Putting Down Roots for the Future

City of Ottawa
Urban Forest Management Plan
2018-2037

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Acknowledgements

Ottawa is located on unceded territory of the Algonquin Anishinabeg people.

The City of Ottawa honours the land and peoples of the Algonquin Anishinabeg Nation, whose ancestors have lived on this territory for millennia, and whose culture and presence have nurtured and continue to nurture this land.

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Ottawa Environmental Stewardship Advisory Committee
Ottawa Invasive Plant Council
Ottawa Stewardship Council
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Executive Summary

Introduction

Putting Down Roots for the Future is a 20-year strategic Urban Forest Management Plan (UFMP) for the City of Ottawa. This UFMP identifies 26 Recommendations to be implemented between 2018 and 2037. These recommendations have been developed based on input from City staff, other stakeholders and members of the public, assessments of the current status of the urban forest management and planning framework in Ottawa, and identified opportunities for improvement based on best practices.

Putting Down Roots for the Future is intended to provide the strategic and technical guidance required to achieve urban forest sustainability in Ottawa over the coming decades. The Plan takes a comprehensive and integrated approach to sustaining and growing Ottawa's urban forest by addressing challenges and opportunities related to four key topic areas:

- Urban forest management program structure and administration
- Planning for the urban forest
- Maintaining and growing the urban forest, and
- Urban forest outreach, education and stewardship.

The review of current practices and opportunities in Ottawa (found in Section 4), as well as the recommendations that emerge from this review (found in Section 5), are organized by these topic areas.

Purpose

Putting Down Roots for the Future is meant to be used as a resource by City of Ottawa staff and Council, members of the community, and all internal and external stakeholders. The Plan is intended to help all users better understand the range of policies, practices and standards which directly and indirectly influence Ottawa's urban forest. It is also intended, through implementation of the recommendations, to guide the City and its partners in working towards achieving the vision, objectives and targets identified for the urban forest in this Plan.

Ottawa's urban forest and its benefits

Ottawa's urban forest includes all of the trees, and their growing environments, within the City's urban boundary and urban expansion areas. The City of Ottawa alone manages over 148,000 trees along urban streets, and tens of thousands

more trees in parks and open spaces. The City also owns and manages over 2,100 hectares of wooded natural areas in the urban area. In addition to trees and wooded natural areas managed by the City, Ottawa's urban forest includes lands managed by the National Capital Commission[1] (NCC), hundreds of treed properties owned by various levels of government, and thousands of privately-owned residential, commercial and institutional properties.

The urban forest is a vital part of the city's green infrastructure that provides wide-ranging benefits and services to the city's residents and makes Ottawa a healthy, vibrant, safe, and prosperous place to live. These benefits and services make the urban forest an invaluable community investment. The benefits of Ottawa's urban forest are described in detail in Section 1.3.

Vision

The vision statement for *Putting Down Roots for the Future* represents an ideal description or image of the urban forest as it will appear in twenty years, following implementation of the strategies, practices and action items recommended in this Plan.

The Vision for Ottawa's Urban Forest

Ottawa's urban forest is healthy, diverse, resilient, and always growing. It sustains vibrant, livable and unique neighbourhoods and promotes health and well-being equitably for all of the city's residents and visitors.

Guiding Principles

The following eight guiding principles should be considered whenever actions and decisions related to the urban forest are made:

1. The urban forest must be recognized and managed as a valuable infrastructure asset and a positive investment.

2. The City and its partners should be bold and innovative in urban forest management.

[1] The City does not have jurisdiction over NCC lands. Therefore, this UFMP does not apply directly to NCC lands. However, the NCC and the City continuously work together on shared goals and objectives for urban forest management in Ottawa.

3. Urban forest management is a shared responsibility, and working together is the key to achieving success.
4. Urban forest management encompasses a wide range of actions.
5. Urban forest management must be flexible, adaptive, and information-based.
6. All of Ottawa's residents deserve equitable access to the benefits provided by the urban forest.
7. All trees are valuable and large trees require special considerations.
8. Increasing diversity builds resilience against climate change and other stressors.

Objectives and Targets

The vision of *Putting Down Roots for the Future* will be realized, in part, through the achievement of the following strategic objectives:

1. Work towards achieving urban forest sustainability.
2. Enhance urban forest protection and establishment.
3. Improve knowledge of the urban forest and its management.
4. Expand community engagement and stewardship in the urban forest.
5. Foster a resilient, diverse and functional urban forest.
6. Minimize risk related to the urban forest.
7. Manage the urban forest more proactively.

The Plan does not establish a specific urban forest canopy cover target, as the City of Ottawa has not yet completed a comprehensive urban forest canopy cover study to verify or revise the current target of 30%. The UFMP recommends that the City undertake such a study within the first management period to support more accurate target setting to grow the urban forest (Recommendation #4).

Plan framework

Ottawa's UFMP is based on a twenty-year planning horizon (2018 to 2037), set on a three-tier framework. The framework includes:

1. ***A 20-year Strategic Plan*** to outline the long-term vision, guiding principles, objectives and targets to be realized over the planning horizon. This Plan considers current and best practices to identify opportunities for improvement of the urban forest management program, and provides recommendations to do so.

2. ***A series of five 4-year Management Periods***, which facilitate ongoing UFMP review and adaptive management, including review of Plan recommendations. The status of the UFMP will be reviewed near the completion of each 4-year Management Period.

3. ***Annual Operating Plans***, which are to be developed for internal use by City staff each year to plan to facilitate the day-to-day implementation of Plan recommendations.

This timeframe and framework will provide a realistic opportunity for the City and its partners to fulfill the Plan's recommendations and achieve its vision.

Framework for monitoring the urban forest: Criteria and Indicators (C&I)

Putting Down Roots for the Future includes a target setting and performance assessment framework in the form of 30 Criteria and Indicators (C&I) intended to allow urban forest managers to identify where specific goals or targets have been met and when adaptations to management approaches may be necessary.

A C&I-based review of the urban forest management program in Ottawa was undertaken at the outset of the UFMP development process to examine the current status of the City's urban forest management program and to identify areas for improvement. This same assessment framework will be the primary tool used to assess the status of Ottawa's urban forest, level of engagement, and urban forest management program over the Plan's 20-year planning horizon.

The Criteria and Indicators and the findings of the primary assessment are outlined in detail in Appendix 2 and are referenced throughout the Plan.

Recommendations

Putting Down Roots for the Future provides 26 Recommendations for implementation over the Plan's 20-year horizon, which are organized under the plan's four topic areas. The recommendations have been developed with consideration of existing conditions in Ottawa's urban forest and the City's urban forest management program, an assessment of available resources, relevant best practices and precedents in the scientific and technical literature and in other jurisdictions, and input from consultations with City staff, internal and external stakeholders, and members of the general public. The UFMP recommendations are described in detail in Section 5 of the Plan, and are summarized in Appendix 5. The recommendations are listed in Table 1, below.

The periodic Plan review cycle built into the UFMP framework through the five 4-year Management Periods requires the review of recommendations and their associated priorities in response to future changes in environmental conditions, resource availability, or community values. This process (Recommendation #1) will ensure that *Putting Down Roots for the Future* remains a useful and practical strategic tool for many years to come.

Table 1: Summary of UFMP recommendations, Ottawa UFMP 2018-2037.

#	Summary of Recommendation	Lead[2]	Mgmt. Period
Urban forest management program structure and administration			
1[3]	Adaptive management	NSEP	All
2	Internal & External Working groups	NSEP	1
3	Urban Forest Inventory Collection & Maintenance	FMU	1
4	Urban Forest Canopy Study	NSEP	1
5	Asset Management	NSEP/ FMU	All
Planning for the urban forest			
6	Improve policy implementation through internal outreach and engagement	NSEP	All
7	Significant Woodlands	NSEP	1
8	Review of Tree By-laws: a. Municipal Tree By-law b. Urban Tree Conservation By-law c. Heritage Tree By-law	 FMU NSEP NSEP	1

[2] NSEP is the Natural Systems and Environmental Protection Unit of Planning, Infrastructure and Economic Development and FMU is the Forest Management Unit of Public Works and Environmental Services.
[3] Recommendations to be completed within the first management period are shaded in grey.

Table 1, cont'd: Summary of UFMP recommendations, Ottawa UFMP 2018-2037.

#	Summary of Recommendation	Lead	Mgmt. Period
9	Tree Planting and Establishment Guidelines: a. Greenfield Areas (Street Tree Manual) b. Existing Conditions c. Urban Hardscapes	NSEP FMU FMU	1
10	Outreach, enforcement, and monitoring of policies and by-laws	NSEP/ FMU	2
Maintaining and growing the urban forest			
11	Assumption of trees in new developments	FMU	1
12	Forested Areas Maintenance Strategy	FMU	1
13	Review City tree planting programs	FMU	1
14	Tree Compensation Guidelines	NSEP	1
15	Review lifecycle maintenance program	FMU	2
16	Assess maintenance for newly planted trees	FMU	2
17	Urban tree product utilization strategy	FMU	2
18	Assess tree risk management – City trees	FMU	2
19	Pest and Disease management strategy	NSEP/ FMU	2
20	Neighbourhood planting plans	FMU	2
21	Tree nursery stock growing contracts	FMU	2
Urban forest outreach, education, stewardship and partnerships			
22	Expand Community Engagement, public education	FMU	1
23	Outreach and engagement strategy	FMU	1
24	Incentives for tree conservation	NSEP	1
25	Neighbourhood stewardship plans	FMU	2
26	Outreach to tree care, landscaping, private and institutional landowners	FMU	2

1. Ottawa and its urban forest

1.1. Introduction

Ottawa's long and storied history begins centuries ago and reveals a long and evolving relationship with the area's forests. Algonquin peoples lived, hunted, traded and traveled in the Ottawa Valley at least 8,000 years before the arrival of Europeans in North America. In those times, the region would have been densely forested, and the Algonquins would have relied on these forests for shelter and sustenance.

By the early 1800s, the mature white pines which graced the forests would become central to the area's economic development. In these years, rafts of timber were a common sight on the Ottawa River, and the construction of the Rideau Canal ushered in a new era of urban expansion and economic development in Bytown. In 1855, Bytown was no longer a small settlement but instead a growing city, and was incorporated as the City of Ottawa on January 1st of that year. With Confederation in 1867, Ottawa became the new Dominion of Canada's official capital. While Parliament Hill remains largely unchanged since the early days of the Dominion, Ottawa has grown into a major Canadian city, and continues to grow.

The current City of Ottawa was formed in 2001 through the amalgamation of 11 urban and rural municipalities under one government structure responsible for delivering services to a population of over 960,000 (2015) residents living in an area of 2,796 square kilometres. Today, Ottawa is among the largest Canadian cities by area, and encompasses a highly-developed urban area, villages, large expanses of rural green space, and vast areas of prime agricultural lands and countryside. It is important to recognize that Ottawa is located on unceded territory of the Algonquin Anishinabeg people.

One of the qualities most cherished by Ottawa's residents is the city's proximity to nature and its green and open character. Residents enjoy a healthy and prosperous community, and the city's urban forest is one of the most important contributors to that high quality of life. As part of the city's green infrastructure, the urban forest is as important as engineered (or "grey") infrastructure in maintaining a healthy and livable community. The urban forest ensures that vital ecological services such as clean air, water and shade are sustained, and that such services will continue to be available to residents and visitors for generations to come. The urban forest also improves the physical and mental well-being of residents by supporting outdoor leisure and recreation, alleviating stress and anxiety, fostering creativity, and contributing to a sense of place.

However, Ottawa's urban forest will face increasing challenges in the coming years.

The City's population is projected to grow to over 1.14 million by 2031, an increase of nearly 20% above the current population. Climate change will present challenges for tree health and longevity as a result of more frequent and extreme weather events, while pests and other invasive species will continue to threaten the health of the urban forest. In order to sustain this vital community asset and to increase Ottawa's urban tree canopy, the protection and provision of adequate growing space for trees must become a high priority in infill areas and new greenfield communities alike.

Therefore, now is the time to develop and implement a comprehensive and strategic plan to increase Ottawa's urban tree canopy and ensure that Ottawa's urban forest is protected, maintained, and enhanced for today's residents and for generations to come. *Putting Down Roots for the Future*, a Term of Council Strategic Initiative for the City of Ottawa, is a 20-year Urban Forest Management Plan (UFMP) for the City of Ottawa that recognizes the value and importance of the city's urban forest and supports the community's commitment to the continued and improved stewardship of this valuable asset. The 26 Recommendations outlined in this Plan will enable the City to protect and manage existing trees more effectively, achieve greater success in tree establishment, increase the urban tree canopy, and engage the community in support of urban forest stewardship.

Ottawa – the local context

Demographics

Population (2015, estimated): 960,756
Population (2031, projected): over 1.1 million
Land area (urban): 617 square kilometres
Land area (total): 2,796 square kilometres
Major economies: Government, tourism, high-tech, finance/ insurance/real estate, trade, agriculture

Biophysical conditions

Plant hardiness zone: 4B
Forest region: Great Lakes – St. Lawrence mixed forest
Ecoregion: 6E (Lake Simcoe-Rideau)
Parkland: 1,037 parks (~3,500 hectares)
Open space: 9,501 hectares
National Capital Commission (NCC) Greenbelt: over 20,000 hectares
Potential urban forest canopy cover: Unknown

Sources: City of Ottawa website

Purpose

Putting Down Roots for the Future is meant to be used as a resource by City of Ottawa staff and Council, members of the community, and numerous other internal and external stakeholders. The Plan is intended to help all users better understand the range of policies, practices and standards which directly and indirectly influence Ottawa's urban forest. It is also intended, through implementation of the Plan's recommendations, to guide the City and its partners in working towards achieving the vision, objectives and targets established for the urban forest. The Plan highlights the challenges to urban forest health and sustainability, and provides solutions to strategically, proactively and effectively manage and grow this valuable asset.

Putting Down Roots for the Future is intended to be integrated into the implementation of all relevant City of Ottawa plans and strategies. Stemming from the City's Official Plan, the UFMP has clear and strong linkages to the Air Quality and Climate Change Management Plan, the Greenspace Master Plan, the Building Better and Smarter Suburbs initiative, the Environment Strategy, all Parks and Recreation manuals and plans, the Complete Streets initiative, the Infrastructure Master Plan, the Transportation Master Plan, and Ottawa Public Health's Mandate, among others. In addition, the principles and objectives of the UFMP are meant to be considered in all future City design, planning, social, policy, engineering, and construction initiatives and projects.

1.2. What is the urban forest?

The term 'urban forestry' was coined in the 1960s by Erik Jorgensen, commonly regarded as Canada's first urban forester. According to his definition, urban forestry: *"… is a specialized branch of forestry and has as its objectives the cultivation and management of trees for their present and potential contribution to the physiological, sociological and economic well-being of urban society. These contributions include the over-all ameliorating effect of trees on their environment, as well as their recreational and general amenity value."*

Urban forestry is synonymous with terms such as urban forest management and community forestry. It embraces the management of trees and associated biotic (living) and abiotic (non-living) components in large and small communities alike, and focuses on the provision of a wide array of benefits to urban society.

Ottawa's urban forest includes all of the trees, and their growing environments, within the City's urban boundary and urban expansion areas. The urban forest includes trees in parks and natural areas, along streets, and near waterways. The urban forest also crosses property and jurisdictional boundaries, and includes trees on private and institutional properties and on lands managed by various public agencies, including the City of Ottawa, National Capital Commission (NCC), the Federal and Provincial governments, and Conservation Authorities.

Figure 1 shows the Study Area for this Plan and important jurisdictional boundaries within the city. The Plan considers the urban forest within Ottawa's urban boundary, as defined by the City's Official Plan, and in the six urban expansion areas identified at the time this Plan was developed. Over time, as the urban area is further expanded, it is intended that the scope of this Plan will be extended to cover future urban expansion areas.

It is important to note that the City of Ottawa only has direct jurisdiction over City-owned land, but has policies and programs in place to help address urban forest opportunities and challenges on privately owned and institutional lands. The City does not have jurisdiction or direct influence on urban forest management on lands owned or managed by other governments and agencies, including NCC and Federal Urban Lands and the NCC Greenbelt (shown in Figure 1). As significant landowners in Ottawa, the Federal and Provincial governments and the NCC can significantly influence urban forest species composition, health and structure. Therefore, the NCC and the City continuously work together to develop shared goals and objectives for urban forest management and to implement strategies to achieve them collaboratively.

The urban forest management roles and responsibilities of various agencies and other significant landowners in Ottawa are described below.

