering & Planning Services at 1-877-969-0094 ext. 6041.

#### PLEASE AVOID:

- Watering every day since roots can become waterlogged.
- Mounding mulch or soil around the base of the tree. While being aesthetically pleasing, it can decrease roots of oxygen and encourage diseases.
- Cultivating, digging, planting, or constructing borders around the mulched area, as this may damage the roots and restrict growth.
- Also, do not tie anything to the tree that could restrict its growth.
- Using a nylon cord trimmer close to the base of the tree as broken/cut bark can cause the tree to die.

**Thank you for your cooperation and assistance in helping to create a more beautiful and healthy environment in the Township of Woolwich**



## CARING FOR YOUR BOULEVARD TREE

### TREE SPECIES PLANTED:

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**Thank you for your cooperation and assistance in helping to create a more beautiful and healthy environment in the Township of Woolwich**

## **APPENDIX IV**

### Tree Diseases

## **Tree Diseases**

### **Asian Long-horned Beetle**

The Asian Long-horned Beetle (*Anoplophora glabripennis*) has caused 2 infestations in Ontario. The first was observed in 2003 near the border between Toronto and Vaughan. It was deemed eradicated in April 2013 after infected trees were removed and no additional beetles were observed in 5 years of monitoring. In August 2013 another infestation was found in Mississauga and Toronto which is actively being eradicated. This beetle affects Maples (*Acer* sp.), Birches (*Betula* sp.), Poplars (*Populus* sp.), and Willows (*Salix* sp.).

### **Beech Bark Disease**

This disease effects American Beech (*Fagus grandifolia*) and is caused by a non-native insect-fungus relationship. The Beech Scale (*Cryptococcus fagisuga*), a European insect likely introduced to Canada in the 1890s, feeds on the outer bark of Beech trees. After 2 to 10 years of feeding, the tree declines in vigour, growth, and resistance to infection. It is then infected with the canker fungus, *Neonectria faginata*, which kills the tree. This disease was first confirmed in Ontario in 1999.

### **Butternut Canker**

Butternut canker is an infection caused by a fungus, *Ophiognomonia clavignenti-juglandacearum*, affecting the Butternut (*Juglans cinerea*) tree. It was first confirmed in Ontario in 1991. The fungus is spread by rain-splashed spores, as well as possibly by insects, birds, and seeds. The fungus causes cankers on the stem that eventually girdle and kill the tree.

### **Dutch Elm Disease**

Dutch Elm Disease is caused by a fungus (*Ophiostoma ulmi* or *Ophiostoma novo-ulmi*) that is spread by either the European Elm Bark Beetle (*Scolytus multistriatus*) or the native Elm Bark Beetle (*Hylurgopinus rufipes*). The disease was first confirmed in Canada in 1947. It attacks and blocks the water-conducting systems in Elm trees (*Ulmus* sp.) and kills the infected tree within 1 to 3 years.

### **Emerald Ash Borer**

Emerald Ash Borer (*Agrilus planipennis*), a beetle originally from Asia, was first observed in Ontario in the Windsor area in 2002. The beetle kills any type of Ash (*Fraxinus* sp.) tree by feeding off its inner bark, thereby interfering with the circulation of nutrients and water. These

beetles kill the tree within 2 to 3 years after infestation. In Waterloo Region, Emerald Ash Borer was discovered in approximately 2011 and since then, has killed almost all Ash trees in the Region. A typical sign that a tree is infected is the flecking on the bark, where bark falls off due to foraging by Chickadees, Nuthatches, and Woodpeckers.

### **European Gypsy Moth**

The European Gypsy Moth (*Lymantria dispar dispar*) was introduced to Massachusetts in 1869. Gypsy Moth caterpillars have a voracious appetite, eating leaves of many different tree species, although Red Oak (*Quercus rubra*), White Oak (*Quercus alba*), Poplar species (*Populus* sp.), and White Birch (*Betula papyrifera*) are preferred.

### **Hemlock Woolly Adelgid**

The Hemlock Woolly Adelgid (HWA, *Adelges tsugae*) is an aphid-like insect that feeds at the base of Eastern Hemlock (*Tsuga canadensis*) needles, killing the tree. This disease was introduced to eastern North America in the 1950's from Japan, and was first identified in Ontario in 2012 and 2013 in Etobicoke and Niagara Falls, respectively. It is hoped that the infestations in Ontario have been destroyed; it was last observed in 2015. HWA affects all variety of Hemlock species.

### **Magnolia Scale**

Magnolia Scale (*Neolecanium cornuparvum*) affects Magnolia trees (*Magnolia* sp.) and Tulip Tree (*Liriodendron tulipifera*). The insects cause damage to trees by feeding on the tree's sap through its vascular system; they can kill entire branches and weaken the tree. The scale excretes a sticky substance that is referred to as 'honeydew', on which black mold grows.

### **Oak Wilt**

Oak Wilt is a lethal disease caused by a fungus (*Ceratocystis fagacearum*) that affects all Oak species (*Quercus* sp.). The fungus is most serious in members of the Red Oak family, including Red Oak (*Quercus rubra*), Black Oak (*Q. velutina*), and Pin Oak (*Q. palustris*); it can kill these trees within several months. In White Oak trees, including White Oak (*Q. alba*), Swamp White Oak (*Q. bicolor*), and Bur Oak (*Q. macrocarpa*), trees may survive several years, or even defeat the disease. This disease has not yet been documented in Canada, although it is found throughout Michigan, including Detroit. The disease is transmitted by insects or between tree roots.

## **Tar Spot**

Tar Spot is a leaf disease that is caused by the fungus *Rhytisma acerinum*. Although it can appear in several different species, it mostly occurs in Maples (*Acer* sp.). Tar spot does not cause long-term damage to the tree, but it is aesthetically unappealing. The dark spots on the leaves are the fruiting structures of the fungus, that spread through spores in the spring.

## **Tent Caterpillars / Fall Webworm**

The larvae of several moth and butterfly species are referred to as tent caterpillars for the large, tent-like webs they built on the end of tree branches. They are found in large groups that enabling them to defoliate trees in a short amount of time. Fall Webworm (*Hyphantra cunea*) is one such common species in Ontario. Although unsightly, they rarely cause too much damage to a tree. The caterpillars affect many different tree species, but prefer Birch (*Betula* sp.), Black Walnut (*Juglans nigra*), Ash (*Fraxinus* sp.), Cherry (*Prunus* sp.), and Apple (*Malus* sp.).



## **APPENDIX V**

Street Tree Inventory:

2017 Elmira Street Tree Inventory Map

Example Data Sheet for Tree Inventories

Tree Assessment Criteria (Tables A and B)