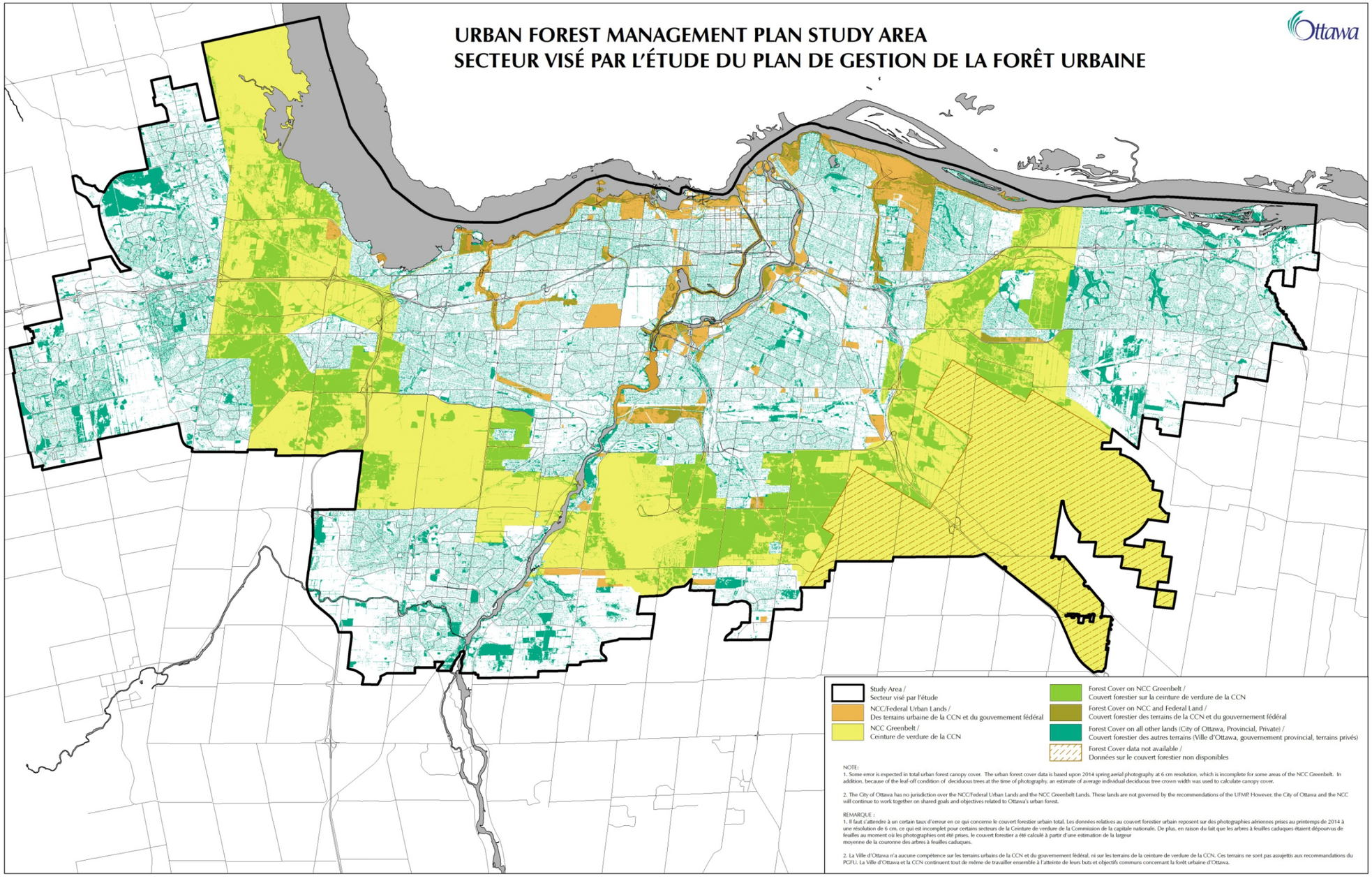

Figure 1: Urban Forest Management Plan study area.

1.2.1. City of Ottawa

In Ottawa, responsibility for managing the municipally-owned portion of the urban forest belongs to City of Ottawa staff in several departments, who are collectively referred to in this Plan to as 'urban forest managers'. Where legislation and policies allow, these urban forest managers may also have the ability to influence urban forest management on privately-owned lands or lands managed by other agencies. However, it is recognized that community members, private landowners, and other stakeholders have the primary responsibility for stewardship of the urban forest on such lands.

Street trees

The City of Ottawa manages over 148,000 street trees in the urban area. Street trees include trees growing in municipal rights-of-way, including trees in hardscapes (i.e., paved areas) in the urban core, trees in boulevards in residential areas, and trees along other roadways throughout the city.

Proactive management is required to help build the resilience of this group of trees and to maximize their health and longevity in this high-stress environment. Because these trees are often at the interface between public and private property, public education and engagement in their stewardship are also critical to their success.

The City maintains an inventory of municipal trees in the built environment, including those in the municipal rights-of-way. This street tree inventory was analysed at the neighbourhood level and for the City as a whole using the data available in September 2015. The approach and results of this analysis are provided in Appendix 1 and are discussed in various sections of this Plan.

Parks and open space

The City of Ottawa also manages thousands of trees in over 1,000 parks in the urban area, which are currently being added into the City's tree inventory system. Like street trees, trees in parks are a large and important part of the urban forest. Given the generally better growing conditions found in park settings than in the road right-of-way, these may be more suitable environments for site-sensitive species and may improve the chances of trees to reach their genetic potential. Trees in parks, especially in natural areas, provide significant environmental benefits, and their presence can also promote the use of urban green spaces and improve the health and well-being of urban residents.

Urban woodlands

Ottawa has many hectares of wooded natural areas interspersed throughout its urban area, and there are also extensive wooded natural areas within the NCC Greenbelt. Many of these woodlands are designated as Urban Natural Features, Natural Environment Areas, or Significant Wetlands through the City's Official Plan. Most of the designated Urban Natural Features (more than 2,100 hectares) are City-owned woodlands that provide numerous ecological and health services and serve as invaluable community amenities.

1.2.2. National Capital Commission (NCC)

The National Capital Commission (NCC) is a federal Crown corporation responsible for the planning, development, conservation and improvement of Canada's Capital Region.

The NCC owns over 10% of the lands in Canada's Capital Region, totalling 473 km^2, and 20% of the lands in the Capital's core. This makes the National Capital Commission the region's largest landowner. The NCC is also responsible for the management of the Greenbelt and Gatineau Park, and manages 15 urban parks and green spaces in the Capital Region. It owns 106 km of parkways in Ottawa and Gatineau Park, as well as more than 200 km of recreational pathways that are part of the Capital Pathway network. It manages 1,664 properties in its real estate portfolio. This includes 560 properties leased for residential, agricultural, institutional, recreational and commercial purposes.

Three master plans address the Greenbelt and the NCC's Ontario urban lands, all located within the study area of the City of Ottawa Urban Forest Management Plan.

- *Canada's Capital Greenbelt Master Plan*: This master plan applies to all Federally-owned Greenbelt lands and takes an integrated land use planning approach that incorporates ecological, economic and social factors. The primary role of the Greenbelt is to protect and enhance natural areas, ecosystems and habitats.

- *The Capital Urban Lands Plan:* This master plan provides planning direction and day-to-day management guidance for Federal property to support a shared vision to be implemented over the long term. The plan aims to reinforce urban vegetation cover and conserve the Capital's picturesque landscapes through the protection of urban trees and the enhancement of the Capital's cherished landscapes. The plan outlines the NCC's "Urban Tree Protection Policy", which recognizes the importance and value of urban trees and includes specific policy directions for enforcement of tree removal prohibitions, removal compensation

measures, indigenous species plantings, tree preservation planning and other measures to manage trees under the NCC's jurisdiction.

- *Canada's Capital Core Area Sector Plan:* The main purpose of the plan is to guide development, programming and transportation, and to promote environmental integrity and design quality on federal lands in the Capital's Core Area. The goal for the natural environment is to demonstrate leadership in the application of sustainable development practices within the Core Area.

The Plan for Canada's Capital 2017-2067 (PFCC), which will be officially launched on May 9, 2017, sets the planning direction that will carry the Region from 2017 to Canada's bicentennial in 2067. The regeneration of the Capital Forest is one of the projects identified in the PFCC. The NCC will develop a thirty-year capital program to regenerate the forests on Federal lands that have been degraded through urbanization and invasive species.

While the NCC plans do not specifically address cooperation and coordination with the City of Ottawa on urban forestry issues, it is anticipated that the NCC's demonstrated commitment to urban forest stewardship will be complemented by such efforts, and that existing relationships between the City and the NCC will be continued and enhanced. For example, there are agreements already in place whereby Forestry manages trees on certain NCC parcels. When required, Forestry collaborates with the NCC on projects such as ash tree removal or on other City or NCC projects where trees are present on NCC or City lands. When warranted, the NCC, Federal and Provincial governments are also circulated for feedback during the development review process.

1.2.3. Federal government

The Federal government is involved, to a limited degree, in urban forestry on a national scale. In addition to research support, the government monitors and controls the spread of invasive insect pests such as Asian long-horned beetle and emerald ash borer. These roles are fulfilled through Natural Resources Canada - Canadian Forest Service (NRCan-CFS) and the Canadian Food Inspection Agency (CFIA).

1.2.4. Provincial government

The Province of Ontario is a relatively small landowner in Ottawa, although some of its properties are treed and contribute to the provision of urban forest benefits. As with the Federal government, the direct involvement of the Province in urban forestry issues is relatively limited, leaving the majority of responsibilities to

municipalities. However, there are several Provincial statutes, policies and plans that affect municipal urban forest management. These include:

- *Electricity Act, 1998*: wherein S. 40(4) states, "A transmitter or distributor may enter any land for the purpose of cutting down or removing trees, branches or other obstructions if, in the opinion of the transmitter or distributor, it is necessary to do so to maintain the safe and reliable operation of its transmission or distribution system."

- *Endangered Species Act, 2007:* which identifies and protects species at risk, including butternut and other tree species.

- *Forestry Act, 1990:* which regulates aspects of forestry in Ontario and makes provisions pertaining to boundary trees.

- *Health Protection and Promotion Act, 1990*: which specifies mandatory health programs and services provided by boards of health.

- *Invasive Species Act, 2015:* which provides the power to make regulation prescribing invasive species and classifying them as either prohibited or restricted.

- *Municipal Act, 2001:* which establishes municipal powers. S. 135 allows any municipality with a population greater than 10,000 to regulate the injury or destruction of trees on public and private lands through tree by-laws, while S.135 to 146 provides the legal framework for such tree and site alteration by-laws.

- *Ontario Heritage Act, 1990:* which allows for the designation of heritage properties and cultural heritage landscapes, including trees on such lands that may have identified heritage value.

- *Planning Act, 1990:* which establishes a framework for municipal planning in the province. It empowers municipalities to develop Official Plans and regulate development, including requiring landscaping with trees and shrubs on the site (s. 41) and parkland dedication (s. 42, s. 51.1).

- *Provincial Policy Statement, 2014:* which provides guidance for land use planning, protection for significant woodlands, and encourages jurisdictions to integrate green infrastructure, including urban forests. Section 1.8 (Energy Conservation, Air Quality and Climate Change) states: "*Planning authorities shall support energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions, and climate change adaptation through land use and development patterns which: g) maximize vegetation within settlement areas, where feasible.*"

Provincial plans and standards which relate to urban forests include:

- *Ontario Invasive Species Strategic Plan, 2012*: which identify high-level strategies for management of invasive species.
- *Ontario Public Health Standards, 2009*: which provide direction to Boards of Health to promote healthy built environments and policies supportive of healthy communities.
- *Go Green: Ontario's Action Plan on Climate Change, 2007*: which sets a planting target of 50 million new trees in Southern Ontario by 2020, and provides funding for volunteer-driven tree planting projects.
- *Ontario's Biodiversity Strategy, 2011*: which sets out a framework for engaging people, reducing threats, enhancing resilience and improving knowledge in relation to indigenous biodiversity and ecosystems, including woodlands.

1.2.5. Conservation Authorities

Three Conservation Authorities (Rideau Valley, Mississippi Valley, and South Nation) undertake watershed-based management across lands in Ottawa. Pursuant to the *Conservation Authorities Act, 1990*, the Conservation Authorities have enacted regulations to control development and other alterations within wetlands, shorelines and other lands which may impact watercourses. They also implement programs such as reforestation, landowner engagement, public outreach, plan review and watershed planning.

1.2.6. Private property

Private lands include residential, institutional, commercial, and industrial properties. These lands make up approximately 40% of the urban area in Ottawa, if NCC Greenbelt lands are considered as part of the urban area under analysis. This portion increases to approximately 60% if NCC Greenbelt lands are excluded from the analysis. The extent of land area under private ownership and management presents a challenge to urban forest management and sustainability, but also an important opportunity for community engagement and stewardship.

On residential lands, the urban forest may be threatened through new or infill development. When such lands are developed, existing trees may be removed or their rooting environments may be encroached upon to accommodate buildings and infrastructure, leading to loss of urban forest cover. Residential property owners may also be unaware of the importance or need for tree care and maintenance, which may lead to tree decline, particularly under circumstances such as drought or

pest infestation. Residents on private lands may also unwittingly plant invasive species, which can adversely affect natural areas.

However, private residential lands also represent a significant opportunity for urban forest enhancement. Through improved public education and awareness, community led-initiatives such as neighbourhood tree inventories, and other programs to support private urban forest stewardship, opportunities to conserve existing urban forest canopy and establish more trees can be realized. Trees established in residential areas that grow to become large canopied specimens provide the entire neighbourhood with valuable services such as clean air, shade, cooling, and others.

Institutional lands, such as those owned and managed by hospitals, colleges or universities also represent an opportunity for urban forest stewardship and enhancement. Institutional property owners, who often manage large tracts of land that include open spaces, have a unique ability to establish, maintain and protect extensive forested and treed areas.

Employment lands and properties owned and managed by businesses are found throughout the urban area and vary widely in size. The urban forest challenges and opportunities encountered on these lands often relate to their size and function. For example, some business properties require large areas of paved surfaces to provide parking or fulfill other functions, which can restrict growing space for trees. However, established trees can screen and beautify buildings, provide outdoor amenity spaces for employees, and help visually integrate employment uses into communities.

Open grounds on school properties also present good opportunities for tree establishment and urban forest expansion due to large available growing areas and soil volumes. Trees provide important benefits such as encouraging active play and hands-on learning, reducing stress, and improving cognitive functioning. They also promote stewardship education, and provide direct health benefits from shading, cooling and air quality improvement. These benefits are recognized and promoted though the construction of natural playgrounds and outdoor classrooms, which are becoming increasingly popular and desirable features, demonstrating the importance and value of school properties as part of the urban forest.

Although generally publicly-owned and operated, schools are not managed by the City of Ottawa and have many priorities beyond establishing and sustaining trees on their properties. For example, concerns about safety may preclude the planting or retention of trees on school property, and woodlands in proximity to school grounds may also be perceived by some as safety concerns. These challenges can

be overcome through consultative tree establishment planning, education on the benefits of trees and natural environments in a school setting, and the support of partners to make trees and wooded natural areas part of Ottawa's school grounds.

1.3. Urban forest benefits

The benefits and services provided by the urban forest make critical contributions to the daily quality of life of those who live, work and play in Ottawa. An ever-increasing body of scientific and technical literature shows that trees and green spaces in urban areas provide direct and indirect benefits to human health, and can also help improve indicators of economic and social health and well-being. As is discussed in more detail in this section, the innate human-nature connection is a cornerstone of human health, and urban forests help to sustain that connection.

What is green infrastructure?

Green infrastructure is *"the natural vegetation and vegetative technologies that collectively provide society with a broad array of products and services for healthy living."*

- Green Infrastructure Coalition Ontario, 2014

The urban forest is a vital part of the City's green infrastructure, and is as important to the people, economy and environment of Ottawa as what is commonly referred to as "grey infrastructure" – the city's roads, buildings, utilities and other constructed elements.

However, investment in management of the urban forest is different from investment in grey infrastructure, which depreciates over time. As trees grow in size and their canopy and leaf area increases, the amount and value of the benefits and services they provide increases exponentially (Figure 2). This makes the urban forest one of the only municipal infrastructure assets that actually increases in value as it ages.

For example, a TD Economics special report (2014) about Toronto's urban forest confirmed that investments in tree maintenance can return more than $3 worth of benefits for every $1 spent, with only environmental benefits being accounted for[4]. A strategic approach to management as presented in this Plan will help ensure that the vital social, health, economic and environmental benefits provided by the urban forest are sustained and expanded over time.