**Table A. Tree Health Assessment Criteria**

<b>Assessment Criteria*</b>	<b>Definition<sup>1</sup></b>
Excellent	Represents a tree in near perfect form, health, and vigor. This tree would exhibit no deadwood, no decline, and no visible defects.
Good	Represents a tree ranging from a generally healthy tree to a near perfect tree in terms of health, vigor and structure. This tree exhibits a complete, balanced crown structure with little to no deadwood and minimal defects as well as a properly formed root flare.
Fair	Represents a tree with minor health, balance or structural issues with minimal to moderate deadwood. Branching structure shows signs of included bark or minor rot within the branch connections or trunk wood. The root flare shows minimal signs of mechanical injury, decay, poor callusing, or girdling roots. Trees in the category require minor remedial actions to improve the vigor and structure of the tree.
Poor	Represents a tree that exhibits a poor vigor, reduced crown size (<30% of crown typical of species caused by overcrowding or decline), extreme crown unbalance, or extensive rot in the branching and trunk wood. Fungus could be seen from these rotting areas, suggesting further decay. These trees have extensive crown die back with a large amount of deadwood, and possibly dead sections. These weakened areas can lead to a potential failure of tree sections. Rooting zones show signs of extensive root decay or damage (fruiting bodies or mechanical damage) or girdling roots. Trees in this category require more extensive actions to prevent failure. A tree identified as poor would be a candidate for removal in the near future.
Very Poor	Represents a tree that exhibits major health and structural defects. Quite often the defects or diseases affecting this tree will be fatal. Large quantities of fungus, large dead sections with possible cavities and bark falling off all are signs that a tree is in a major state of decline and would be identified as very poor. These trees have a probable or imminent potential for structural failure. These trees should be identified for removal.
Dead	Represents a tree that exhibits no sign of new growth, including buds, foliage, or shoot growth. These trees have a probable or imminent potential for structural failure. These trees should be identified for removal.
<p>* Trees which are located within dense groupings are evaluated as individual specimens. Trees within these stands quite often have a reduced crown size (&lt;30% of crown typical of species), off balanced crowns, and prioritized upward growth (i.e. low trunk taper and few lateral branches). As such, these trees would be considered to have poor vigour. As well, these trees pose a probable potential for structural failure when newly exposed edges or individual trees are isolated through removal of surrounding trees. This is often the case with overstocked plantations. Individual trees which meet the above criteria will be identified as poor or probable potential for structural failure.</p>	

<sup>1</sup>Dunster 2009

**Table B. Tree Risk Assessment Criteria**

<b>Assessment Criteria*</b>	<b>Definition<sup>1</sup></b>
Improbable	The tree or branch is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified time frame.
Possible	Failure could occur, but it is unlikely during normal weather conditions within the specified time frame.
Probable	Failure may be expected under normal weather conditions within the specified time frame.
Imminent	Failure has started or is most likely to occur in the near future, even if there is no significant wind or increased load. This is a rare occurrence for a risk assessor to encounter, and it may require immediate action to protect people from harm.
*A specified time frame of 1 year will be used when assessing potential for structural failure.	

<sup>1</sup>Dunster et al. 2013

## References

- Dunster, J.A. 2009. Tree Risk Assessment in Urban Areas and the Urban/Rural Interface: Course Manual. Silverton, Oregon: Pacific Northwest Chapter, International Society of Arboriculture.
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**Table A. Tree Health Assessment Criteria**

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**Table B. Tree Risk Assessment Criteria**

<b>Assessment Criteria*</b>	<b>Definition<sup>1</sup></b>
Improbable	The tree or branch is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified time frame.
Possible	Failure could occur, but it is unlikely during normal weather conditions within the specified time frame.
Probable	Failure may be expected under normal weather conditions within the specified time frame.
Imminent	Failure has started or is most likely to occur in the near future, even if there is no significant wind or increased load. This is a rare occurrence for a risk assessor to encounter, and it may require immediate action to protect people from harm.
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## **APPENDIX VI**

### Street Tree Recommended Species



Township of Woolwich  
Street Tree Recommended Species

Scientific Name	Common Name	CC	CW	SRANK	Location Suitability			Small Stature Tree
					Parks / Residential Lots	Boulevards	Buffers / Natural Areas	
<b>Cupressaceae</b>		<b>Cypress Family</b>						
<i>Juniperus virginiana</i>	Eastern Red Cedar	4	3	S5	•		•	
<i>Thuja occidentalis</i>	White Cedar	4	-3	S5	•		•	
<b>Ginkgoaceae</b>		<b>Ginkgo Family</b>						
<i>Ginkgo biloba</i>	Maiden-hair Tree				•	•		
<b>Pinaceae</b>		<b>Pine Family</b>						
<i>Abies balsamea</i>	Balsam Fir	5	-3	S5	•		•	
<i>Larix decidua</i>	European Larch		5	SE2	•			
<i>Larix laricina</i>	Tamarack	7	-3	S5	•		•	
<i>Picea abies</i>	Norway Spruce		5	SE3	•			
<i>Picea glauca</i>	White Spruce	6	3	S5	•		•	
<i>Picea pungens</i>	Colorado Spruce			SE1	•			
<i>Picea rubens</i>	Red Spruce			S3	•		•	
<i>Pinus resinosa</i>	Red Pine	8	3	S5	•		•	
<i>Pinus strobus</i>	Eastern White Pine	4	3	S5	•		•	
<i>Tsuga canadensis</i>	Eastern Hemlock	7	3	S5	•		•	
<b>Aceraceae</b>		<b>Maple Family</b>						
<i>Acer pensylvanicum</i>	Striped Maple	7	2	S5	•	•	•	•
<i>Acer rubrum</i>	Red Maple	4	0	S5	•	•	•	
<i>Acer saccharinum</i>	Silver Maple	5	-3	S5	•	•	•	
<i>Acer saccharum ssp. saccharum</i>	Sugar Maple	4	3	S5	•	•	•	
<i>Acer saccharum ssp. nigrum</i>	Black Maple	7	3	S4?	•	•	•	
<i>Acer X freemanii</i>	Freeman's Maple				•	•	•	
<b>Betulaceae</b>		<b>Birch Family</b>						
<i>Betula alleghaniensis</i>	Yellow Birch	6	0	S5	•	•	•	
<i>Betula occidentalis</i>	River Birch	2		S3?	•	•		
<i>Betula papyrifera</i>	White Birch		2	S5	•	•	•	
<i>Betula populifolia</i>	Gray Birch	5	0	S5	•	•	•	
<i>Ostrya virginiana</i>	Hop Hornbeam / Ironwood	4	4	S5	•	•	•	

Scientific Name	Common Name	CC	CW	SRANK	Location Suitability			Small Stature Tree
					Parks / Residential Lots	Boulevards	Buffers / Natural Areas	
<b>Cornaceae Dogwood Family</b>								
<i>Cornus alternifolia</i>	Alternate-leaved Dogwood	6	5	S5	•	•	•	•
<i>Cornus florida</i>	Eastern Flowering Dogwood *	7	4	S2?	•	•	•	•
<b>Fabaceae Pea Family</b>								
<i>Cladrastis kentukea</i>	Kentucky Yellowwood			SE1	•	•		
<i>Gleditsia triacanthos</i>	Honey Locust	3	0	S2			•	
<i>Gleditsia triacanthos var. inermis</i>	Honey Locust				•	•		
<i>Gymnocladus dioica</i>	Kentucky Coffee-tree *	6	5	S2	•	•	•	
<b>Fagaceae Beech Family</b>								
<i>Castanea dentata</i>	American Chestnut *	8	5	S2	•	•	•	
<i>Fagus grandifolia</i>	American Beech	6	3	S5	•	•	•	
<i>Fagus sylvatica</i>	European Beech				•	•		
<i>Quercus alba</i>	White Oak	6	3	S5	•	•	•	
<i>Quercus bicolor</i>	Swamp White Oak	8	-4	S4	•	•	•	
<i>Quercus ellipsoidalis</i>	Northern Pin Oak	9	5	S3	•	•	•	
<i>Quercus macrocarpa</i>	Bur Oak	5	1	S5	•	•	•	
<i>Quercus muhlenbergii</i>	Chinquapin Oak	9	5	S4	•	•	•	
<i>Quercus palustris</i>	Pin Oak	9	-3	S4	•	•	•	
<i>Quercus prinoides</i>	Dwarf Chinquapin Oak	10		S2	•	•	•	•
<i>Quercus robur</i>	English Oak			SE1	•	•		
<i>Quercus rubra</i>	Red Oak	6	3	S5	•	•		
<i>Quercus shumardii</i>	Shumard Oak	7	-5	S3	•	•	•	
<i>Quercus velutina</i>	Black Oak	8	5	S4	•	•	•	
<b>Hamamelidaceae Witch-hazel Family</b>								
<i>Liquidambar styraciflua</i>	Sweet Gum				•	•		
<b>Hippocastanaceae Buckeye Family</b>								
<i>Aesculus glabra var. glabra</i>	Ohio Buckeye	10	-1	S1	•	•		
<i>Aesculus hippocastanum</i>	Horse Chestnut		5	SE2	•	•		

Scientific Name	Common Name	CC	CW	SRANK	Location Suitability			Small Stature Tree
					Parks / Residential Lots	Boulevards	Buffers / Natural Areas	
<b>Juglandaceae</b>		<b>Walnut Family</b>						
<i>Carya cordiformis</i>	Bitternut Hickory	6	0	S5	•	•	•	
<i>Carya ovata</i> var. <i>ovata</i>	Shagbark Hickory	6	3	S5	•	•	•	
<i>Juglans nigra</i>	Black Walnut	5	3	S4	•		•	
<b>Lauraceae</b>		<b>Laurel Family</b>						
<i>Sassafras albidum</i>	Sassafras	6	3	S4	•	•	•	
<b>Magnoliaceae</b>		<b>Magnolia Family</b>						
<i>Liriodendron tulipifera</i>	Tulip Tree	8	2	S4	•	•	•	
<i>Magnolia acuminata</i>	Cucumber Tree *	10	1	S2	•	•		
<i>Magnolia soulangeana</i>	Saucer Magnolia				•	•		•
<b>Moraceae</b>		<b>Mulberry Family</b>						
<i>Maclura pomifera</i>	Osage Orange		3	SE2	•	•		
<b>Nyssaceae</b>		<b>Sour Gum Family</b>						
<i>Nyssa sylvatica</i>	Black Gum	9	-4	S3	•	•		
<b>Oleaceae</b>		<b>Olive Family</b>						
<i>Syringa vulgaris</i>	Common Lilac		5	SE5	•	•		•
<i>Syringa reticulata</i>	Ivory Silk Lilac				•	•		•
<b>Platanaceae</b>		<b>Plane-tree Family</b>						
<i>Platanus occidentalis</i>	Sycamore	8	-3	S4	•	•	•	
<i>Platanus X acerifolia</i>	London Plane-tree		5	SE1	•	•		
<b>Rosaceae</b>		<b>Rose Family</b>						
<i>Amelanchier arborea</i>	Downy Juneberry		3	S5	•	•	•	•
<i>Amerlanchier canadensis</i>	Serviceberry				•	•		•
<i>Amelanchier laevis</i>	Smooth Juneberry	5	5	S5	•	•	•	•
<i>Prunus americana</i>	American Plum	6	5	S4	•	•	•	•
<i>Prunus pensylvanica</i>	Pin Cherry	3	4	S5	•	•	•	•
<i>Prunus serotina</i>	Black Cherry	3	3	S5	•	•	•	
<i>Prunus virginiana</i> ssp. <i>virginiana</i>	Choke Cherry	2	1	S5	•	•	•	•

Scientific Name	Common Name	CC	CW	SRANK	Location Suitability			Small Stature Tree
					Parks / Residential Lots	Boulevards	Buffers / Natural Areas	
<i>Sorbus americana</i>	American Mountain-ash	8	-1	S5	•	•	•	•
<i>Sorbus aucuparia</i>	European Mountain-ash		5	SE4	•	•		•
<i>Sorbus decora</i>	Showy Mountain-ash	8	3	S5	•	•	•	•
<b>Rutaceae</b>		<b>Rue Family</b>						
<i>Ptelea trifoliata</i>	Common Hop-tree	9	2	S3	•	•		•
<b>Salicaceae</b>		<b>Willow Family</b>						
<i>Populus balsamifera ssp. balsamifera</i>	Balsam Poplar	4	-3	S5	•	•	•	
<i>Populus grandidentata</i>	Large-tooth Aspen	5	3	S5	•	•	•	
<i>Populus tremuloides</i>	Trembling Aspen	2	0	S5	•	•	•	
<b>Tiliaceae</b>		<b>Linden Family</b>						
<i>Tilia americana</i>	American Basswood	4	3	S5	•	•	•	
<i>Tilia cordata</i>	Small Leaf Linden			SE1	•	•		
<b>Ulmaceae</b>		<b>Elm Family</b>						
<i>Celtis occidentalis</i>	Common Hackberry	8	1	S4	•	•	•	
<i>Ulmus americana</i>	White Elm	3	-2	S5	•	•	•	
<i>Ulmus rubra</i>	Slippery Elm	6	0	S5	•	•	•	
<i>Ulmus thomasii</i>	Rock Elm	6	-1	S4?	•	•	•	
<i>Ulmus species</i>	Elm cultivars				•	•		

\* Possession, planting, and cultivation of these species is permissible, however removal or harm is subject to Sections 9 and 10 of the Endangered Species Act.

## **Legend**

**CC - Co-efficient of Conservatism:** This value, ranging from 0 (low) to 10 (high), is based on a species tolerance of disturbance and fidelity to a specific habitat integrity.

**CW - Wetness Index:** This value, ranging from -5 (obligate wetland) to 5 (upland) provides the probability of a species occurring in wetland or upland habitats.

**SRANK - Provincial Status:** Provincial ranks are used by the NHIC to set protection priorities for rare species and natural communities. These ranks are not legal designations. S4 and S5 species have populations that are generally secure in the province. Species ranked S1-S3 are considered to be rare (imperiled or vulnerable) in Ontario.

# 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.

Shade Density	HEAVY SHADE					
Tree Name <i>Species</i>	American Basswood <i>Tilia americana</i>	Black Maple <i>Acer nigrum</i>	Northern Catalpa* <i>Catalpa speciosa</i>	Freeman Maple <i>Acer freemanii</i>	Hackberry <i>Celtis occidentalis</i>	Red Maple <i>Acer rubrum</i>
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	12 to 20 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
Tolerates high winds	✗	✓	✓	✓	✓	✗
Drought resistant	Somewhat	Somewhat	✓	✓	✓	✗
Salt resistant <sup>1</sup>	✗	✗	Somewhat	✗	✓	Poor
Tolerates air pollution	Somewhat	✗	✓	✓	✓	✓
Tolerates poor soil	Somewhat	Somewhat	✓	✓	✓	✓
Resistant to insects/disease <sup>2</sup>	✗	✗	Disease	✓	Disease	Disease
Tolerates sun	✓	Somewhat	✓	✓	✓	✓

\*Introduced species  
(not native to Waterloo Region or Ontario)

### Soil moisture tolerance

- Wet to dry, well-drained

- Moist to well-drained

- Moist to well-drained

- Moist, well-drained, to occasionally dry
- Tolerates flooding

- Wet to occasionally dry

- Wet to occasionally dry
- May require irrigation in well-drained soils

### Pruning needs and other considerations

- Needs pruning to develop strong structure

- Responds well to pruning
- Prune to maintain shape
- Sensitive to reflected heat (some cultivars)

- Young bark is thin and 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 can form weak connections
- Bark easily damaged
- Surface roots can cause problems



# 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.

Shade Density	HEAVY SHADE				MEDIUM SHADE	
Tree Name <i>Species</i>	Red Oak <i>Quercus rubra</i>	Silver Maple <i>Acer saccharinum</i>	Sugar Maple <i>Acer saccharum</i>	White Oak <i>Quercus alba</i>	Accolade Elm* <i>(interspecific hybrid)</i> <i>Ulmus x accolade</i>	Bur Oak <i>Quercus macrocarpa</i>
Height	20 to 26 metres	20 to 30 metres	15 to 25 metres	18 to 32 metres	12 to 20 metres	20 to 30 metres
Canopy spread	16 to 22 metres	15 to 20 metres	12 to 20 metres	18 to 25 metres	10 to 12 metres	20 to 30 metres
Rate of growth	Medium	Fast	Slow to medium	Slow	Fast	Medium
Tolerates high winds	Somewhat	✗	✓	✓	✓	✓
Drought resistant	✓	Somewhat	✗	Somewhat	✓	✓
Salt resistant <sup>1</sup>	✓	Somewhat	✗	✓	✓	✓
Tolerates air pollution	✓	✓	✗	✓	✓	✓
Tolerates poor soil	✓	✓	✗	Somewhat	✓	✓
Resistant to insects/disease <sup>2</sup>	✗ Insects (Gypsy moth/fall cankerworm), Disease (Oak wilt)	Disease	✗	Insects (Gypsy moth)	✓ (resistant to Dutch Elm Disease)	Insects (Gypsy moth)
Tolerates sun	✓	✓	✓	✓	✓	✓