Recognizing urban forest benefits in Ottawa's plans and policies

"Natural land in the urban area also imparts individual and community health benefits, including development of strong neighbourhood ties, environmental awareness among urban residents, and a sense of tranquility and well-being. At the same time, natural land improves water quality, air quality and carbon absorption, and generally mitigates environmental degradation in the urban environment, doing so efficiently and at a low cost."

-City of Ottawa Greenspace Master Plan (2006)

"Forests and wetlands provide major benefits to the community, including reduced hard infrastructure costs for water filtration and storage, additional cooling, and community liveability benefits."

"Adding climate change mitigation and adaptation values enriches the business case for land stewardship and securement, for the purposes of flood protection and cooling sinks, among others."

-City of Ottawa Air Quality and Climate Change Plan (2014) Appendix G: Risk Mitigation through the Protection of Natural Areas

[4] This study indicated that that each tree on average saves Toronto $5.28 in storm water interception, $1.87 in air pollution removal, $0.63 in energy savings related to cooling, $0.12 in carbon sequestration and $0.06 in reduced carbon emissions from climate moderation for a total of $7.95 per tree annually. In 2011, about $4.20 was invested in maintenance per tree in Toronto. Therefore, the environmental benefits alone far outweighed the investment.

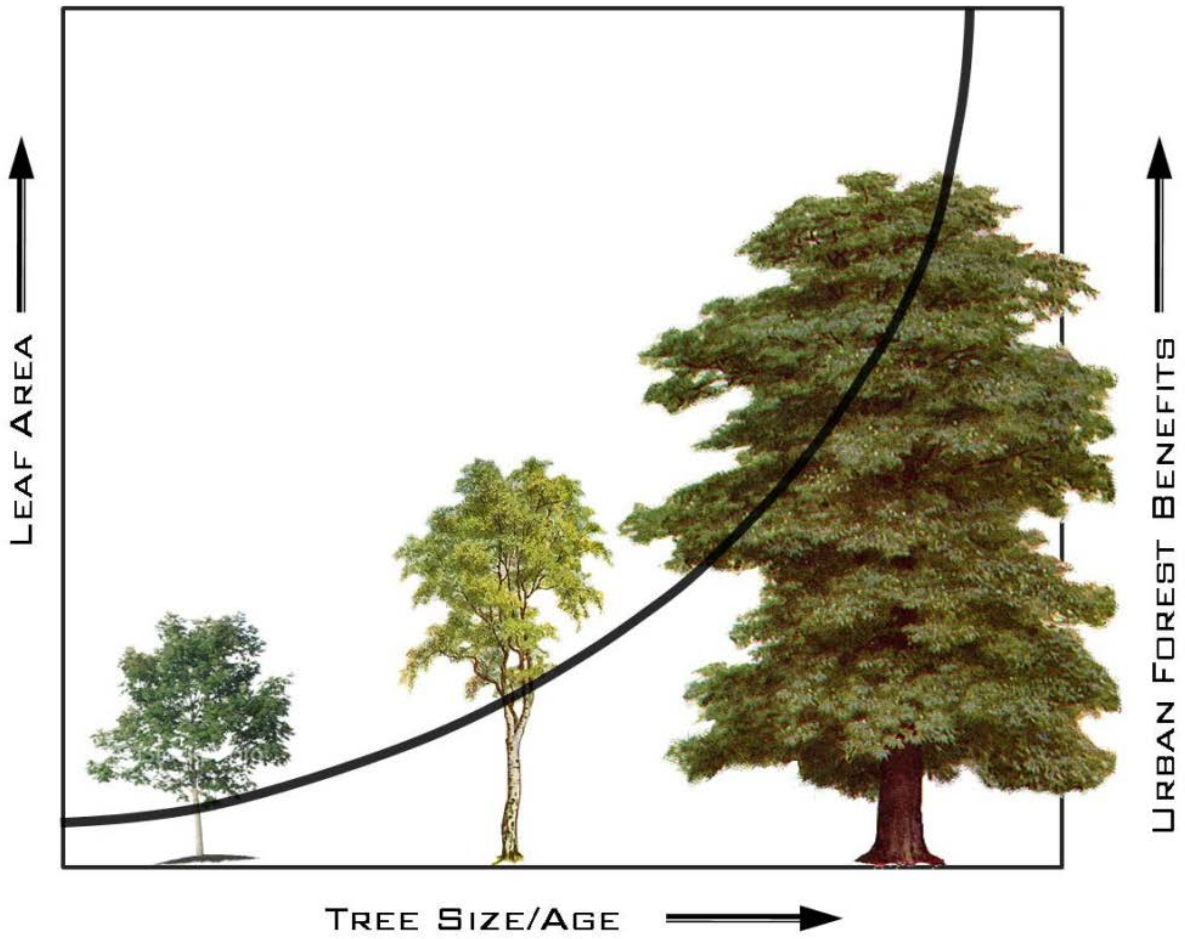

Figure 2: Social, economic and environmental benefits provided by the urban forest increase exponentially in quantity and value as tree size and leaf area increase.

According to the City's Environmental Strategy (2003), Ottawa's average annual temperatures have already increased by over 1°C in the past 40 years, and this warming trend is projected to continue (NRCAN, 2008). As a result of climate change, global average temperatures are anticipated to continue to rise in conjunction with adverse events, such as storms, drought, forest fires and heat waves, which are anticipated to increase in intensity, frequency and duration.

Because climate change is inevitable and ongoing, the global response must be two-pronged, and includes both mitigation and adaptation. Mitigation involves reducing emissions and stabilizing the levels of greenhouse gases in the atmosphere, while adaptation involves adjustment to expected future climatic conditions. As recognized in the City's Air Quality and Climate Change Management Plan (2014), the urban forest contributes to Ottawa's climate change mitigation and adaptation efforts. Urban trees contribute to climate change mitigation by capturing atmospheric carbon and storing it in wood, either temporarily until the wood decays

(carbon sequestration) or permanently in wood products (carbon storage). Large mature trees sequester and store exponentially more carbon than smaller trees – for example, trees greater than 75 centimetres in trunk diameter sequester more than four times as much carbon as trees less than 45 centimetres in diameter every year, and store nearly nine times as much. Through their cooling and shading functions, trees also lower demand for energy, thereby reducing emissions of carbon dioxide and air pollutants.

Perhaps more importantly, however, urban forests also help cities better adapt to urban environmental stressors such as air pollution, UV exposure, urban heat island effects, and flooding (see Section 1.3.3), which are exacerbated by climate change. Trees and forested spaces can even strengthen community resilience to climate change by promoting social interaction and building community stability.

Urban forests and climate change

The impacts of climate change are being felt in Ottawa and across the world, and the year 2015 was the hottest on record. According to the City's first Air Quality and Climate Change Management Plan (2004), Ottawa can expect more frequent freezing rain and heat wave events, increased precipitation, and other environmental stressors in coming years. These impacts will directly affect trees, which will incur greater drought stress, and wind or ice loading. This may result in increased tree mortality, structural failure, or susceptibility to pests or diseases.

However, maintaining and expanding the urban forest can play a role in urban climate change mitigation efforts. Urban forests can significantly lower the demand for seasonal heating and cooling, thereby reducing energy use and greenhouse gas emissions. Urban trees can also sequester and store atmospheric carbon, a major greenhouse gas.

Urban forests are also a vital climate change adaptation tool for cities. By providing services such as shading, microclimate cooling, and stormwater and pollutant capture, urban forests make climate change-affected cities safer and more comfortable places to live.

Figure 3: Urban forest benefits (LEAF, 2015).

1.3.1. Health and social benefits

Urban forests improve the physical, mental and social well-being of urban residents. Some of the vital health and social benefits provided by urban forests include:

- Improving physical health and well-being
- Improving mental health and cognitive functioning
- Increasing social cohesion and strengthening communities

A comprehensive review of the public health value of urban trees and green spaces, prepared by Ottawa Public Health, can be found in Appendix 3.

Improving physical health and well-being – When urban design incorporates green space and trees, cities can be healthy, vibrant places to live. Studies suggest that urban residents in proximity to green areas and trees enjoy better long-term health outcomes and greater longevity than residents without access to such features.

The ways in which urban forests promote health are wide-ranging. Urban forest health benefits stem from both direct functions, such as removal of air pollutants, shading (and UV protection) or food production, and indirect influences, such as promotion of outdoor activities and walkability, or reducing the perceived severity of stressful life events.

Numerous studies demonstrate the direct correlation between trees and urban forests and improved human health. Various findings suggest people recover from surgery more quickly, are more likely to undertake physical activity such as cycling or walking, have lower blood pressure and rates of sun exposure-related diseases (such as skin cancer and cataracts), and even have higher anti-cancer cell activity, when provided with regular access or views of urban natural areas, trees or other vegetation.

Urban forests and human health

The link between urban forests and human health is becoming increasingly recognized by the public health and medical communities. In the United States, the National Environmental Education Foundation (NEEF) works with doctors to promote the concept of "Prescriptions for Outdoor Activity", especially for children with health issues such as obesity and asthma. The Healthy Active Living and Obesity Research Group (HALO) at the Children's Hospital of Eastern Ontario (CHEO) is currently researching the linkages between active play in nature and the outdoors and child health and wellbeing. The City of Santa Fe, New Mexico, manages a series of "prescription trails", specifically designed to promote healing through access to natural areas, while in Japan the concept of "shinrin-yoku", or "forest bathing" has been a cornerstone of preventive healthcare and healing for decades. In Europe, the concept of "green care" has been adopted by many healthcare practitioners as a key part of a multi-faceted approach to healthcare. These initiatives, and many others around the world, demonstrate the real and valuable links between urban forests and other natural features and human health and well-being.

Improving mental health and cognitive functioning – In addition to being potentially challenging for physical health, urban life can lead to adverse mental health outcomes such as stress, depression, and poor cognitive functioning. Similarly to their positive effects on physical health outcomes, urban forests can benefit mental health.

Among urban nature's most important contributions to improved mental health is its restorative function. Ulrich (1991) found significant positive effects upon stress reduction among subjects exposed to a natural setting within just 5 to 7 minutes.

Urban nature can also encourage calmness, learning, inquisitiveness and alertness, and improve creativity and cognitive function through attention restoration (Berman et al., 2008).The importance of urban nature to improved mental restoration and function has also been studied among children. For example, one study (Taylor et al., 2001) conducted in Chicago among children with Attention Deficit Disorder (ADD) found that reported symptoms were milder for children with access to green play settings. Nordh et al. (2009) found that the number of trees visible from a given point of view was among the most important components of small urban parks that positively affected mental restoration.

Increasing social cohesion and strengthening communities - Community cohesion and social equity are important components of vibrant, sustainable communities. Increased social interaction among community members may lead to desirable outcomes such as environmental and community stewardship and engagement in civic life, volunteerism, and improved public health (Sullivan et al., 2004). Research suggests that urban green spaces and natural areas can provide areas for people to come together, and that people tend to prefer natural or green settings over hardscaped spaces for outdoor social interactions (Kuo et al., 1998). Other studies have reported significant positive correlations between green spaces and increased social interaction, reduced fear, and lower incidence of crime.

Protecting against UV rays, wind and noise – Communities that are designed with shade trees provide residents with shelter from the sun and decreases health risks associated to sun exposure (Canadian Cancer Society, 2014). Trees planted strategically can buffer the effects of wind, reducing wind tunnels and wind chill during winter. The Forest Commission from the United Kingdom states that trees planted in dense wide belts in soft ground have the potential to reduce noise by 50%.

1.3.2. Economic benefits

The management and maintenance of urban forests requires a significant expenditure of capital and human resources to cover the costs and complexities of planning, operations, community engagement and a range of other activities. However, urban forests also provide valuable and tangible economic benefits which have been shown to outweigh thesecosts and represent a positive return on investment.

Some of the important economic benefits provided by urban forests include:

- Increasing residential and commercial property values
- Increasing local economic activity
- Reducing energy use demand and cost
- Reducing healthcare costs
- Reducing infrastructure maintenance cost

Increasing residential and commercial property values – Mature and healthy trees can significantly increase the value of residential and commercial properties. Trees in yards, and even neighbouring street trees, have been shown to add between 3% to 15% to residential property values when comparing otherwise similar treed and non-treed properties (Wolf, 2007). In Ottawa, this translates to over $55,000 of property value for an average house. Houses with trees on or near the property also sell faster, according to one study (Donovan and Butry, 2010). Similarly, high-quality landscapes with mature trees can increase average office rental rates by up to 7% over similar properties without attractive landscape features. These figures reflect the tremendous value trees have for home and office owners alike.

Increased local economic activity – The presence of well-maintained, mature and healthy trees increases the visual quality of urban landscapes, including commercial areas and business districts. This can directly boost economic activity in such areas, and consumers are willing to travel farther and more often to, and spend more time and money in, well-treed and attractively landscaped shopping areas. Studies have found that consumers may be willing to pay, on average, up to 12% more for goods and services in well-treed business districts (Wolf, 2007).

Reducing energy use demand and cost – Energy use to cool and heat buildings represents a significant cost for Ottawa's residents. Well-situated trees, such as conifers on the north side or deciduous trees on the west side of buildings, can

significantly reduce the energy demands associated with heating and cooling by providing windbreak or shading functions. This translates to immediate and important energy cost savings for homeowners and businesses, and also reduces emissions and energy usage associated with electricity generation. One study found household energy usage for heating and cooling was reduced by up to 25% in homes surrounded by well-placed trees, compared to similar houses without trees (Heisler, 1986).

Reducing healthcare costs – Urban forests are associated with reduced stress and improved physical health for urban residents, and the benefits to public health of maintaining and expanding the urban forest are potentially significant. For example, one study (Ulrich, 1984) found that exposure to trees significantly reduced recovery time from surgery, demonstrating healthcare cost reductions related to the urban forest. A recent study (Donovan *et al.*, 2013) found a correlation between the loss of ash trees due to emerald ash borer and an increase in cardiovascular illness and mortality, clearly demonstrating the positive health benefits and cost savings of trees. Air quality-related illnesses were predicted to cost Ontario over $4.3 million in 2015 alone (NICAP, 2008); such costs could potentially be reduced through the air quality improvement function of healthy trees in urban forests.

Reducing infrastructure maintenance costs – It is commonly acknowledged that poorly situated or insufficiently maintained trees can cause damage to infrastructure, such as public utilities or sidewalks. However, the positive contribution of trees to prolonging the service life of some types of infrastructure is often overlooked. For example, properly planted and well maintained trees can reduce the required maintenance frequency of UV and heat-sensitive infrastructure, such as roadway asphalt, thereby reducing lifetime maintenance costs by up to 60% (McPherson and Muchnick, 2005). Trees have a similar positive effect on structures such as playgrounds, slowing the breakdown of plastics and making children's play areas safer and longer-lasting. By absorbing rainwater, urban forests can also slow stormwater runoff and reduce pressures on storm sewer systems and watercourses. Currently, the ability to fully quantify tree-related reductions in urban infrastructure maintenance costs is limited, and trees are often perceived as detrimental. As the body of scientific and technical literature about urban trees continues to grow, these significant benefits will become more readily apparent and will further support the integration of trees into urban environments and infrastructure networks.

Trees feed people and wildlife

Fruit and nut trees provide food for humans, birds, other wildlife, and even soil. Stewardship of this annual abundance of serviceberries, cherries, pears, apples, hazelnuts, black walnuts and other foods is part of many local cultures.

Since 2012, Hidden Harvest Volunteers have held harvest events to rescue local fruit and nuts from more than 770 trees in Ottawa. The food was shared with more than 37,000 people through the group's partnerships with community food banks, community food programs, local food processors, restaurants and craft breweries.

Hidden Harvest Ottawa's motto is "pick, share and take good care".

- *Provided by Hidden Harvest, 2017*

1.3.3. Environmental benefits

The environmental benefits provided by urban forests make Ottawa a more liveable, safe and healthy community. Some of these benefits include:

- Reducing air pollution and improving air quality
- Cooling the air and reducing the urban heat island effect
- Reducing flooding and improving water quality
- Providing wildlife habitat and ecosystem connectivity

These benefits help urban areas mitigate and adapt to climate change impacts, such as longer periods of heat and drought or more intense storms that can result in flash flooding. Humans, wildlife, and ecosystems benefit greatly from urban forests.

Reducing air pollution and improving air quality – Ottawa's air quality is generally considered good, and average levels of a wide range of air quality indicators typically fall below World Health Organization (WHO) guidelines for maximum concentrations. However, some 500 premature deaths are estimated to occur per year in the Ottawa-Carleton census district due to air quality issues (Ontario

Medical Association, 2008), and Ottawa is situated within the Windsor-Quebec City industrial corridor, which is the most polluted in Canada.

Urban forests are among the most efficient and cost-effective air-cleaning mechanisms available in urban areas to reduce harmful concentrations and effects of air pollutants such as nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), and particulate matter of 10 microns or less (PM_{10}).