\* Introduced species  
(not native to Waterloo Region or Ontario)



### Soil moisture tolerance

- Moist to dry
- Wet to well-drained
- Well-drained to moist
- Moist to well-drained
- Moist to well-drained
- Wet to dry, well-drained

### Pruning needs and other considerations

- Prune with care (dormant or summer)
- Frequent pruning needed
- Responds well to pruning, prune to maintain shape
- Area under dripline susceptible to disturbance
- Needs pruning
- Large drooping lower branches may need pruning
- Invasive roots
- Sensitive to reflected heat (some cultivars)
- Difficult to transplant
- Can sucker extensively
- Deep tap roots
- Branches and twigs break easily
- Aggressive root system
- Avoid use near structures
- Surface roots may cause problems
- Cultivar

# 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.

Shade Density	MEDIUM SHADE						LIGHT SHADE
Tree Name <i>Species</i>	Horse Chesnut* <i>Aesculus hippocastanum</i>	Ironwood <i>Ostrya virginiana</i>	London Plane* <i>Platanus x acerifolia</i>	American Sycamore <i>Platanus occidentalis</i>	Tuliptree <i>Liriodendron tulipifera</i>	Yellowwood* <i>Cladrastis kentuckea</i>	Honey Locust <i>Gleditsia triacanthos</i> <i>var. inermis - Shademaster</i>
Height	20 to 25 metres	10 to 15 metres	22 to 32 metres	25 to 30 metres	22 to 30 metres	10 to 17 metres	14 to 16 metres
Canopy spread	15 metres	7 to 9 metres	18 to 26 metres	15 to 20 metres	12 to 15 metres	14 to 18 metres	14 metres
Rate of growth	Rapid (young) Slow (mature)	Slow	Medium	Fast	Medium to fast	Medium to fast	Fast
Tolerates high winds	Somewhat	✓	✓	✓	✓	✗	Somewhat
Drought resistant	Somewhat	✓	✓	✓	Somewhat	Somewhat	✓
Salt resistant <sup>1</sup>	Somewhat	✗	Somewhat	Somewhat	✗	Somewhat	✓
Tolerates air pollution	Somewhat	✓	✓	✓	✓	Somewhat	✓
Tolerates poor soil	✓	✓	✓	✓	✗	✓	✓
Resistant to insects/disease <sup>2</sup>	✗	✓	✗	✗	✗	Disease	✗
Tolerates sun	✓	✓	✓	✓	✓	✓	✓

\* Introduced species  
(not native to Waterloo  
Region or Ontario)

### Soil moisture tolerance

- Moist to well-drained
- Moist to well-drained
- Wet to dry
- Fairly wet to well-drained
- Very moist to well-drained
- Moist to well-drained
- Moist to well-drained

### Pruning needs and other considerations

- Prune for shape and strength
- Prune to maintain shape
- Responds well to pruning, prune to maintain shape
- Surface roots can cause problems
- Bark easily damaged
- May need pruning to maintain shape
- Prune for shape and strength
- Extensive clean-up needed for large flowers, nuts and leaf litter
- Short-lived
- Surface roots can cause problems
- Insects (Aphids can cause honeydew deposits)
- Insects (Aphids can cause honeydew deposits)
- Weak crotches
- Most trees are seedless, seeds grow in pods
- Surface roots can cause problems
- Bark easily damaged
- Surface roots can cause problems



# Shade Tree List

A Supplement to the Shade Audit Guide + Tool

## Notes:

<sup>1</sup> Some trees' tolerance for soil salt may be higher than for airborne (aerosol) salt.

<sup>2</sup> Most trees act as hosts to insect/disease but usually do not die as a result. This column indicates problematic reaction to either an insect or disease, if applicable.

\*Introduced Species (not native to Waterloo Region or Ontario)

There are many variables that confound the ratings in this document. Combinations of environmental variables may cause unusual reactions to any given condition. Stressed trees are always more susceptible to normally benign factors. Stress is created by changing climate conditions, changed drainage, outbreaks of invasive insects or diseases, and other events.

## Planting for diversity

Rather than planting all one type and size of tree, various species of trees should be considered to reduce the risk of losing all trees on a site due to disease or insects. Also, a variety of sizes and ages of trees should be on a site.

## Planting, maintenance, and protection

Urban trees are up against many stressors and it is essential that trees are properly planted and maintained to increase their life expectancy.

## Considerations:

**Tree selection** – Select tree species that are appropriate for the climate and site conditions. If possible, plant trees with a minimum of 70 mm caliper. If budget is an issue, it is better to plant fewer but more established trees. Select trees that optimize shade coverage because of their dense canopy.

**Planting** – Consider whether the planting site has adequate space and plant trees a sufficient distance apart (for most hardwoods 5 to 6 metres apart). Determine if you need to apply amendments to improve the soils or to remove invasive species to reduce competition. Stakes and ties can be used to provide some support after planting depending on tree size and soil characteristics, but the stakes and ties should be removed after one year.

**Pruning** – At planting, ensure that any larger roots circling the pot are spread out to prevent girdling and prune excessive surface roots. Over the years, look at the upper branches of the tree to decide if pruning is necessary.

**Maintenance** – Plan for proper maintenance of a tree and build this into your budget. Proper maintenance includes applying mulch, using wrap or fencing for protection, watering until established and completing necessary pruning. Vigorous trees tend to be more resistant to stress and vigor can be maintained through good stewardship – soil, water and nutrients should all be monitored and managed as much as possible.

## Considerations for planting shade trees:

### Shade Audit Information Guide + Tool:

<http://bit.ly/1wu0xZZ>

- Plant trees in areas/zones on the site that are used the most frequently by vulnerable users (e.g., playgrounds, rest areas)
- Plant to the south and southwest of the area that you are hoping to shade

### Tree species:

- Ontario's Tree Atlas-Ministry of Natural Resources: <http://bit.ly/1DEB4kp> (native species specific to Waterloo Region)
- Evergreen's Native Tree Database: <http://nativeplants.evergreen.ca>

### Planting, maintenance and protection:

- Evergreen's Mulch is Magic! <http://bit.ly/12jm9yQ>
- Evergreen's The Bucket Method: Watering Guidelines for Newly Planted Trees <http://bit.ly/2b1ojtf>

Developed in partnership with the Shade Work Group of Waterloo Region, Region of Waterloo Public Health and Emergency Services and Region of Waterloo Community Environmental Fund.



### Resources/additional information:

The Shade Work Group of Waterloo Region  
[www.regionofwaterloo.ca/shade](http://www.regionofwaterloo.ca/shade)

**Compiled based on the expertise of:** Albert Hovingh, *RFP, Principal Planner – Stewardship*, Region of Waterloo; Paul Willms, *Sustainability Planner*, City of Cambridge; Chris Gosselin, *Manager of Environmental Planning*, Region of Waterloo; Dennis Wendland, *Community Member*

Alternate formats of this document are available upon request. Please contact 519-575-4400 (TTY: 519-575-4608) to request an alternate format.

## **City of Waterloo Preferred Street Tree Species List**

Source:

[https://rapidtransit.regionofwaterloo.ca/en/projectinformation/resources/2014Schedule15-Sch.15-2AppendixETreeList\\_RFPV3.pdf](https://rapidtransit.regionofwaterloo.ca/en/projectinformation/resources/2014Schedule15-Sch.15-2AppendixETreeList_RFPV3.pdf)

## List of preferred species for Urban Trees

SPECIES CODE	LATIN NAME	COMMON NAME	Salt Tolerance	Native	Soil pH	Soil Moisture	Soil Compaction Tolerance	Shade Tolerance	Flowers	Mature Size (m) (height & width)	Form	Planting Site Location
Aca	Acer campestre	Hedge Maple				D		T		10x10	R	1,2,3,4
Af	Acer x freemanii	Silver/Red Maple				W,A,D						3,4
Afar	Acer x freemanii 'Armstrong'	Armstrong Maple				W,A,D						3,4
Ag	Acer ginnala	Amur Maple			6.1-7.5	A				7x7	R	1,2,3,4
Ar	Acer rubrum	Red Maple	S	X	4.5-6.5	W,A	I			17x15	O	3,4
Arb	Acer rubrum 'Bowhall'	Bowhall Maple	S	X	4.5-6.5	W,A	I			17x15	O	3,4
Arf	Acer rubrum 'Frank Jr.'	Redpointe Maple	S	X	4.5-6.5	W,A	I			17x15	O	3,4
Asa	Acer saccharinum	Silver Maple		X	4.0-7.3	W,A						4
Asas	Acer saccharinum 'Silver Queen'	Silver Queen Maple				W,A						3,4
As	Acer saccharum	Sugar Maple	S	X	6.0-7.5	W,A	S	T		20x15	O	3,4
At	Acer tataricum	Tatarian Maple										2,3
Ac	Amelanchier canadensis	Serviceberry	T	X	6.0-6.5	W,A	S	T	X	8x3	O	1,2,3,4
Cb	Carpinus betulus	Hornbeam										2,3
Cbf	Carpinus betulus 'Frans Fontaine'	Frans Fontaine Hornbeam										2
Co	Celtis occidentalis	Common Hackberry	T	X	6.0-6.5	W,A,D	M	M		20x18	R	3,4
Cl	Crataegus laevigata 'Paul's Scarlet'	Paul's Scarlet Hawthorn				D			X			1,2,3,4
Gbp	Ginkgo biloba 'Princeton Sentry'	Princeton Sentry Ginkgo	M		4.5-7.0	A		S		17x11	I,P	2,3,4
Gbp	Ginkgo biloba 'Saratoga'	Sartoga Ginkgo	M		4.5-7.0	A		S		17x11	I,P	3,4
Gt	Gleditsia triacanthos var. inermis 'Skycole'	Skyline Honeylocust	T		6.0-7.5	W,A,D	T	S		15x13	P	3,4
Gt	Gleditsia triacanthos var. inermis 'Draves'	Street Keeper Honeylocust	T		6.0-7.5	W,A,D	T	S		15x13	P	3,4
Gme	Gymnocladus dioica 'Espresso-JFS'	Espresso Kentucky Coffee Tree	T			A,D	T	S				3,4
Ltf	Lirodendron tulipifera 'Fastigiatum'	Columnar Tulip Tree	M			A	T					2,3,4
Mr	Malus 'Royal Raindrops'	Royal Raindrops Crab Apple	T		5.5-6.5	A,D	I	S	X	20x15	R	1,2,4
Ns	Nyssa sylvatica	Black Gum	T	X		W,A,D						3,4
Pab	Platanus x acerfolia 'Bloodgood'	Bloodgood London Plane Tree	M		5.5-7.5	W,A		S				3,4
Pa	Platanus occidentalis	Sycamore	S	X	6.5-8.5	W,A	T	M		35x20	O	3,4
Po	Populus tremuloides	Trembling Aspen	M	X	4.3-9.0	W,A						4
Pc	Pyrus calleryana	Calleryana Pear							X	13x7	O	2,3,4
Ov	Ostrya virginiana	Ironwood		X	4.2-7.6	A		T				2,3,4
Qa	Quercus alba	White Oak	M	X	4.5-6.8	A,D						3
Qac	Quercus alba x robur 'Crimschmidt'	Crimson Spire Oak	M									2,3,4
Qb	Querus bicolor	Swamp Oak	M	X	4.5-6.5	D				15x15	R	4

Qm	Quercus macrocarpa	Bur Oak	T,M	X	4.0-8.5	W,A,D	S			18x13	O	3,4
Qr	Quercus robur	English Oak	T		5.0-7.0	A	S	S		18x13	R	3,4
Qrf	Quercus robur fastigiata	English Pyramidal Oak	T		5.0-7.0	A	S	S		15x5	F	2,3,4
Qru	Quercus rubra	Red Oak	T	X	4.5-6.5	A	S	T		16x15	R	4
Saf	Sorbus aucuparia fastigiata	Pyramidal European Mountain Ash	M						X	11x2	F	2
Sd	Sorbus decora	Showy Mountain Ash	M	X	4.0-7.0	W,A			X			1,2
Stf	Sorbus thuringiaca fastigiata	Oakleaf Mountain Ash	M						X	7x3	F	1,2,4
Sr	Syringa reticulata 'Ivory Silk'	Japanese Ivory Silk Lilac							X			1,2,4
Ta	Tilia americana	Basswood	M,S	X	6.5-7.5	A	S			25x13	P,R	3,4
Tcc	Tilia cordata 'Corzam'	Corinthian Linden	M,S		6.5-7.5	A	S		X	25x13	P,R	2,3,4
Tch	Tilia cordata 'Halka'	Summer Sprite Linden	M,S		6.5-7.5	A	S		X	25x13	P,R	2,3,4
Uav	Ulmus americana var. resil	American Elm, DED resistant varietie	M		5.0-8.0	D						3,4
Up	Ulmus propinqua 'JFS-Bieberich'	Emerald Sunshine Elm	M		5.0-8.0	D						3,4
Zs	Zelkova serrata	Zelkova			6.0-6.9							3,4

**All Fraxinus Species Are Temporarily Prohibited Due To Emerald Ash Borer Infestation In Waterloo Region**

last updated: Feb, 2012

SALT TOLERANCE, S - Sensitive, M - Moderately Sensitive, T - Tolerant

SOIL pH, On scale of 1.0 (acid) to 14.0 (base) with 7.0 (neutral)

SOIL MOISTURE, W - Moist, A - Average, D - Dry

SOIL COMPACTION TOLERANCE, S - Sensitive, M - Moderately Sensitive, T - Tolerant

TRANSPLANTING EASE, S - Sensitive, M - Moderately Sensitive, T - Tolerant

SHADE TOLERANCE - T-Tolerance to Shade, M -Moderately Tolerant of Shade (Semi-shade), S -Sensitive to Shade

FORM - O-oval, R-round, F-fastigate,I-irregular,P-pyramidal

PLANTING SITE LOCATION - 1 - Under Utility Lines, 2 - Center Median Plantings, 3 -Street Tree, 4 -Park Plantings

File: h:pws/for-hort/forestry/policies/species.xls

Yellow New Additions

# Town of Oakville

Source: <https://www.oakville.ca/residents/native-species.html>

## Native Species

Thinking about planting a tree on your property? There are many trees that are native to Southern Ontario and well-suited to local conditions, including:

- Balsam Fir (*Abies Balsamea*)
- Red Maple (*Acer Rubrum*)
- Sugar Maple (*Acer Saccharum*)
- Silver Maple (*Acer Saccharinum*)
- Common Hackberry (*Celtis Occidentalis*)
- Red Cedar (*Juniperus Virginiana*)
- Eastern Larch (*Larix Laricina*)
- Tulip Tree (*Liriodendron Tulipifera*)
- White Spruce (*Picea Glauca*)
- White Pine (*Pinus Strobus*)
- Sycamore (*Platanus Occidentalis*)
- White Oak (*Quercus Alba*)
- Bur Oak (*Quercus Macrocarpa*)
- Red Oak (*Quercus Rubra*)
- American Basswood (*Tilia Americana*)
- Eastern Hemlock (*Tsuga Canadensis*)

For a detailed list and planting tips, visit the Ontario [Tree Atlas](#) website.