Cooling the air and reducing the Urban Heat Island effect–Average temperatures in urban areas can be several degrees higher than in less built-up areas. This phenomenon is termed the Urban Heat Island effect, and occurs when grey infrastructure in urban areas absorbs sunlight and reradiates it as heat (Figure 3).Climate change is expected to exacerbate the Urban Heat Island effect as average temperatures increase. In Ottawa, projected population growth and related residential and commercial development will also likely increase the Urban Heat Island, both in extent and intensity.

Trees provide substantial cooling benefits (heat and humidity control) in urban centres, particularly when planted in groups and situated with consideration of shading patterns and air flow. For example, one study in Toronto (Slater, 2010) found that well-treed parks can be up to 7°C cooler than surrounding streets. Another study (Coutts and Harris, 2012) found that large-canopied trees are effective at cooling wide urban streets and that trees planted in medians can effectively lower road surface and neighbourhood air temperatures.

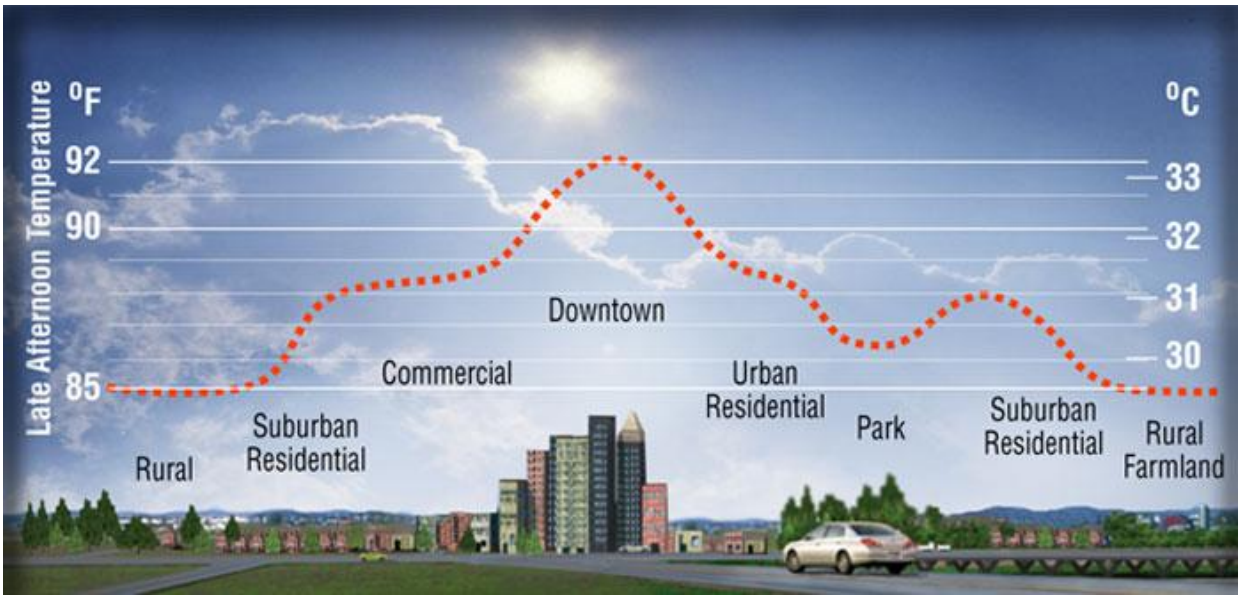

Figure 4: The Urban Heat Island effect. Source: Berkeley Lab Heat Island Group, 2016.

Reducing flooding and improving water quality – Urban areas are characterized by large areas of impermeable surfaces, low rates of water infiltration into soils, and grading designed to channel runoff to storm sewers and watercourses rather than retaining water on-site. Managing water quality and volume in urban areas is a significant challenge. As rainfall runs over hard surfaces, it accumulates pollutants such as oils, heavy metals and fertilizers. Water quality in urban streams and other waterbodies is frequently degraded as a result of high pollutant and sediment loading and increased temperatures. These conditions can adversely affect habitat for aquatic invertebrates and fish and make waters less suitable for recreation and consumption. During significant rain events or spring runoff, water flow can overwhelm drainage infrastructure and cause erosion, flooding, and combined sewer overflows, which further impact water quality.

Urban forests can protect and improve water quality and help to reduce stormwater runoff, erosion and flooding. Soils with tree root activity are more pervious than compacted soils or hard surfaces, and absorb more water before it reaches storm sewers or causes surface flooding. Trees also intercept rainfall in their canopies and on their trunks, slowing its course towards drains and waterbodies and reducing the likelihood that these systems will be overwhelmed or fail. In urban Ottawa, expanding and improving the health of the urban forest, in conjunction with increasing use of Low Impact Development (LID) measures, will improve water quality in the Ottawa and Rideau rivers and the Rideau Canal, reduce flooding, and improve habitat for aquatic wildlife. In June 2016, Ottawa City Council approved the City's Water Environment Strategy to protect the health of the City's waterways, wetlands and groundwater and to reduce the impacts of human activity. The Strategy recognizes the importance of forest cover in protecting water quality, supports the implementation of Ottawa's Urban Forest Management Plan, and identifies increasing forest cover as a strategic initiative.

Providing wildlife habitat and ecosystem connectivity – Alteration of forest cover and replacement of natural ecosystems with urban landscape features represents one of the greatest threats to global biological diversity (Lerman *et al.*, 2014). While urban forests are often diverse in plant species, wildlife species richness typically declines in urban areas (Faeth *et al.*, 2011).

However, with good planning, urban forests can provide important habitat for diverse flora and fauna, particularly by improving and increasing connectivity between ecological features (Fernandez-Juricic, 2000). Improving connectivity can increase the abundance and diversity of fauna such as migratory birds, mammals and invertebrates such as butterflies. Urban wildlife habitat has intrinsic value, and also enables urban residents to more closely and frequently interact with nature, contributing to psychological well-being and a more liveable community.

1.4. Urban forest challenges and opportunities

Ottawa's urban forest faces constant and significant challenges from a wide range of stressors and factors. Significant challenges to Ottawa's urban forest include:

1. Invasive species, pests and pathogens
2. Land use change and development
3. Difficult growing conditions in urban environments
4. Cumulative tree loss on private property
5. Limited community awareness and engagement
6. A need for better integration among City staff and others whose work can impact the urban forest.

Strategic urban forest planning and management is needed to respond effectively to these threats and challenges if the benefits provided by Ottawa's urban forest are to be sustained and enhanced.

These challenges, and opportunities to respond to the threats they pose, are discussed generally below and more specifically in relation to Ottawa in Section 4.

1.4.1. Challenge: Invasive species, pests and pathogens Opportunity: Proactive urban forest health management

Invasive species are any plants or animals whose introduction or spread may threaten or adversely affect the environment, economy or society, including human health. Invasive species are considered the second most significant threat to global biodiversity after loss and degradation of habitat. While invasive species are usually introduced from elsewhere by accident, they may also be indigenous to the local area but may, through influences such as habitat degradation or climate change, develop invasive tendencies.

In the urban forest, invasive species may outcompete indigenous species for habitat or resources. For example, plant species such as Norway maple or common buckthorn can crowd out indigenous vegetation. Invasive insect species, such as the emerald ash borer, Asian long-horned beetle or gypsy moth, can cause widespread devastation by killing large populations of trees. Tree diseases (pathogens) can have similarly devastating effects upon the urban forest.

The challenge of controlling and responding to invasive species, pests and pathogens is becoming increasingly urgent for urban forest managers. Trees in urban areas are often more susceptible to such threats due to the challenging growing conditions they experience, such as drought or compacted soils. The effects of pests and pathogens may be further compounded by factors such as limited tree species diversity, use of low-quality nursery stock, or generally inadequate tree maintenance practices. Cumulatively, these factors make the urban forest more susceptible to invasive species, pests and pathogens.

Ottawa is currently experiencing the effects of perhaps the most costly and damaging urban forest pest in living memory – emerald ash borer (EAB). Since its discovery in the city in 2008, this invasive wood-boring beetle has already killed or forced the removal of tens of thousands of ash trees across Ottawa. As much as 25% of the city's tree population is composed of ash species, and the loss of these trees is having an obvious and significant adverse impact on streetscapes, parks and wooded natural areas.

The most effective response to the threat posed by invasive species and urban forest pests and pathogens is a multi-tiered approach to their management. This approach must combine proactive management, such as increasing urban tree species diversity, regular pest monitoring and early detection, adaptation to biological invasions, and promotion of overall urban forest health, with the necessary reactive actions such as tree removal, replanting and, when required, pest and pathogen control. Building resilience through tree species diversity and tree health will reduce the urban forest's potential susceptibility to these threats, while developing strategies to manage these issues before they arise will ensure that the necessary actions and resources are implemented early, when the chances of successful management are greatest. Effective invasive species and pest management may require considerable investments of effort and resources. However, failure to make such investments may result in wide-scale species loss, environmental degradation, and significant social costs if invasive species, pests or pathogens proliferate and the urban forest is degraded.

Specific recommendations to address this challenge in Ottawa are provided in Recommendations #12, #16 and #19, found in Section 5.

1.4.2. Challenge: Land use change and development Opportunity: Commitment to tree retention, protection, and establishment

In Ottawa's urban area, as in most urban municipalities, land use changes associated with development present one of the greatest threats to the protection, establishment and growth of the urban forest. As more of the city is converted to residential, commercial, industrial and institutional uses, along with related expansions in transportation and servicing networks, it becomes increasingly difficult to protect remaining trees and woodlands and to find adequate and appropriate space to plant and restore these assets.

Above ground level, trees compete for growing space with buildings, utilities, transportation infrastructure, and people. In addition, grading for site development may damage existing trees or adversely alter soils and drainage patterns, making tree protection and establishment difficult. Urban intensification, which seeks to move the focus of new residential and commercial development to existing built places, can leave less space for mature and large-growing urban trees as building lot and infrastructure density are increased.

Below ground level, tree roots must compete for space with utilities and building foundations, while soils designed to support above-ground infrastructure are often too compacted to provide the water, air and nutrients required by trees. In addition, grading for site development may damage trees or adversely alter drainage patterns. Trees must also contend with maintenance activities such as de-icing salt application or infrastructure repair, which can be harmful and injurious.

Development-related land use change can, however, also present opportunities for both the integration of existing trees and woodlands, as well as tree establishment. This requires:

- a multi-disciplinary approach that includes operational considerations to ensure that spaces planned for tree protection and establishment provide the space, conditions and care to support tree growth to maturity and beyond
- securing space and other habitat needs for trees (e.g., sufficient soil volumes) early on and throughout the planning process;
- protection of significant treed natural areas (including mature woodlands/forests) and hazard lands through the planning process;

- commitment by the City and all its partners to protecting, sustaining and enhancing Ottawa's urban forest;
- genuine recognition and understanding of the value brought to a community through the integration of trees and woodlands; and
- a willingness among both the City, the development community and other partners to engage in creative planning, including the acceptance of alternative design standards, that support maximizing opportunities for both tree conservation and establishment while still addressing other planning and development objectives.

Specific recommendations to address this challenge in Ottawa are provided in Recommendations #6, #7, #10 and #24 found in Section 5.

1.4.3. Challenge: Urban conditions Opportunity: Designing for the urban forest

Even if efforts are made to provide suitable growing conditions for trees, urban environments are far removed from the natural forest conditions where trees thrive. Urban environments are characterized by degraded and compacted soils, altered moisture regimes, little or no natural regeneration, and substantially reduced biological activity. Urban conditions stress trees by depriving them of moisture, air and nutrients and exposing them to high heat, pollutants or vandalism. Climate change, which is already being experienced in Ottawa and across the globe, will further compound these environmental stressors.

Officials, planners, engineers and everyday citizens are increasingly recognizing the value of trees as green infrastructure, but more needs to be done to ensure urban spaces are designed with trees in mind. Too often, trees are an afterthought in the urban design process, or their needs are not well understood or planned for. In recent years, however, great strides have been made in the development of design and construction methods and materials that enable the successful integration of trees as long-term components of urban landscapes. Success requires the provision of adequate above and below-ground space, adequate volumes of good quality soil, and effective irrigation and drainage solutions within the tree rooting zone.

Ottawa will need to explore and undertake innovative approaches to site design, on varying scales, if the urban forest is to be sustained and expanded. Fortunately, as the city continues to grow and develop, new opportunities for innovation and tree-friendly design will arise in new communities, infill sites, public spaces and urban

streetscapes. Capitalizing on these numerous opportunities will be the key to a healthy, resilient and sustainable urban forest.

Specific recommendations to address this challenge in Ottawa are provided in Recommendations #6 and #9 found in Section 5.

1.4.4. Challenge: Tree loss on private property
Opportunity: Tree preservation on private property

The loss of trees, particularly mature trees, is considered a significant concern by many in the community. Mature trees provide exponentially more benefits and services than smaller trees, and are therefore often a more greatly appreciated and more highly valued asset by the community. Although evidence is anecdotal, the perception is that mature trees in Ottawa's urban areas are being removed, sometimes indiscriminately and without appropriate provisions for the replacement of the lost canopy.

Some tree loss, including some mature tree loss, is unavoidable as urbanization and intensification proceed. However, there a number of tools can be used to limit this loss. These include by-laws regulating the disturbance or removal of trees (both individual trees and in woodlands), outreach and education about the value of mature trees, and incentives for mature tree protection. The City of Ottawa already has a number of these tools in place, as described in Section 4.2.

Specific recommendations to address this challenge in Ottawa are provided in Recommendations #6, #7, #8 and #10 found in Section 5.

1.4.5. Challenge: Limited community awareness and engagement
Opportunity: Improving awareness and engagement

In most municipalities, a large portion of the urban forest is located on private lands. For example, 60% of the urban forest in the City of Toronto is on private property (City of Toronto, 2013). This figure appears to be consistent for many urban municipalities (e.g., Oakville 57%; London, England 57%). If the NCC and other federal lands are excluded from the urban area analysis, approximately 60% of Ottawa's urban area is also privately-owned. It can therefore be assumed that the majority of benefits generated by Ottawa's urban forest are associated with private property and NCC Greenbelt lands.

Community engagement related to the urban forest in public parks, at schools and along streets is important and a number of programs are already in place to support these efforts (see Section 4.4). Programs to engage citizens in stewardship on private lands are less well-developed. This is a challenge as most neighbourhoods in Ottawa (as in other municipalities) do not have established organizations or programs to support a coordinated and strategic effort to sustain or enhance the urban forest on private lands.

Given the importance of private lands to the urban forest, the management approach must incorporate the direction from the Official Plan and expand awareness and engagement related to the urban forest by investing in a range of tools and strategies. These should include developing Ottawa-specific, informative and engaging urban forest materials; directly and indirectly supporting private land urban forest stewardship initiatives; and seeking out new partnerships and innovative approaches to achieving the vision laid out in this UFMP. Awareness and engagement programs and initiatives should seek to engage community groups, large and small landowners, the development community and local decision-makers in urban forest stewardship.

Specific recommendations to address this challenge in Ottawa are provided in Recommendations #2, #22, #23, #25 and #26 found in Section 5.

1.4.6. Challenge: Need for integration
Opportunity: Building internal and external partnerships

There are many diverse stakeholders in the city who manage property that supports or could support parts of the urban forest. Similarly, there are many organizations, agencies and departments within the City administration and beyond that have an influence on the urban forest or a stake in the sustainability of the benefits provided by the forest.

The City is directly responsible for trees along roads and in parks and open spaces. Hydro Ottawa prunes more than 40,000 trees each year as part of its regular maintenance program (Hydro Ottawa, 2016) and the Ministry of Transportation maintains major roads and rights-of-way through the city, many of which are lined with trees or have the potential to contribute to the city's canopy. The presence of the NCC creates a unique situation among Canadian municipalities, with 35% of the City's urban area on NCC or other Federal lands.

Ottawa's municipal departments, the agencies mentioned above, private contractors and citizens are all directly involved in decision-making, funding and management processes that affect the health, structure and function of the urban forest. Communication, coordination and common direction among these parties can be challenging but are critical to realizing urban forest sustainability and implementing effective management programs and practices. Formal and informal partnerships must be put in place to ensure that the vision and objectives for the urban forest, as outlined in this Plan, can be realized. These partnerships must be established and sustained to facilitate the exchanges of ideas and concerns with all major activities within the city that will have an impact on the urban forest.

Specific recommendations to address this challenge in Ottawa are provided in Recommendations #2, #23 and #26 found in Section 5.