Oakvillegreen, the town's largest residents' association, has been working for almost a decade to protect our environment, promote sustainable planning and make sure that new development pays for itself. Learn more about [Oakvillegreen](#) and their tree planting initiatives.

**THE REGIONAL MUNICIPALITY OF YORK  
ACCEPTABLE STREET TREE SPECIES FOR REGIONAL ROADS**

Regional road allowances present an extremely harsh environment for street tree establishment and growth. Only a select group of hardy tree species establish and thrive in this environment. The Regional Municipality of York has developed the following street tree species lists and guidelines to ensure that only those hardy tree species proven to establish and thrive along Regional roads are planted.

The Region continually reviews these lists and guidelines in an attempt to ensure they reflect the most current knowledge and are as broad as possible. The Region is continually trying new species and varieties in controlled trials to identify additional species for the lists.

**Top Performing Street Tree Species**

The Regional Municipality of York has developed a list of “Top Performing Street Tree Species” based on an extensive literature review, results of recent street tree health assessments and anecdotal records of species performance in Regional road allowances.

This list represents species which have desirable characteristics and are tolerant of the harsh growing environment present along Regional roads. While being sensitive to species diversity, this list has been developed to ensure that trees planted meet performance expectations and achieve the expected benefits for Region residents. These species will form the majority of species planted within Regional road allowances.

At a minimum, 75% of trees planted along Regional roads will come from the Region’s top performing street tree species list. In road side locations where conditions are particularly harsh, up to 100% of species planted may come from the top performing street tree species list.

**TABLE 1: Top Performing Small Form (Hydro Acceptable) Species List**

Species Name	Native	Characteristics
Shubert cherry ( <i>Prunus virginiana</i> ‘Shubert’) <sup>1</sup>	Yes	Very susceptible to black knot, requires annual pruning to control fungus Prone to suckering from base of tree
Ivory silk lilac ( <i>Syringa reticulata</i> )	No	Showy lilac-like blooms in early summer, followed by seed capsules that persist on the tree Fairly pest and disease resistant

**TABLE 2: Top Performing Full Form Species List**

Species Name	Native <sup>1</sup>	Characteristics
Silver maple ( <i>Acer saccharinum</i> ) <sup>1</sup>	Yes	Develops large crown, therefore plant in locations with adequate space
Ohio Buckeye ( <i>Aesculus glabra</i> ) <sup>1</sup>	Yes	Showy flower spikes followed by seed husks covered in soft spines Less susceptible to leaf scorch and leaf blotch than horsechestnut
Horsechestnut ( <i>Aesculus hippocastanum</i> ) <sup>1</sup>	No	Showy flower spikes, less seed production than Ohio buckeye, seed husks covered in soft spines Susceptible to leaf scorch and leaf blotch
Honeylocust ( <i>Gleditsia triacanthos</i> var. <i>inermis</i> )	Yes	Small leaves provide a filtered shade Can be susceptible to defoliation by leafhoppers Acceptable cultivars for Regional roads include: Shademaster
Kentucky coffee tree ( <i>Gymnocladus dioicus</i> ) <sup>1</sup>	Yes	Coarse branching structure, large double-compound leaves with small leaflets Dioecious tree with male and female plants, male tree preferred

Notes:

<sup>1</sup>Spring planting only

<sup>2</sup>A native tree is defined as a tree whose natural range is within Ontario and/or the northern U.S lake states.

### Notable Street Tree Species for Select Planting Sites

The Regional Municipality of York has developed a list of “Notable Street Tree Species for Select Planting Sites” based on an extensive literature review, results of recent street tree health assessments and anecdotal records of species performance in Regional road allowances.

This list represents species which have many desirable characteristics and tolerances, but are sensitive to specific environmental conditions (exposure to prevailing winds, de-icing salt, etc.). Their use is limited to specific sites where the environmental conditions are ideal for their initial survival and long term performance. These species will form a minor component of species planted within Regional road allowances.

The Region has developed a series of street tree species fact sheets that provide additional information on many of these species. These are available upon request.

**TABLE 3: Notable Full Form Species List**

Species Name	Native <sup>2</sup>	Planting/Site Restrictions
Norway maple ( <i>Acer platanoides</i> )	No Invasive	This species is invasive. Although some of the cultivars are less invasive, it is not to be planted near natural areas.
Autumn Blaze maple ( <i>Acer x freemanii</i> 'Autumn Blaze') <sup>1</sup>	Yes	Sensitive to desiccation from winter winds. Use in locations sheltered from prevailing winds.
Hackberry ( <i>Celtis occidentalis</i> ) <sup>1</sup>	Yes	Sensitive to de-icing salts (airborne spray). Use in locations where exposure to salt spray will be minimized, e.g. wide boulevards (6 m +) on the north and west sides of roads.
Swamp white oak ( <i>Quercus bicolor</i> ) <sup>1</sup>	Yes	Of the oak species, this has shown the greatest tolerance to Regional road conditions. Still considered sensitive to de-icing salts (airborne spray). Use in locations where exposure to salt spray will be minimized, e.g. wide boulevards (6 m+) on the north and west sides of roads.
Bur oak ( <i>Quercus macrocarpa</i> ) <sup>1</sup>	Yes	Has shown tolerance to Regional road conditions. Still considered sensitive to de-icing salts (airborne spray). Use in locations where exposure to salt spray will be minimized, e.g. wide boulevards (6 m+) on north and west sides of roads.
Littleleaf linden ( <i>Tilia cordata</i> )	No	Sensitive to desiccation from winter winds and de-icing salt. Plant in locations where exposure to salt spray will be minimized, e.g. wide boulevards (6 m+) on the north & west sides of roads and in a location sheltered from prevailing winds. Acceptable cultivars for Regional roads include: Glenleven and Greenspire
Accolade elm ( <i>Ulmus japonica</i> x <i>Ulmus wilsoniana</i> )	No	Initial plantings of this species have shown tolerance to the growing conditions on Regional road allowances. Experience with this species is limited and it should be used in limited quantities until further evaluation of its performance is completed.
Colorado spruce ( <i>Picea pungens</i> ) <sup>1</sup>	No	Sensitive to desiccation from winter winds and de-icing salt. Plant a minimum of 6 m from edge of road, and preferably in a sheltered location. Should always be planted behind sidewalk/pedestrian zone Susceptible to yellow-headed spruce sawfly defoliation
White spruce ( <i>Picea glauca</i> ) <sup>1</sup>	Yes	More sensitive to desiccation from winter winds and de-icing salt than Colorado or Norway spruces. Plant a minimum of 6 m from edge of road, and preferably in a sheltered location. Should always be planted behind sidewalk/pedestrian zone Can be susceptible to yellow-headed spruce sawfly defoliation
Norway spruce ( <i>Picea abies</i> ) <sup>1</sup>	No	Sensitive to desiccation from winter winds and de-icing salt. Plant a minimum of 6 m from edge of road, and preferably in a sheltered location. Should always be planted behind sidewalk/pedestrian zone Fairly pest and disease resistant
Austrian pine ( <i>Pinus nigra</i> ) <sup>1</sup>	No	Sensitive to desiccation from winter winds and de-icing salt. Plant a minimum of 6 m from edge of road, and preferably in a sheltered location. Should always be planted behind sidewalk/pedestrian zone Susceptible to Diplodia blight, select locations with good air flow and avoid mass plantings of this tree



**TABLE 4: Notable Small Form (Hydro Acceptable) Species List**

Species Name	Native <sup>2</sup>	Planting/Site Restrictions
Hedge maple ( <i>Acer campestre</i> )	No	Sensitive to desiccation from winter winds. Use in locations sheltered from prevailing winds.
Ornamental pear ( <i>Pyrus calleryana</i> ) <sup>1</sup>	No	Sensitive to desiccation from winter winds. Use in locations sheltered from prevailing winds. Acceptable cultivars for Regional roads include: Chanticleer Pear
Columnar Norway maple ( <i>Acer platanoides</i> 'Columnare')	No Invasive	Species suitable for planting adjacent to overhead hydro due to its narrow width. Must be planted a minimum of five (5) metres from overhead hydro
English pyramidal oak ( <i>Quercus robur</i> 'fastigiata') <sup>1</sup>	No	Species suitable for planting adjacent to overhead hydro due to its narrow width. Must be planted a minimum of five (5) metres from overhead hydro Should always be planted behind sidewalk/pedestrian zone

Notes:

<sup>1</sup>Spring planting only

<sup>2</sup>A native tree is defined as a tree whose natural range is within Ontario and/or the northern U.S lake states.

## TREES ON THE PUBLIC ROAD ALLOWANCE

The City of Toronto owns a portion of land between roadways and private property, known as the public road allowance. Urban Forestry plants and maintains trees on this land to help grow Toronto's urban forest and to reach the City's goal of increasing the tree canopy to 40 per cent.

## BENEFITS OF STREET TREES

Trees provide many benefits in urban settings. They clean the air, reduce stormwater runoff, provide habitat for birds and other wildlife, and enhance the urban landscape. Street trees have an enormous impact on our urban environment. Street trees benefit property owners by providing shade, reducing heating and cooling costs, and increasing property values.

## CHOOSING THE RIGHT TREE

This brochure highlights the tree species that are available for planting by the City. Trees grow best when they are planted in the right growing conditions. Amount of sunlight, soil type and moisture, and available room to grow are the key considerations for selecting the right tree.

## REQUESTING THE TREE

Property owners can submit a tree planting request for the City-owned road allowance in front of their home or business by calling 311 or visiting [toronto.ca/311](http://toronto.ca/311). The City's Urban Forestry staff will then visit the site to confirm the right tree species and determine the ideal planting location. The actual planting will take place during the next planting season (typically spring or fall).

## CARING FOR THE TREE

Urban Forestry will plant and maintain the tree on the City-owned road allowance. Newly planted trees are very sensitive to the difficult growing conditions along urban streets. Property owners can assist by watering newly planted trees during the first two to three years after planting.



















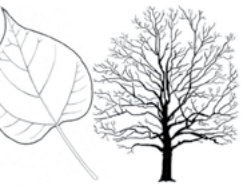














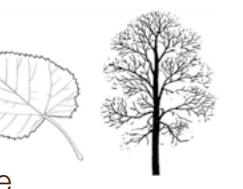

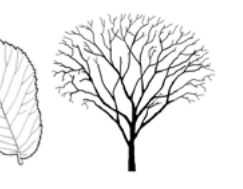
# EVERY TREE COUNTS

Help Grow Toronto's Street Tree Canopy

[toronto.ca/trees](http://toronto.ca/trees)




Call **311**


<p><b>1. BLACK MAPLE</b> <i>Acer nigrum</i></p>  <p>Large Hardy Gorgeous fall colour, creates deep shade</p>	<p><b>2. RED MAPLE</b> <i>Acer rubrum</i></p>  <p>Medium Hardy Brilliant fall colour, excellent shade tree</p>	<p><b>3. SILVER MAPLE</b> <i>Acer saccharinum</i></p>  <p>Large Very Hardy Attractive winter buds, fast growing, excellent shade tree</p>	<p><b>4. SUGAR MAPLE</b> <i>Acer saccharum</i></p>  <p>Large Sensitive Brilliant fall colour</p>	<p><b>5. OHIO BUCKEYE</b> <i>Aesculus glabra</i></p>  <p>Medium Sensitive Showy white flowers, attracts hummingbirds</p>	<p><b>6. HACKBERRY</b> <i>Celtis occidentalis</i></p>  <p>Medium Very Hardy Interesting bark and leaves</p>	<p><b>7. KENTUCKY COFFEETREE</b> <i>Gymnocladus dioica</i></p>  <p>Large Very Hardy Interesting leaves, creates dappled shade</p>	<p><b>8. TULIP TREE</b> <i>Liriodendron tulipifera</i></p>  <p>Large Sensitive Large flowers, attractive seed pods, gorgeous fall colour</p>	<p><b>9. CUCUMBER TREE</b> <i>Magnolia acuminata</i></p>  <p>Medium Sensitive Interesting seed pods, rare in Toronto</p>	<p><b>10. BLACK GUM</b> <i>Nyssa sylvatica</i></p>  <p>Medium Sensitive Brilliant fall colour, rare in Toronto</p>	<p><b>11. IRONWOOD</b> <i>Ostrya virginiana</i></p>  <p>Medium Hardy Interesting bark, attractive form, showy seed pods</p>	<p><b>12. WHITE SPRUCE *</b> <i>Picea glauca</i></p>  <p>Medium Sensitive Excellent shade tree, great winter bird habitat</p>
<p><b>13. WHITE PINE *</b> <i>Pinus strobus</i></p>  <p>Large Sensitive Provincial tree of Ontario, great shade tree</p>	<p><b>14. WHITE OAK</b> <i>Quercus alba</i></p>  <p>Large Sensitive Majestic form when mature, rare in Toronto</p>	<p><b>15. SWAMP WHITE OAK</b> <i>Quercus bicolor</i></p>  <p>Medium Hardy Interesting bark and leaves, rare in Toronto</p>	<p><b>16. BUR OAK</b> <i>Quercus macrocarpa</i></p>  <p>Medium Hardy Majestic tree, leaves stay on tree over winter</p>	<p><b>17. CHINQUAPIN OAK</b> <i>Quercus muehlenbergii</i></p>  <p>Large Hardy Interesting leaves, rare in Toronto</p>	<p><b>18. RED OAK</b> <i>Quercus rubra</i></p>  <p>Large Hardy Majestic tree, vibrant fall colour</p>	<p><b>19. NORTHERN CATALPA</b> <i>Catalpa speciosa</i></p>  <p>Large Hardy Showy white flowers, attractive seed pods</p>	<p><b>20. YELLOW-WOOD</b> <i>Cladrastis kentukea</i></p>  <p>Small Moderately Hardy Showy white flowers in hanging clusters, small bean-like pods</p>	<p><b>21. SWEET GUM</b> <i>Liquidambar styraciflua</i></p>  <p>Medium Sensitive Brilliant fall colour, attractive seed pods</p>	<p><b>22. BLACK LOCUST</b> <i>Robinia pseudoacacia</i></p>  <p>Medium Hardy Showy white fragrant flowers, creates dappled shade</p>	<p><b>23. FREEMAN MAPLE</b> <i>Acer x freemanii</i></p>  <p>Medium Very Hardy Brilliant fall colour, attractive red winter buds, fast growing</p>	<p><b>24. RUBY RED HORSE CHESTNUT</b> <i>Aesculus x carnea 'Briotii'</i></p>  <p>Medium Moderately Hardy Showy red flowers, interesting seed pods</p>
<p><b>25. HORSE CHESTNUT</b> <i>Aesculus hippocastanum</i></p>  <p>Medium Hardy Showy white flowers, interesting seed pods</p>	<p><b>26. JAPANESE KATSURA</b> <i>Cercidiphyllum japonicum</i></p>  <p>Medium Moderately Hardy Brilliant fall colour, attractive form, interesting seed pods</p>	<p><b>27. TURKISH HAZEL</b> <i>Corylus colurna</i></p>  <p>Medium Moderately Hardy Interesting leaves and bark</p>	<p><b>28. EUROPEAN BEECH</b> <i>Fagus sylvatica</i></p>  <p>Large Sensitive Majestic tree, attractive smooth bark, slow growing</p>	<p><b>29. GINKGO</b> <i>Ginkgo biloba</i></p>  <p>Large Very Hardy Unique foliage, interesting pyramidal form</p>	<p><b>30. SKYLINE HONEY LOCUST</b> <i>Gleditsia triacanthos 'Skyline'</i></p>  <p>Medium Very Hardy Gorgeous fall colour, fast growing, creates dappled shade</p>	<p><b>31. DAWN REDWOOD *</b> <i>Metasequoia glyptostroboides</i></p>  <p>Large Sensitive Brilliant fall colour, majestic tree, attractive bark</p>	<p><b>32. LONDON PLANE-TREE</b> <i>Platanus x acerifolia</i></p>  <p>Large Moderately Hardy Attractive leaves, interesting bark and fruit</p>	<p><b>33. ENGLISH OAK</b> <i>Quercus robur</i></p>  <p>Large Hardy Majestic tree, leaves stay on tree over winter</p>	<p><b>34. REDMOND LINDEN</b> <i>Tilia americana 'Redmond'</i></p>  <p>Large Hardy Attractive, fragrant flowers</p>	<p><b>35. LITTLE LEAF LINDEN</b> <i>Tilia cordata</i></p>  <p>Large Hardy Attractive, fragrant flowers</p>	<p><b>36. VALLEY FORGE ELM</b> <i>Ulmus americana 'Valley Forge'</i></p>  <p>Large Hardy Interesting form, fast growing, resistant to Dutch Elm Disease</p>