2. Urban forest management planning

2.1. Context and background

Ottawa's urban forest is fundamental to the city's social, economic, public and environmental health and sustainability. The city's trees and associated components of the urban forest provide numerous valuable benefits and services. The City recognized the importance of a strategic approach to sustaining these benefits by identifying the development of an "Urban Forest Management Strategy" as a Strategic Initiative in the Term of Council Strategic Plan for 2015-2018. A strategic approach to urban forest management will ensure that these benefits are sustained and maximized and that urban forest management resources are invested and spent wisely and effectively.

Forest ecosystems are complex and the processes of tree regeneration, growth, decline, death and decay are all part of a functioning natural forest. When the complexity of forest systems is envisioned within the built environment, the survival and growth of trees becomes more challenging. Some natural tree mortality due to animal browse, diseases, insects and weather events is generally acceptable in natural woodlands, where there is also natural regeneration, but comparable levels of loss among trees outside of natural areas in the urban forest are generally unacceptable, particularly when tree establishment costs are high and suitable planting sites are limited. As trees in the natural forest begin to decline and eventually die they continue to contribute as habitat and through nutrient cycling as standing or down woody debris. In the built environment, these processes are seldom tenable because of concerns about aesthetics and risk management.

Trees and forests are remarkable in their resilience and adaptability for change, but most trees in the urban forest (including those within wooded natural areas) require special planning, management and stewardship that considers their protection, maintenance, replacement and integration into the built environment. Investment in this valuable asset is essential to sustaining it, and as discussed in Section1.3, this investment has been shown to yield good returns in the form of both quantifiable and immeasurable benefits to City residents, visitors, and the broader environment. These benefits will become increasingly important as Ottawa's population continues to grow and the challenges of a changing environment become more pressing.

2.2. Plan structure

Ottawa's UFMP is based on a twenty-year planning horizon (2018 to 2037). This timeframe will ensure that the critical components of the Plan, including its vision, guiding principles, objectives, targets, and recommended actions, are carried forward to inform the City's urban forest management program even if the technical aspects of urban forest management change or new challenges to the urban forest arise. This timeframe will also provide a realistic opportunity for the City and its partners to realize the Plan in its entirety.

This UFMP is based on a three-tier strategic planning framework. This framework has been successfully applied to urban forest planning by numerous other communities in Ontario and beyond, and enables effective linkages between high-level strategic directions and day-to-day forest management activities. The Plan framework is described below and illustrated in Figure 5.

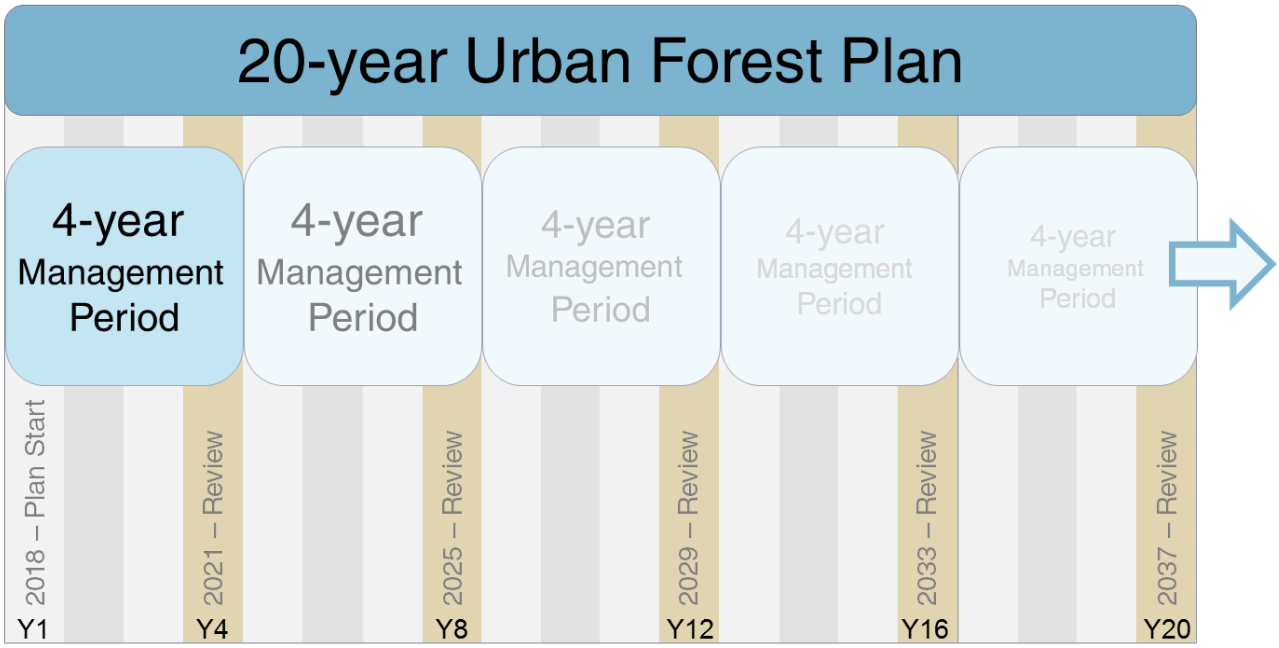

Figure 5: Three-tier urban forest management planning and implementation framework.

2.2.1. Tier 1: 20-year Strategic Plan

The top tier of the UFMP outlines the long-term vision, guiding principles, strategic objectives and targets to be realized over the twenty-year horizon of the UFMP. These Plan elements have been developed with consideration for input from community members, City staff and other stakeholders, and guide the Plan's critical analyses and the development of recommended actions.

The 20-year strategic plan also reviews current practices in Ottawa in relation to several key topic areas, and examines best practices found in the scientific and technical literature. Tier 1 of the Plan identifies high-level opportunities to improve Ottawa's urban forest management practices, programs and policies in a way that is appropriate for the City's context and consistent with its long-term vision for the urban forest.

Topics in *Putting Down Roots for the Future*

The UFMP for the City of Ottawa addresses the following topic areas:

- **Urban forest management program structure and administration,** which reviews how the City administers the delivery of various urban forest services and programs and how the City manages its tree inventory systems
- **Planning for the urban forest,** which reviews how land use and planning policies and practices affect the urban forest
- **Maintaining and growing the urban forest,** which reviews how urban forest maintenance is undertaken, and reviews tree planting and establishment programs and policies
- **Urban forest outreach, education and stewardship,** which reviews how existing and potential partnerships can be leveraged to enhance community awareness and support of the urban forest

Section 4 of the plan is organized to address each of these topic areas, and identifies current practices in Ottawa and opportunities for improvement related to each. Recommendations are provided in Section 5 and are also organized by these topic areas.

2.2.2. Tier 2: 4-year Management Periods

The second tier of the UFMP is a series of five 4-year management periods, which outline the action-based, prioritized recommendations intended to be implemented during the assigned management period. Dividing the Plan into five periods allows for the Plan to be reviewed by City staff in every fourth year of implementation and updated in response to new or changing objectives, implementation successes and shortcomings, and changes in conditions, resources or threats.

The recommended actions provided in Section 5 of this Plan are prioritized by Management Period with the understanding that these priorities may need to be adjusted as part of the adaptive management process.

2.2.3. Tier 3: Annual Operating Plans

Annual operating plans will be developed for internal use by City staff to provide applied and specific guidance for day-to-day operations in a given year. They will include operational plans for tree planting, pruning, removal, inspection, and other maintenance activities, as well as initiatives such as public engagement and outreach.

2.2.4. Spatial scope of the Plan

This Plan recognizes that the challenges to urban forest sustainability and the City's ability to influence urban forest management are greatest in the urban areas. Therefore, *Putting Down Roots for the Future* focuses on the urban forest within the urban boundary of Ottawa, as defined by the City's Official Plan, and the six urban expansion study areas – a total of approximately 617 square kilometres. This includes the urban area within the Greenbelt, as well as the South, West and East suburban areas, including Orléans, the East Urban Community, Leitrim, Riverside South, Barrhaven, Stittsville, and Kanata (Figure 1). Although the Plan has not been developed for the rural area and villages of Ottawa, some of the strategic directions and recommended actions in this Plan may also apply to Ottawa's rural areas and villages.

The City of Ottawa's jurisdiction is limited to its own lands and lands it is able to influence pursuant to enabling legislation. While lands under the jurisdiction of other governments or agencies are also described and considered in this Plan, the ability to influence the urban forest on such lands is limited.

2.3. Monitoring

Putting Down Roots for the Future recommends actions to be implemented throughout the planning horizon of twenty years. While several recommendations in the Plan prescribe specific measurement and monitoring actions, a comprehensive approach to monitoring and assessing the overall status of the urban forest and the Plan itself is also required. This approach is described in Sections 2.3.1 and 2.3.2 and includes active adaptive management, regular Plan review, and a Criteria and Indicators-based assessment.

2.3.1. Active adaptive management and plan review

What is Active Adaptive Management?

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

- United Nations Millennium Ecosystem Assessment, 2005

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

In keeping with the principle of active adaptive management, the status of the implementation of the Plan's recommendations should be formally reviewed at the end of each management period and findings should be incorporated into the subsequent management period. This review should be undertaken every four years by an interdepartmental urban forestry working group in consultation with an external interagency urban forestry working group (Recommendation #2). The review process should include a review of the status, timing and anticipated budgetary requirements of each action of the Strategic Plan, as well as a Criteria and Indicators-based assessment of the overall urban forest management program (see Section 2.3.2 and Appendix 2). Established targets should also be reviewed to track progress towards achievement, and to determine whether the targets remain appropriate or need to be revised based upon new knowledge, unanticipated conditions, or other factors. The timing of the Plan review period is graphically depicted within the overall UFMP framework in Figure 5, and the active adaptive management process is depicted in Figure 6.

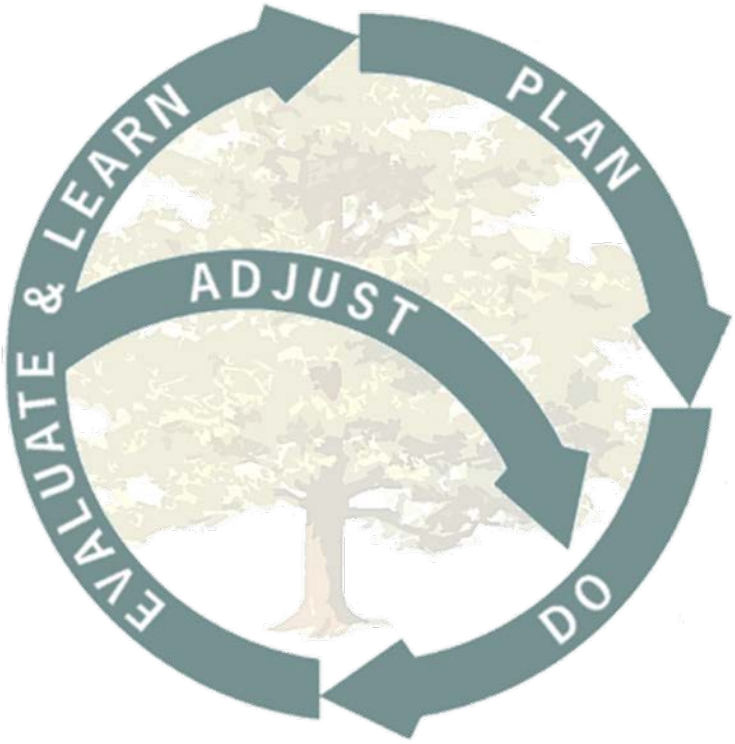

Figure 6: The active adaptive management process for urban forest management and planning.

The UFMP review process is intended to:

- Inform City staff responsible for and involved in implementation of the Plan about the status or recommended actions and progress towards achievement of established targets

- Provide an opportunity to refine or revise the next four-year management period in response changes in: the condition of the urban forest; available resources for urban forest initiatives; community priorities, pests, diseases and other pressures on the urban forest; or other factors, and

- Provide an opportunity to engage Council, the public and other stakeholders about urban forestry issues by providing an update on the status of the Plan and its related targets.

2.3.2. Monitoring using Criteria and Indicators

Urban forest managers must be able to clearly identify where specific goals or targets have been met and when adaptations to management approaches may be necessary. To address this need, *Putting Down Roots for the Future* includes a target setting and performance assessment framework in the form of 30 Criteria and Indicators (C&I).

A Criteria and Indicators-based review was undertaken at the outset of the UFMP development process to examine the current status of the City's urban forest management program and to identify areas where improvement was necessary. The Criteria and Indicators are outlined in detail in Appendix 2, along with the findings of the baseline assessment. Criteria are also referenced throughout the Plan in sections corresponding to those specific Criteria.

This same assessment framework will be the primary tool used to assess the status of Ottawa's urban forest and urban forest management program through the implementation of the UFMP over its 20-year planning horizon. As outlined in the Plan framework (Section2.2), such a review should be undertaken every four years during the formal Plan review process, although the reassessment of some Criteria every four years may not be feasible due to resource requirements or complexity. The review process will also consider the addition of new Criteria if necessary to better reflect Ottawa-specific challenges and opportunities. However, Indicators used in the initial baseline assessment will be carried forward in future reviews to maintain a consistent approach to assessing the urban forest and its management. The Criteria and Indicators approach will enable comparison between the baseline ratings of each criterion at the outset of the Plan to the ratings during the review period, and will facilitate progress tracking, goal-setting, and resource allocation planning. This will result in an increased likelihood of achieving successful outcomes and will facilitate active adaptive management, as outlined in Section 2.3.1.

One of the strategic objectives of the Plan is to achieve an Indicator ranking of Good or Optimal for each of the 30 Criteria within the Plan's 20-year horizon, and doing so will demonstrate urban forest management program success and progress towards achieving urban forest sustainability.

Figure 7 shows the ratings from the 2017 baseline assessment of the Criteria & Indicators for Ottawa. The figure should be read in combination with the detailed descriptions of each Criterion in Appendix 2. The Criteria numbers are indicated around the outside of the circle (e.g. V1, V2, etc.) and the green fill indicates the current Indicator rating. Ideally, each Criterion will have achieved an Optimal rating by 2037, making the outer section of the circle entirely green.

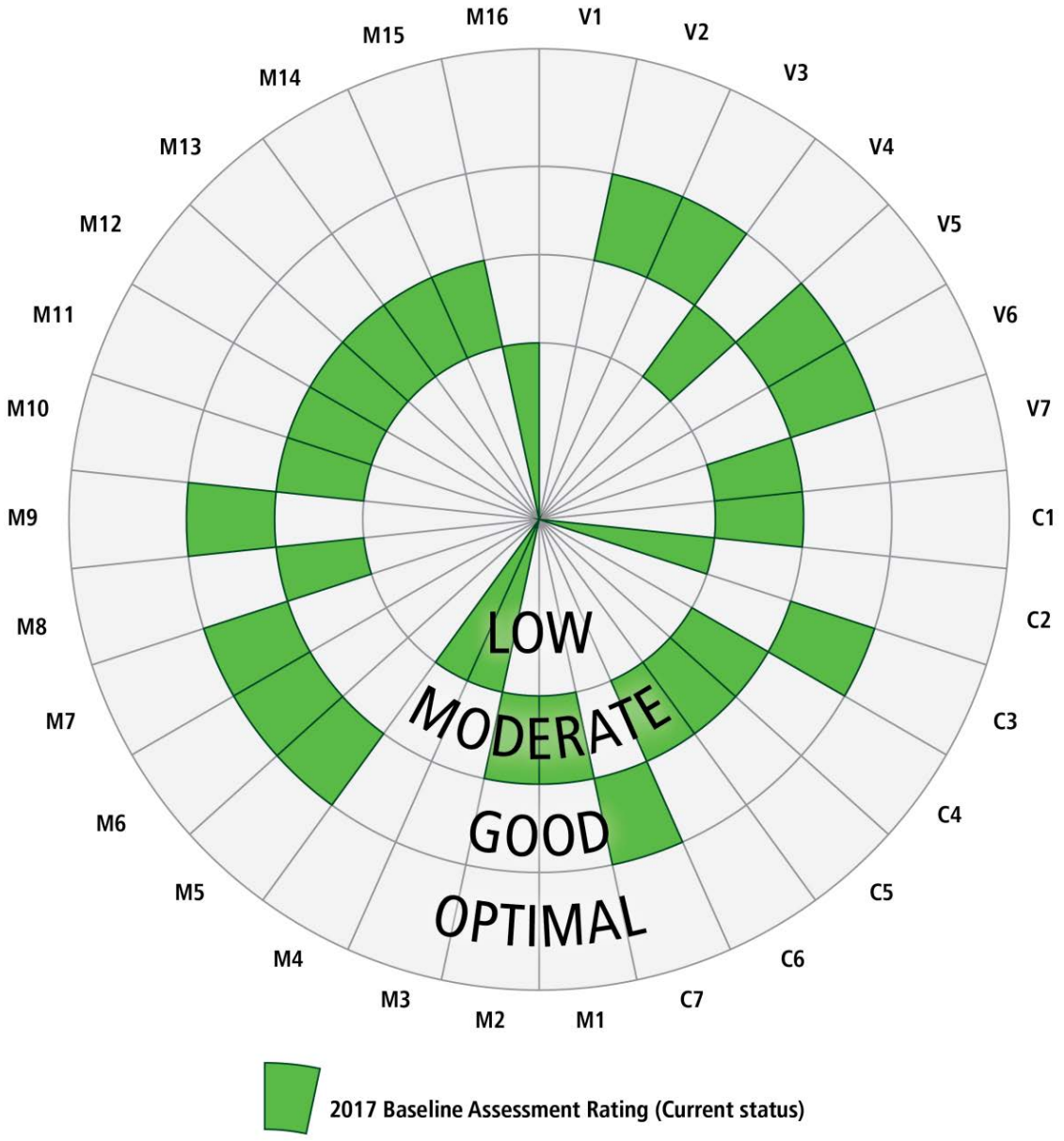

Figure 7: Criteria & Indicators 2017 baseline assessment ratings.

3. Putting Down Roots for the Future: Ottawa's Urban Forest Management Plan

3.1. Purpose of this Plan

Putting Down Roots for the Future is intended to provide the strategic and technical guidance required to achieve urban forest sustainability in Ottawa over the coming decades. It is also intended as a tool to ensure that urban forest-related policies in the City of Ottawa Official Plan are implemented consistently and effectively. This UFMP is meant to be used as a resource by City of Ottawa staff and Council, members of the community, and all internal and external stakeholders. The Plan should help all users better understand the many policies, practices and standards which directly and indirectly relate to and influence Ottawa's urban forest. Finally, it also provides a framework for long-term monitoring of the City's urban forest management program and the urban forest itself.

3.2. Stakeholder and community consultation

Putting Down Roots for the Future, the UFMP for the City of Ottawa, has been developed in consultation with a broad cross-section of interested stakeholders. These included members of the general public, staff from various City departments directly and indirectly involved in urban forest management, and external stakeholders such as local community associations, environmental groups, the development community and others.

3.2.1. Local support for the UFMP

In September 2015, a public event was held at Lansdowne Park to celebrate National Tree Day and launch Ottawa's UFMP initiative. The event attracted over 200 participants and the associated Tree Expo showcased 17 environmental organizations with a strong link to Ottawa's urban forest, demonstrating a high level of public interest in urban forest issues in the city.

From the early stages of the urban forest management planning process, organizations such as the Ottawa Stewardship Council, Ecology Ottawa, Hidden Harvest Ottawa, the Greenspace Alliance, Big Trees of Kitchissippi, Tree Canada, Ottawa Public Health, the Federation of Citizens' Associations of Ottawa, the Champlain Park Community Association, and many other Community Associations have supported the development of this Plan and promoted it through their networks and social media outlets. In addition, a number of neighborhood and

community newspapers and e-newsletters have drawn attention to the Plan, particularly with respect to the public consultation meetings.

Examples of support from local groups include:

- The Federation of Citizens' Associations of Ottawa posted a submission regarding the UFMP on its web site January 11, 2016, indicating its intention to "*work with the city to make preservation of existing trees and forests, and replanting a forest for the benefit of future generations, a reality*". It also suggested key points for consideration in the Plan.

- According to its website, the Ottawa Stewardship Council "*... is fully supportive of the City of Ottawa's Urban Forest Management Plan initiative*". It has also posted input regarding challenges, opportunities and recommendations for this Plan.

- Ecology Ottawa circulated a petition calling on "*… the City of Ottawa to release a strong, updated and publically available Forest Management Strategy in order to ensure that Ottawa emerges from the Emerald Ash Borer crisis with an even stronger and healthier urban tree canopy.*" Over 10,000 supporting signatures have been obtained to date.

These selected examples clearly illustrate that individuals, groups and agencies within the Ottawa area recognize the need for an UFMP to help guide the future direction for the forest in the City's urban area.

3.2.2. Stakeholder consultation

The public and other stakeholders played a key role in the development of the Plan. The consultation approach included two phases. The Phase 1 consultations for the plan were held in November 2015 and provided the public with an opportunity to discuss key issues, challenges, and opportunities facing the city's urban forest and to provide input into the vision and direction for Ottawa's UFMP. The draft UFMP was developed with careful consideration of the input gathered through the Phase 1 consultations. The Phase 2 consultations were held in November 2016 and provided an opportunity for the public and stakeholders to provide comment on the draft UFMP, which is reflected in the final Plan.

Phase 1 and Phase 2 Stakeholder Consultations Reports are available online at www.ottawa.ca/urbanforest and are also held on file at the City.

3.3. Vision

The vision statement for *Putting Down Roots for the Future* represents an ideal description or image of the urban forest as it will appear in twenty years, following implementation of the strategies, practices and action items recommended in this Plan.

The vision is based on input from consultation participants and other stakeholders. It reflects local values, aspirations, desires and concerns for the urban forest. The City of Ottawa's UFMP and urban forest management program will be considered successful if the vision statement, when read again in 2037, accurately represents the current state of the urban forest.

The Vision for Ottawa's Urban Forest

Ottawa's urban forest is healthy, diverse, resilient, and always growing. It sustains vibrant, livable and unique neighbourhoods and promotes health and well-being equitably for all of the city's residents and visitors.

The vision recognizes that residents of Ottawa value the urban forest and appreciate that it provides important social, economic and environmental benefits that contribute to the health, sustainability and livability of the city. It inspires the City, residents and other stakeholders to work collaboratively to identify and solve urban forest issues and to grow, sustain, protect and enhance the urban forest through all aspects of their day-to-day activities. As the Nation's Capital, the City of Ottawa should inspire others across Canada and throughout the world to care for, sustain and enhance their urban forests for the many benefits they provide.

Urban Forest Values

To help develop the vision for *Putting Down Roots for the Future,* consultation participants were asked, "*What do you value most about the trees in Ottawa's urban and suburban areas?*" Some notable responses among many included:

- ***"We are Canada's capital and the vision for our urban forest should be an inspiration to the rest of the country."***
- ***"Ottawa's forest cleans our air, improves the health of our residents, beautifies our communities, and overall improves our quality of life."***
- ***"A reminder of nature's capacity for renewal and resilience, as I witness how older trees have bent and grown under adverse conditions."***
- ***"I value most the connection between nature and the urban landscape, from trees planted within the community, and woodlots for people to enjoy."***

3.4. Guiding principles

The following eight principles have guided the development of this UFMP. All of these principles are considered equally important, and should be considered whenever actions and decisions related to the urban forest are made.

Guiding principle 1: The urban forest must be recognized and managed as a valuable infrastructure asset and a positive investment.

The urban forest is an immensely valuable asset that provides, among other benefits, services that directly complement conventional constructed infrastructure. While significant resources are dedicated to the construction, maintenance and replacement of conventional infrastructure, a healthy and well-maintained urban forest is often perceived as 'nice-to-have' but not essential infrastructure. The urban forest must be recognized as a network of relatively low-cost, renewable and highly functional 'green infrastructure' that is essential to sustaining a livable and healthy community. It should be given the same consideration as conventional infrastructure and other municipal assets by all City of Ottawa Councillors, staff, residents and others engaged in all aspects of urban planning, maintenance and development. Strategic and proactive urban forest management will realize

significant financial returns through increased provision of social, economic and environmental benefits and reduced costs of reactive maintenance.

Related recommendations: #2, #4, #5, #6, #7, #22, #24.

Guiding principle 2: The City and its partners should be bold and innovative in urban forest management.

Achieving desired results often demands a departure from the 'business-as-usual' approach. A willingness to make tough but sound decisions and to experiment with novel approaches can result in significant gains, successes and achievements that could not happen without such boldness and innovation. The City of Ottawa and its partners (including other governmental agencies, non-governmental organizations, the development community, local businesses, and the community at large) should the approach the threats facing the urban forest as challenges to be overcome on the road towards achieving established targets, strategic goals and ultimately, urban forest sustainability.

Related recommendations: ALL

Guiding principle 3: Urban forest management is a shared responsibility, and working together is the key to achieving success.

Decisions and actions affecting the urban forest are made and taken by a broad spectrum of stakeholders, including as local Councillors, City of Ottawa staff, community groups, businesses and individual residents. While the City's urban forestry staff are experts in a wide range of urban forestry issues and successful management approaches, it is also recognized that there are many other urban forest stakeholders and partners with unique skills, knowledge, experience and resources to share.

It is therefore incumbent upon every one of these groups and individuals to recognize their contributions to urban forest management and the positive or adverse implications their actions may have. There is also a shared responsibility among all stakeholders to work collaboratively to find creative and practical solutions to the challenges of sustaining and integrating the urban forest in an increasingly urbanizing context.

If the UFMP's vision, objectives and targets are to be realized, these groups must work together in a spirit of cooperation, transparency and mutual respect. *Putting Down Roots for the Future* has been developed in consultation with various urban forest stakeholder groups and is intended to reflect their values and perceptions in

a balanced way. It should therefore form the starting point for better collaboration between different urban forest stakeholders with a shared vision and common goals.

Related recommendations: #2, #6, #10, #22-26.

Guiding principle 4: Urban forest management encompasses a wide range of actions.

It may be easy to think that urban forestry entails little more than tree planting, pruning and removal. While tree maintenance is certainly a large component of urban forest management, there are many other activities in this important and inter-disciplinary municipal portfolio. On a daily basis, Ottawa's urban forestry staff engage in activities as varied as development plan review, mapping, urban forest pest management, by-law enforcement, interdepartmental coordination, contract administration, public education, community consultation and engagement and, of course, tree planting, pruning and removal. These activities, and others, should be recognized by the community and other City departments as important to the functioning of a well-managed and sustainable city and vital to the success of Ottawa's urban forestry management program.

Related recommendations: ALL.

Guiding principle 5: Urban forest management must be flexible, adaptive, and information-based

Cities and their urban forests are complex and dynamic entities. As land uses, practices, policies or environmental conditions change, urban forest managers and the community alike must be ready to adapt, face new challenges, and embrace new opportunities to achieve their goals. If public values change or new information becomes available, urban forest program goals may also need to be adapted, and urban forest managers and stakeholders should not hesitate to review and modify their program targets if necessary. Urban forestry should also be informed by up-to-date and comprehensive data, such as canopy cover assessments, species diversity analyses, tree inventories, invasive species monitoring results, or full-cost accounting measures.

Related recommendations: #1, #3, #4.

Guiding principle 6: All of Ottawa's residents deserve equitable access to the benefits provided by the urban forest.

In many cities, neighbourhoods with higher property values and other economic indicators often have greater urban forest cover than other areas, suggesting that some residents may not enjoy an equitable share of urban forest benefits. It is recognized that spatial distribution of the urban forest cannot be equal across the entire urban area, due largely to the constraints imposed by land development patterns. However, promoting an increasingly equitable distribution of urban forest benefits should inform certain urban forest management decisions, especially related to tree establishment and land use planning. Efforts should focus on increasing and improving urban forest cover and condition in traditionally under-served areas and among vulnerable communities without compromising levels of service in areas with a proportionately greater share of urban forest cover.

Related recommendations: #2, #3, #4, #7, #9, #13, #20, #22-26.

Guiding principle 7: All trees are valuable and large trees require special considerations.

Every tree in the urban forest, regardless of size, has value and contributes some benefit. While small trees may fulfill important functions for constrained sites, provide food resources or better withstand site development impacts, large trees do provide exponentially more benefits than small trees and represent the most cost-effective means of obtaining those benefits. Large trees are also difficult to replace once they are lost, and today's large trees have benefited from less disturbed soils and good growing conditions. Trees planted today will take several decades to develop to maturity, even in optimal growing conditions, and many trees may never grow to their full genetic potential to deliver important urban forest benefits.

Stakeholder consultations clearly demonstrate that Ottawa's residents highly value the city's large trees for their environmental, aesthetic and spiritual values, and many residents' sense of community and heritage is directly linked to large-statured trees. Furthermore, the preservation of large trees is essential to achieving urban forest canopy, age class diversity and other targets; if these trees are lost, the urban forest will move further away from these benchmarks of success and sustainability. Unfortunately, large trees are particularly vulnerable during land development, as they may conflict with lot coverage objectives, grading or other development needs and requirements. Therefore, existing large trees are deserving of and require more specialized planning considerations to ensure their effective protection. Perhaps more importantly, outreach and education efforts to communicate the value and importance of large trees must be made to ensure their

effective protection. Finally, concerted efforts must be made to ensure that today's young trees, or those that will be planted in the future, have the ability to grow into the large specimens that still grace many of Ottawa's leafy neighbourhoods.

Related recommendations: #6, #8, #10, #15, #18, #19, #22-26.

Guiding principle 8: Increasing diversity builds resilience against climate change and other stressors.

The urban forest is susceptible to a wide range of physical and environmental stressors, such as invasive species, pests and diseases, or difficult growing conditions. Climate change will further exacerbate these challenges. Increasing diversity on several different levels is an important strategy to improve urban forest resilience against these stressors, and also increases the amount and variety of benefits provided by the urban forest.

Natural diversity comes in several forms, such as genetic, species, ecosystem or structural diversity. It also occurs on different spatial scales, such as neighbourhood-based, local or regional. Planning for the maintenance and, where needed, improvement of diversity in all these forms and at all these scales is central to this Plan. Urban forest diversity can be promoted through management activities such as selecting diverse seed sources for tree nursery stock, promoting uneven age distribution among tree populations, or increasing the variety of tree species planted to fulfill different functions.

While increasing urban forest diversity of various kinds is important to build resilience and provide a wide range of urban forest benefits, invasive species management also needs to be considered in this context. For example, high species diversity in natural areas where invasive species represent much of this diversity is not desirable. Therefore, while increasing species diversity is important, indigenous and non-invasive species should generally be preferred, particularly within and in proximity to natural areas.

Related recommendations: #1, #3, #4, #9, #13, #19, #20, #21, #22-26.

3.5. Objectives and targets

3.5.1. Objectives

The intent of *Putting Down Roots for the Future* is to realize the Plan's vision for Ottawa's urban forest by 2037. This vision will be realized through the implementation of actions designed to achieve the following seven strategic objectives:

Objective 1: Work towards achieving urban forest sustainability.

The Criteria and Indicators framework is a useful tool for assessing progress towards achievement of urban forest sustainability. By the end of the 20-year horizon of this UFMP, all aspects of the urban forest management program will rank as "good" or "optimal" in the assessment of 30 Criteria and Indicators (Appendix 2). Criteria already ranked as "good" or "optimal" will be maintained at these rankings and, where possible, will be improved upon.

Objective 2: Enhance urban forest protection and establishment.

Policies and practices will be implemented to ensure that more existing trees and woodlands are protected during land use change and site development, and that protection efforts are implemented effectively to ensure tree longevity. Similarly, tree establishment will be targeted towards achievement of specified objectives and supported by policies and practices which enable trees to reach their full genetic potential for growth, longevity and the provision of urban forest benefits.

Objective 3: Improve knowledge of the urban forest and its management.

All aspects of urban forest management will be informed by up-to-date knowledge of the status and condition of the urban forest and awareness of current best management practices. Urban forest management will be monitored to assess the successes and shortcomings of implemented approaches and to support adaptive management.

Objective 4: Expand community engagement and stewardship in the urban forest.

The City will engage more broadly with members of the community and other stakeholders and partners to undertake citizen science, broaden community engagement in urban forestry issues, and promote stewardship on private lands and other lands across the city.

Objective 5: Foster a resilient, diverse and functional urban forest.

Species and structural diversity of the urban forest will be increased above current levels and meet or exceed Criteria and Indicators-based targets (Appendix 2). A more structurally and genetically diverse urban forest will be more resilient to external stressors and the exacerbating effects of climate change. Increased diversity, coupled with innovative site design, enhanced programs and novel approaches to management will enable more trees to reach their genetic potential to provide benefits and will complement other sustainability goals. Efforts will be made to promote equitable access across Ottawa to the wide-ranging benefits provided by the urban forest.

Objective 6: Minimize risk related to the urban forest.

All stakeholders will realize that wholly eliminating tree-related risk is not feasible. However, the City will maintain and enhance the policies and practices in place to minimize the risk presented by trees along streets and in parks and woodlands to the greatest degree possible.

Objective 7: Manage the urban forest more proactively and provide resources to urban forest management.