**LEGEND:**

 NATIVE TO SOUTHERN ONTARIO

 NATIVE TO NORTH AMERICA

 NATIVE TO EUROPE/ASIA, HYBRIDS AND CULTIVARS

 Only appropriate for sites of a certain size due to sightline concerns

For definitions of the terms used in this brochure and more information on tree species, their features, attributes, and benefits, visit [toronto.ca/trees](http://toronto.ca/trees)

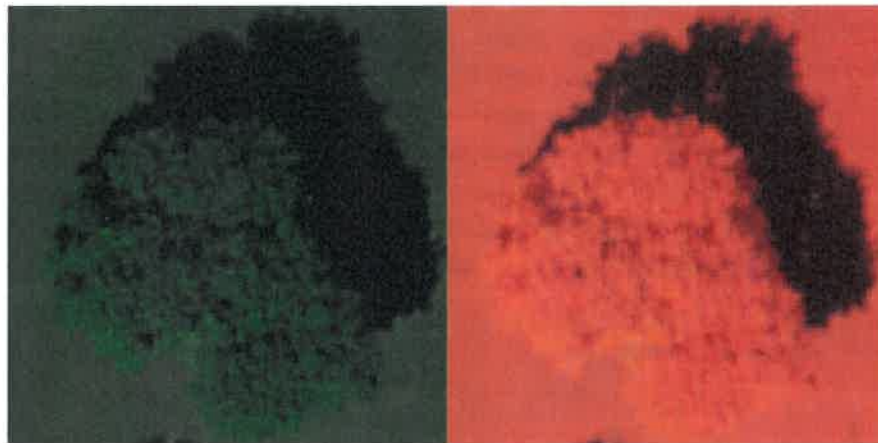
**SOURCES:**

- Trees in Canada (John Laird Farrar)
- Native Trees of Canada (R.C. Hosie)

## Tree Canopy Cover in Elmira

In the spring of 2015, 16.3% of Elmira's urban area was covered by tree canopy. This survey is within a margin of error of plus or minus 1.0 percentage points, nineteen times out of twenty. This was estimated by evaluating aerial photography and using simple statistics.

Aerial photography from the 2015 season of the South Western Ontario Orthoimagery Project (SWOOP) was used. SWOOP photos were chosen because they were high-resolution—30 cm on the ground is represented by one pixel—and included the near-infrared spectrum. Most light that trees and other plants reflect is in the near-infrared spectrum; therefore, this spectrum offers the greatest contrast between plants. For example, a tree in a field that is shaded on the north side can be more accurately distinguished from the grass beneath it using near-infrared as a substitute for the red light (Figure 1).



*Figure 1: An example tree in Bolender Park. Without using near-infrared (left) the tree appears 4.27% smaller (189 m<sup>2</sup>) than it seems under near-infrared light (right; 198 m<sup>2</sup>). This is mostly due to the greater contrast of near-infrared in shaded parts of the tree.*

The statistical protocol used was similar to that of i-Tree Canopy, a program developed by the USDA Forest Service that uses Google Maps photography. To create a random sample of the imagery within Elmira's ROP15 city limits, a list of randomly placed points was generated. To employ sampling-without-replacement—thereby decreasing the standard error of our sample—only one point per pixel was permitted in this list. The center of each point was evaluated manually, at a scale of 1:200, as either a *tree* or *nontree* using the criteria in Table 1. If a tree appeared to be the height of a shrub—such as an apple tree—it was confirmed as a tree using Google Maps Street View. This process was repeated until the 95% confidence interval fell below 1 percentage-point, resulting in 7004 points being evaluated (Table 2). This confidence interval (CI) was calculated using a Binomial approximation:

$CI = \frac{p(1-p)}{n} \times t_{0.025}$ , where  $p$  is the proportion of the sample that was classified as 'tree',  $n$  is the number of points evaluated, and  $t$  is the area of a Student's  $t$ -distribution for a 95% confidence interval.

*Table 1: Criteria for classifying points as nontree or tree.*

Nontree	Tree
The shaded area between trees in a grove or forest	If the center of the sample point is at the edge of a tree, at scale 1:200

A tree devoid of leaves	A tree that is partially defoliated
Shrubs, grass, built-up area, etc.	

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This statistical protocol was chosen instead of semi-automatic classification—a common GIS technique—because it provides consistent accuracy and known precision. Accuracy is the how close the estimate of tree cover is to reality. Precision is how similar repeated estimates of tree cover are each other. To determine if the canopy cover in Elmira is changing, it is imperative that the accuracy of this year’s estimate be similar to that of future estimates. The accuracy of this protocol is determined by use of the near-infrared spectrum and predetermined rules (Table 1). The precision of this protocol, represented by the confidence interval, improves as more points are evaluated until an accepted threshold is reached. In contrast, semi-automatic classification relies on a computer program to identify trees using their color signature. This color signature varies between cameras and changes with the weather, so the color signature in future images will likely be different from the SWOOP 2015 images. Furthermore, the computer often provides an inaccurate identification that a human must correct over many trials. As the observer works to correct the identification, the accuracy improves; work stops when the observer is satisfied that the identification *seems* accurate. There is no way to calculate the precision of a canopy cover estimate produced by semi-automatic classification.

Table 2: 10 of 7004 randomly generated points in Elmira and their classification as tree or nontree. To see the remaining points, activate this table by double-clicking then scroll down.

Coordinates (UTM, NAD '83)		Attribute
Easting (m)	Northing (m)	
535014.7576	4825342.937	Nontree
534826.7354	4828100.743	Nontree
535931.8163	4827565.888	Nontree
536079.2208	4827035.262	Nontree
536495.8219	4828116.858	Nontree
534257.2251	4827844.839	Nontree
534898.4872	4828612.487	Nontree
535930.2798	4827696.792	Tree
535509.4955	4827533.339	Nontree
535445.6722	4825384.464	Nontree

Work completed on the 15<sup>th</sup> of April, 2018, by James H. Seery, B.Sc., ISA Certified Arborist®