The City will continue to manage the urban forest in a proactive manner, will enhance proactive management wherever possible, and will allocate adequate resources to urban forest management. This will be achieved through ongoing implementation of cycle-based tree maintenance and increased levels of service in other aspects of urban forest management, resulting in fewer tree maintenance and service requests, a reduction in work backlogs, and improved tree and urban forest health and condition. The adaptive management framework for this plan will enable staff to assess resourcing requirements on an ongoing basis and make budget requests as necessary.

3.5.2. Quantitative performance targets

Putting Down Roots for the Future is a long-term strategic Plan. The success of the Plan will be determined by the level to which its recommended actions are implemented and whether Plan targets are achieved.

While many of the targets set in the Criteria and Indicators framework (described in Section 2.3.2 and Appendix 2) are qualitative in nature, several quantitative indicators will also be used to establish urban forest performance and sustainability targets and to assess progress towards achievement of those goals. Assessment of the status of these indicators may require the use of specialized technologies or dedicated studies, and not every indicator may be reassessed during each review period due to the resource requirements.

Quantitative targets included in the Criteria and Indicators framework are related to the urban forest itself, as described in Table 2 (below) and are discussed in further detail below.

Table 2: Criteria and Indicators for urban forest sustainability with quantitative targets.

Criterion	Indicator – Good	Indicator – Optimal	Key Objectives	Current Status
V1: Relative Canopy Cover	The existing canopy cover equals 50-75% of the potential.	The existing canopy cover equals 75-100% of the potential.	Achieve climate-appropriate degree of tree cover, community-wide	Unknown
V2: Age distribution	Total tree population across municipality approaches an ideal age distribution of 40% Class I, 30% Class II, 20% Class III, and 10% Class IV	Total population approaches that ideal distribution municipality-wide as well as at the neighbourhood level.	Provide for uneven-aged distribution city-wide as well as at the neighbourhood level.	Good
V3: Species suitability	More than 75% of trees are of species considered suitable for the area.	Virtually all trees are of species considered suitable for the area.	Establish a tree population suitable for the urban environment and adapted to the regional environment.	Good
V4: Species diversity)	No single species represents more than 5% of total tree population; no genus more than 10%; and no family more than 15%.	At least as diverse as "Moderate" rating (10/20/30) municipality-wide – and at least as diverse as "Good" (5/10/15) at the neighbourhood level.	Establish a genetically diverse tree population city-wide as well as at the neighbourhood level.	Moderate

Although Criterion V1 applies to the entire urban forest, Criteria V2, V3 and V4 have currently been assessed based on data specific to the City's street trees, as that is currently the full extent of the City's tree inventory. As the inventory is expanded to include trees in parks and elsewhere, the indicator rankings will be revised accordingly. Analysis of the street tree inventory is provided in Appendix 1.

Criterion V1: *Relative Canopy Cover* is a measure of the canopy cover in a specific part of the city (neighbourhood, ward, or land-use type) relative to the potential canopy cover for that same area. Potential canopy cover represents the maximum canopy that could be supported in an area given the available growing space for trees. Sufficient data were not available for an assessment of Relative Canopy Cover at the time Plan development, but will be available following completion of Recommendation #4.

Criterion V2: *Age distribution*. Tree stem diameter at breast height (DBH) is often used as a proxy for age when describing stand structure or age class distribution. Figure 8 illustrates the distribution of DBH classes for all street trees in the City. Based on DBH, the current status of Criterion V2 for all street trees approaches "good" in the C&I assessment.

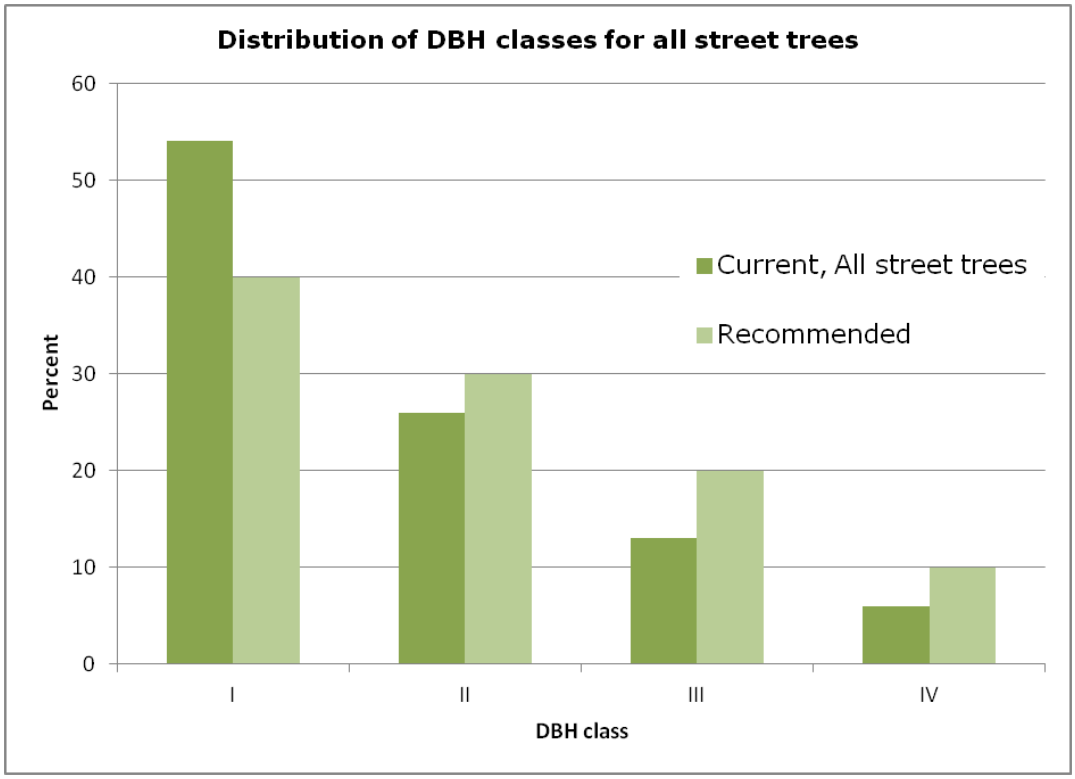

Figure 8: Distribution of DBH classes for all street trees.

Table A1.1 in Appendix 1 provides a similar analysis of the DBH distribution for each neighbourhood in Ottawa.

Relative DBH (RDBH) is intended to account for the inherent difference in the maximum DBH that a tree species can achieve, thereby providing a better representation of the age structure of an urban forest. Figure 9 shows that the distribution of RDBH classes is very close to that considered to be "good" in the C&I analysis. However, the analysis at the neighbourhood level provided in Appendix 1 suggests that more diversification in this area is needed to attain an "optimal" status.

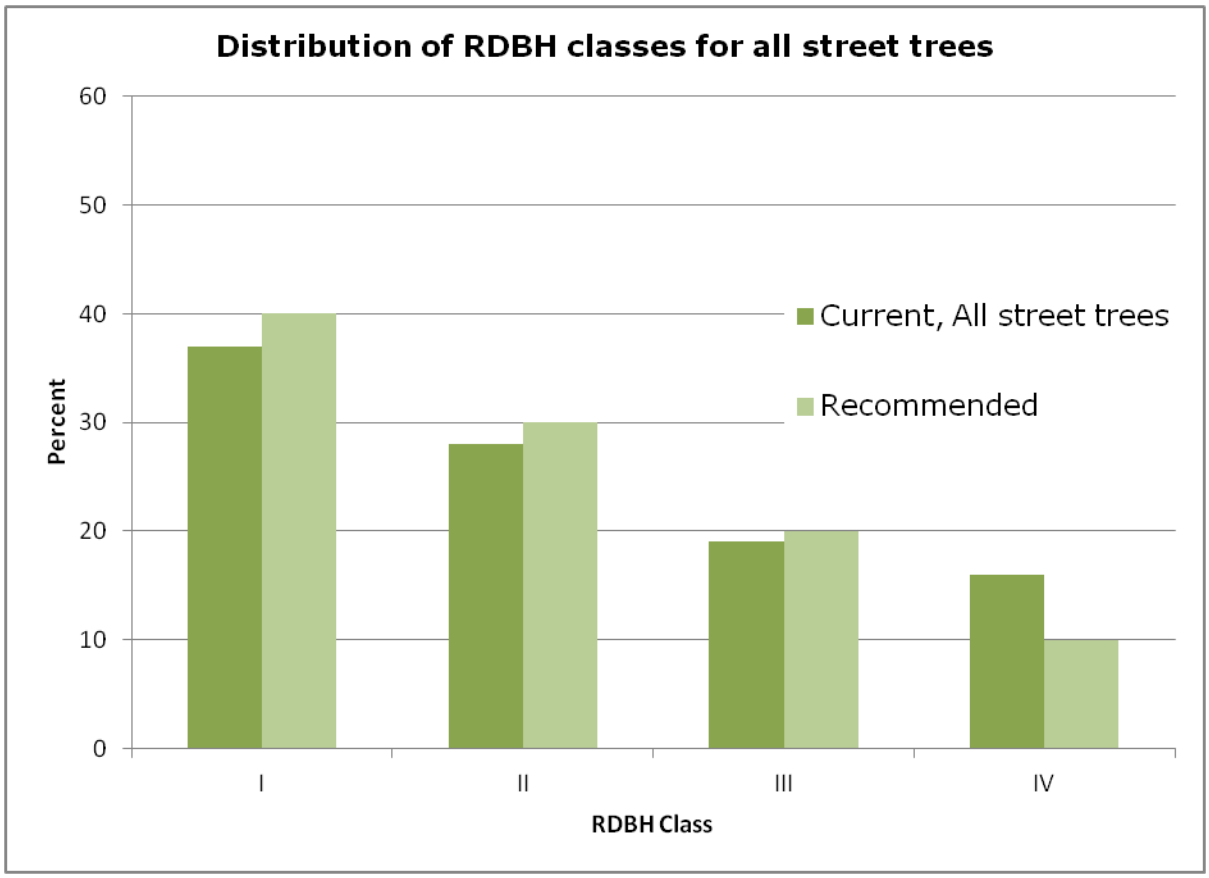

Figure 9: Distribution of RDBH classes for all street trees.

Criterion V3: *Species suitability* (described in more detail in Appendix 1) is currently considered to be "good" as the analysis of the street tree inventory indicated that 90% of all street trees were either in the excellent or good suitability class. The neighbourhood analysis also indicates that, except for two areas with very few trees, all neighbourhoods also met the target of at least 75% suitable.

Criterion V4: *Diversity* was assessed at the species, genus and family level. For all street trees, Norway maple is only slightly over the recommended maximum of 10%. At the genus level, however, the maples are, at 34%, substantially over the recommended maximum of 20%, while all other genera are below. At the family level, *Aceraceae* is slightly over-represented, but all other families are less than the maximum of 30%. In summary, when considering all street trees in the City, Criterion V4 can be considered to be at the low end of the "moderate" level because of the dominance of the maples, and Norway maple in particular. This general pattern also holds for individual neighbourhoods.

3.5.3. Urban forest canopy cover target

A common method to describe the extent of the urban forest is to measure tree canopy cover. This is typically expressed as a percentage, which represents the portion of a given area that is covered by tree canopy as seen from a top-down, or 'bird's eye', view. Many jurisdictions in North America have established targets for urban forest canopy, which commonly range from 30% to 40%.

A preliminary canopy cover assessment for the urban area of Ottawa was undertaken in 2014 and determined that tree canopy cover was approximately 25% in the urban area, including the NCC Greenbelt lands. The tree canopy cover from the 2014 assessment is shown on Figure 1.

Ottawa's Official Plan states, "Pending the completion of a Forest Strategy, the City will maintain a target for forest cover for the entire city of 30 per cent." However, the city's potential canopy cover capacity across various scales (e.g., city-wide, ward or neighbourhood) is currently unknown. Therefore, while *Putting Down Roots for the Future* recognizes that urban forest canopy cover should be sustained and expanded, the Plan does not establish a specific canopy cover target. Instead, the Plan outlines the approaches necessary to develop a more refined urban forest canopy cover target based on currently available assessment methods and recognized best practices (see Section 5.1, Recommendation #4).

4. Current practices and opportunities in Ottawa

This section of *Putting Down Roots for the Future* provides an overview of the current practices related to Ottawa's urban forest and its management and is organized into the following four topic areas:

- Urban forest management program structure and administration (Section 4.1)
- Planning for the urban forest (Section 4.2)
- Maintaining and growing the urban forest (Section 4.3), and
- Urban forest outreach, education, stewardship and partnerships (Section 4.4).

Each section concludes with a summary of opportunities for improving aspects of urban forestry in Ottawa. These opportunities have been identified based on consideration of:

- Ottawa's unique physical, land use and socio-political context (as described in Section 1)
- input from City staff, a range of stakeholders and the public (as described in Section 3.2)
- current practices (as described in Section 4), and
- best practices and precedents from other jurisdictions (with relevant and selected examples highlighted in Section 5).

The 26 recommendations presented in Section 5 have been directly informed by the assessment of current practices, gaps and opportunities presented in this section.

4.1. Urban forest management program structure and administration

4.1.1. Urban forestry responsibilities at the City

Responsibility for implementation of Ottawa's urban forestry program is primarily shared between two municipal departments – Planning, Infrastructure and Economic Development and Public Works and Environmental Services - although several other departments also significantly influence the city's existing and future urban forest.

The Planning, Infrastructure and Economic Development Department focuses on the development, review and implementation of the City's policies and plans (specifically the Official Plan and Zoning By-law, and other related plans and strategies), including all aspects of these planning documents that relate to trees. This department also develops policies and undertakes development application review, community design planning (including planning for parks, natural systems and open spaces), and transportation planning (including Complete Streets, which incorporate street trees). Activities specifically related to planning the urban forest are undertaken within three areas of this department:

- Natural Systems and Environmental Protection unit: Foresters in Natural Systems and Environmental Protection (also referred to as "Foresters in Planning") are responsible for developing and ensuring conformance with the City's urban forest policies and by-laws in the urban area. They review Tree Conservation Reports (TCR) and related Environmental Impact Statements (EIS) submitted with all Site Plan and Plan of Subdivision applications within the urban area and implement the component of the Urban Tree Conservation By-law (UTCB) (2009-200) that applies to properties greater than one hectare, including review of the supporting TCRs.

- Development Review Services: Environmental Planners in the Development Review Services unit review development proposals across the city, including the review and approval of Environmental Impact Statements (EIS), screening for conformity with Ottawa's natural heritage system (NHS), and other vegetation-related policies in the Official Plan and approved sub-watershed studies. Park Planners in this unit review park plans for new communities, including making decisions regarding existing trees in future park blocks and the integration of new trees in these public spaces.

- Infrastructure Services is responsible for the design and construction of many components of the City's infrastructure (such as roads, transit, sewers and other utilities). This department influences the extent and nature of future tree growing environments in many parts of the city through the design and implementation of capital projects, and its projects may affect existing trees.

The Public Works and Environmental Services Department is responsible for the "on the ground" maintenance of the urban forest that occurs on municipal lands through Parks, Forestry and Stormwater Services, and also plays a central role in many aspects of broader urban forest management planning. Within that group, the Forest Management Unit and Forestry Field Operations tasks include:

- reviewing all development, utility and construction plans potentially impacting City trees to identify tree protection opportunities, planting opportunities, and compensation requirements;

- undertaking and maintaining an inventory of City trees (more than 161,000 in the current database) and other urban forest assets , such as equipment;

- responding to more than 18,000 tree-related service requests annually;

- planting and maintaining trees located on municipal rights-of-way, in City parks and municipal forests (including Community Forests), including regular inspections, pruning, watering young trees, removals and replacements;

- implementation of the Municipal Trees and Natural Areas Protection By-law (2006-279) and the distinctive tree permit component of the UTCB for trees of at least 50 cm DBH on private lots that are one hectare or less in area;

- undertaking urban forest pest management;

- informing tree species selection for establishment on municipal lands through plan review, and undertaking or overseeing plantings; and

- leading or participating in community engagement and stewardship related to the urban forest in various locations and with various stakeholders.

Although they are less directly involved in urban forest activities, other City departments or branches regularly undertake activities that impact Ottawa's existing and future urban forest.

In the Recreation, Cultural and Facilities Services Department:

- Parks and Facilities Planning Services plans, develops and administers recreation programs and facilities, including the City's network of parks. Approved upgrades or expansions to existing community facilities, or plans for new facilities (such as sports fields, community buildings, and related parking areas) often require tree removals as well as consideration of how to integrate trees into these areas.

- Facility Operations Services is responsible for maintenance of a range of municipal infrastructure assets.

In the Public Works and Environmental Services Department:

- The Stormwater Management and the Stormwater Engineering Services Units are responsible for overseeing storm water management across the city. While installation of and upgrades to the infrastructure managed by these units can require tree removals, these activities also present opportunities for urban forest renewal and enhancement (such as plantings around storm water management ponds).

- The Parks Operations Unit is responsible for the maintenance and operations of all City-owned and leased park space. Park staff undertake smaller scale park tree maintenance such as clearance pruning and mowing in parkland around trees and natural areas.

In addition to these City departments, Ottawa Public Health (OPH) has an indirect but significant role in urban forest management by advocating for healthy environments. OPH raises awareness of the social determinants of health, including access to treed greenspaces, and promotes community policies to encourage equitable access to resources in the environment that are supportive of health and well-being. OPH has also been active in providing evidence-based information to residents and City partners about the ability of the urban forest to mitigate and help the public adapt to some of the health threats associated with climate change, urban heat islands, and urban living in general (see Appendix 3).

4.1.2. Urban forest asset management and tree inventory

Different aspects of Ottawa's urban forest assets are currently managed through several systems and supporting software tools. The two most important tools from an urban forest management perspective are the SAP and related GIS systems that contain the City's tree inventory data, as described below.

- The primary tool, managed by the Forest Management Unit, is the tree inventory data housed within the City's enterprise asset management system (called SAP). Each inventoried tree has an individual record that can be created, modified or deleted in SAP. This system is used to manage service notifications, track maintenance history, and manage other tree information. The existing tree inventory contains approximately 161,000 records. It is nearly complete for urban street trees and includes some park trees, and is being expanded to include rural streets and City-owned parks in the urban and rural parts of the city. It is anticipated that, upon its completion, the tree inventory will contain information for approximately 250,000 trees.

- Locations of inventoried trees documented in the SAP system are entered in a Geographic Information System (GIS) for planning and management purposes. Staff in Forestry have full access to the inventory data and related mapping which are used to inform ongoing management. Basic information from the tree inventory (such as species, DBH and asset number in the SAP system) is available to City staff and members of the public through OpenData (the City's publicly available online data) and geoOttawa (the City's interactive web mapping tool).

Beyond SAP and the GIS tools which inform municipal planning and maintenance on an ongoing basis, the City receives customer service requests via ServiceOttawa/ 311 through the Lagan system. Requests related to trees are conveyed to Forestry for follow-up. In addition, the Maintenance Management System (MMS) is a broader Public Works information technology initiative which is being implemented with the intent of streamlining all aspects of asset maintenance, including those related to trees.

In addition to these four asset management systems, Foresters in the Planning Department use a business information system called Municipal Application Partnership (MAP) to catalogue all development files. The system indicates (among other things) whether the UTCB applies to a given development file, and is used by Forestry Inspectors in the Forestry Field Operations unit to administer and follow-up on tree by-law permits as needed.

4.1.3. Canopy cover

While a tree inventory is an essential tool for the "on the ground" management of trees that are the City's responsibility, a canopy cover assessment is a much higher level tool for assessing the extent of tree cover across a given jurisdiction and how this cover changes over time. A preliminary GIS-based canopy cover assessment for Ottawa's urban area (including the NCC Greenbelt and the new expansion areas) was completed in 2014, and found that tree canopy cover is approximately 25%. This study was a high level assessment and did not include an analysis of potential canopy cover in the urban area, which should ideally be considered in the identification of a feasible target.

4.1.4. Opportunities for improving urban forest management program structure and administration

More formal interdepartmental coordination

The City of Ottawa has divided its urban forest responsibilities among several departments, with City staff in the Planning, Infrastructure and Economic Development Department and Public Works and Environmental Services Department who are responsible for the activities that relate directly to urban forestry on a daily basis. While urban forestry staff in these two departments currently collaborate and coordinate on a variety of levels, they do so informally. Planners and Foresters in these two departments also sometimes coordinate and collaborate with other City staff on tree-related issues, but not in a regular, formalized manner. Consequently, opportunities to better plan for and enhance Ottawa's urban forest can be overlooked, in some cases simply because of the size of the City and its related administrative framework.

Sustaining the urban forest requires a multi-disciplinary approach. A forum to support regular and formal interactions among City staff in different departments that focuses on tree-related issues would facilitate implementation of a more consistent approach to urban forest planning, maintenance and establishment where the City has jurisdiction over tree-related activities.

Criterion C1 evaluates *municipal agency cooperation.* The current status of this criterion in Ottawa is "good": "*Municipal departments/agencies recognize potential conflicts and reach out to urban forest managers on an ad hoc basis – and vice versa*". An "optimal" status is achieved when there are formal interdepartmental teams that consider urban forest issues and opportunities on all projects under municipal jurisdiction, as is suggested through this Plan and described in Recommendation #2.

Ongoing maintenance and updates to tree inventory management

Maintaining a comprehensive and current inventory of municipally-managed street and park trees is increasingly recognized by municipalities as an essential tool for the effective urban forest management.

Urban forest asset management in Ottawa currently operates in a hybrid framework whereby the SAP tree inventory management tool contains most of the municipal tree-related data and is integrated with a GIS system to provide geographic information that is accessible to both City staff and the public (through geoOttawa). These tools are complemented by the Lagan system whereby tree-related service requests are input and directed to City staff in Forestry. Despite the complexity and occasional data issues related to the use of multiple systems, Forestry staff have indicated that the existing structure is functional and allows them to effectively use the available tree inventory data to plan and execute daily urban forest management operations, as well as manage and respond to service requests.

A tree inventory is a point-in-time 'snapshot' of the state of the urban forest, and moves quickly towards obsolescence if it is not regularly and adequately updated and maintained. Currently, there is no strategic plan to actively manage the City's street and park tree inventory. Continued investment in the expansion (from the current 161,000 to approximately 250,000 tree records) and a plan for ongoing maintenance of these inventory systems will be required to ensure they remain comprehensive and current, thereby maximizing their management utility. As part of this plan, updates to the appropriate systems and processes should be made to:

- improve quality control for inventory data (which will be increasingly important as the number of records increases);

- explore approaches for incorporating new trees planted on municipal lands by developers soon after the work is completed (such as requiring the locations and basic data in GIS as part of the approval process); and

- incorporate additional attributes to the inventory (such as tree health and potential risk to persons or property) that can be used to further inform maintenance priorities and address risk issues more proactively.

Specific guidance is provided in Recommendations #3 and #18.

Making the municipal tree inventory data and tree locations available to City staff and the public through geoOttawa is consistent with best practices. Having this information accessible allows other City staff to access basic tree inventory data to inform their planning, and provides transparency for stakeholders and members of

the public who may be interested. While tree inventory data used to manage City-owned street and park trees should only be collected and modified by trained tree assessors on staff or contracted by the City, having basic tree inventory data available to the public is a progressive tool that can inform research and support public outreach and engagement.

Over the course of the implementation of this Plan, the current approach to tree inventory management may need to be reviewed or updated in relation to corporate-wide or departmental adoption of new information technology systems. Any such changes should be informed by a clear understanding of the operating and data management needs of the Forestry units and other units using tree inventory data.

Once complete, the inventory can also be used to develop new and refine existing neighbourhood-based tree lifecycle maintenance plans. Specific guidance is provided in Recommendation #15.

Integrate the urban forest into the City's Asset Management Program

Integration of the urban forest into the City's Asset Management program would showcase the urban forest and the services it provides for Ottawa. The City's Comprehensive Asset Management Policy and Strategy (2012) includes the intent to integrate natural assets as a part of continuous improvement. Street trees were included in the 2016 State of the Asset Report, although methodologies for valuation and condition assessment need further development. Upon completion of the City tree inventory and an urban forest canopy cover assessment (see next section), the urban forest resource could be reflected within the Asset Management program more completely and accurately. Specific guidance is provided in Recommendation #5.

Urban forest canopy cover assessment and planning

A canopy cover assessment provides a point-in-time assessment of where trees (and large shrubs) occur across a jurisdiction and how much of the land area their canopy covers. Ottawa's preliminary analysis (2014) found that canopy cover in the urban area is approximately 25%. However, the spatial data used in the assessment was incomplete and the analysis was relatively coarse. This preliminary analysis also did not examine the city's potential urban forest canopy, and was not developed so that it could be used as a tool for prioritizing planting areas in the city based on opportunities and/or benefits accrued to the community.

The limitations of canopy cover assessments

Some jurisdictions use urban forest canopy cover percentage as a comparative metric to assess the success of their urban forestry programs in relation to other comparable jurisdictions, and/or to set canopy cover targets. Although it is a popular and easily understood metric, canopy cover does not address other important aspects of the urban forest, such as urban forest diversity, structure or condition, levels of service, or community engagement and stewardship. The canopy cover metric can also be problematic because different assessment methods can provide varying estimates and differing levels of accuracy. Furthermore, overemphasis on canopy cover targets can unduly focus urban forest management on tree planting at the expense of other important strategic initiatives and management actions. Finally, canopy cover targets are often established without a detailed understanding of an area's actual potential canopy cover capacity or the resources required to achieve canopy targets.

The City of Ottawa now has an opportunity to undertake a comprehensive urban forest canopy cover study using the most current remote-sensing tools, which will provide:

- an accurate assessment of current urban forest canopy cover in the urban area on a variety of appropriate scales (such as land use, neighbourhood or ward);

- an accurate assessment of maximum Potential Canopy Cover (PCC) across the jurisdiction and Possible Planting Areas (PPA) at the parcel-level, based on realistic assumptions about tree planting rates and actual potential cover of available and plantable land parcels;

- calculations of potential canopy gains or losses based on different tree establishment scenarios and tree mortality rates; and

- a tool to identify tree planting areas, at appropriate scales, in relation to weighted priorities (such as urban heat island mitigation, energy savings, water quality improvement, canopy cover equity, public health, and others).

While the urban forest canopy cover study described above can provide a wide range of useful analyses, metrics and tools to prioritize and plan tree establishment efforts, it cannot provide "on the ground" information about urban forest species diversity, structure, or function. The most common assessment and analysis

protocol for this type of study is i-Tree Eco, part of the i-Tree suite of urban forest assessment and planning tools developed by the USDA Forest Service and partners. i-Tree Eco relies on modeling and extrapolation of data gathered in the field through randomly located plot-based assessments across an urban study area. City of Ottawa urban forestry staff should assess the value of an i-Tree Eco-based (or similar) urban forest benefits analysis to Ottawa's urban forest program and determine if it should be incorporated as part of the urban forest cover assessment work to be done.

In the urban forest sustainability framework (Appendix 2), three different criteria focus on aspects of urban forest assessment that can be addressed through a comprehensive urban forest canopy study. *Canopy Cover Assessment and Goals* (Criterion M2) which is currently assigned a "moderate" status based on the City's preliminary assessment from 2014, would be improved to "good" with the completion of a comprehensive and detailed urban tree canopy (UTC) assessment, and to "optimal" if this assessment was used to help implement urban forest planning. *Tree Inventory* (Criterion M1) is also currently assigned a "moderate" status, and would be improved to "good" by incorporating a sample-based inventory of privately-owned trees, and to "optimal" if this inventory was included in city-wide GIS. Similarly, for *trees on private property* (Criterion V7) the City is currently ranked "moderate" based on the preliminary canopy assessment from 2014, but would be given "good" status if ground-based samples were collected and an "optimal" status if this data were incorporated within a comprehensive UTC assessment in GIS.

A comprehensive UTC assessment that includes tools to identify and prioritize planting areas and incorporate ground-based data from a subset of private properties is the suggested approach for Ottawa (see Recommendation #4).

4.2. Planning for the urban forest

4.2.1. Planning policies and process

Official Plan

Ottawa's current Official Plan (adopted in 2003, 2013 consolidation which includes Official Plan Amendment 150) provides the policy framework for how land in Ottawa should be used and includes a vision for the City and its development to the year 2031. Ottawa's Official Plan is supportive of sustaining and enhancing the urban forest (both within and outside of natural areas) through both its framework and its policies.

The Official Plan recognizes the need to consider the social, economic, environmental and cultural outcomes of land use decisions. It also recognizes the modern challenges related to climate change and human health, and that a healthy urban forest can help address these challenges. Recognizing the urban forest as a cornerstone of a sustainable community, the Official Plan commits the City to developing in harmony with nature, taking an ecosystem management approach to natural areas protection, and providing incentives and education to increase tree cover.

Section 2.4.5 of the Official Plan includes policies to support the protection, maintenance and expansion of the urban forest, including specific commitments to:

- Implement the Greenspace Master Plan (2006) through designation of greenspaces, integration of natural lands, pursuing greenspace opportunities when undertaking public works, and considering the greenspace function of municipal lands prior to disposition;

- Maintain a City-wide forest cover target of 30% through: (a) protection of designated environmental areas, (b) encouraging tree conservation and planting on public and private lands, and (c) developing tree conservation and planting guidelines, including a tree compensation policy;

- Work with Conservation Authorities, community groups, organizations working with urban forestry or private land forestry, and other interested parties on a strategy to manage and protect Ottawa's forests; and

- Support stewardship of private lands through mechanisms such as publicly-funded programs and provision of information.

Significant woodlands have been identified in Ottawa's rural areas using specific criteria in the Official Plan. This approach is currently under review to ensure compliance with the Provincial Policy Statement (2014). At this time, significant woodlands are not specifically identified as such in the urban area, although Urban Natural Feature and Significant Wetland designations likely capture most of what would also be considered significant woodland and are included in the City's natural heritage system. The City is considering a range of approaches that are appropriate for Ottawa and meet the Province's new requirements to address this policy gap.

Within the urban area, many of Ottawa's wooded natural areas are protected as Significant Wetlands, hazard lands and Urban Natural Features. Under the current land use policies (Section 3.2.3 of the Official Plan), designated Urban Natural Features are to be preserved for conservation or passive leisure uses, and

additional such features may be identified and designated through: (a) City acquisition, (b) adoption of a subwatershed or other environmental study that recommends it, or (c) the development review process. No development is permitted within 30 metres of an Urban Natural Feature unless an Environmental Impact Study (EIS) demonstrates that the development will have no impact on the feature or its ecological functions.

Urban Natural Feature is a designation unique to Ottawa's urban area. Many Urban Natural Features were already in public ownership and designated for protection prior to amalgamation in 2000, and additional features were identified through an Urban Natural Areas Environmental Evaluation Study (UNAEES) undertaken over 2005 and 2006. This study did not include the urban expansion areas which were, at that time, part of Ottawa's rural areas. The subsequent Urban Natural Features Strategy (UNFS) (2007) was developed to implement the findings of the UNAEES. Through this strategy, all City-owned Urban Natural Areas were identified for retention (even if assessed as having "low" significance), while privately-owned Urban Natural Areas not owned by the City but rated as being of "high" or "moderate" ecological significance were prioritized for securement, as long as they were not already committed to development. Since 2007, the City has acquired approximately 50 hectares of priority Urban Natural Area and designated them as Urban Natural Features. However, purchase of the remaining medium and high priority urban natural areas (approximately 100 hectares) is becoming increasingly difficult due to rising land values. A staff report to Council in September 2013 indicated that in order to proceed with further acquisitions, additional funding would be required, but none has been approved to date. Under the current policies, if the City is unable to secure the remaining privately-owned Urban Natural Areas, the landowners can apply to have the lands re-designated for development. Any development applications would need to be supported by an EIS and a Tree Conservation Report (TCR) prepared in accordance with the City's guidelines.

A different approach is being implemented in the urban expansion areas where Urban Natural Features were not previously identified or designated. In these areas, potentially significant woodlands are first identified using guidance provided in the Provincial Natural Heritage Reference Manual (OMNR, 2010), then screened for significance using the ecologically-based criteria established in the UNAEES. If the feature scores "moderate" or "high" using those criteria it is considered part of the NHS and is required to be conveyed to the City for a nominal value. If not, it may be developed in part or in whole with the provision of a Tree Conservation Report that is in compliance with applicable guidelines and by-laws.

Outside of significant natural areas, the Official Plan has a range of policies that support the protection, integration, and enhancement of tree cover where possible and appropriate as part of both infill and greenfield developments. These policies, largely found in Sections 2.5 and 4.7, recognize the importance of incorporating shade trees in public spaces and along boulevards, and of incorporating natural spaces into the urban matrix. The policies specifically state that development proponents must:

- demonstrate how the proposed development (such as grading, building locations) has considered tree conservation

- outline measures for the preservation of trees identified for protection (during and following construction)

- describe the tree loss and propose compensation measures (where preservation is not feasible), including specific recommendations for landscaping, including the use of indigenous species.

Sensitive Marine Clay Soils (SMCS) Policy

Several areas of Ottawa are underlain by a unique type of clay soil known as Champlain Sea clay, quick clay, or leda clay, and known in Ottawa as "Sensitive Marine Clay Soil" (SMCS). This clay soil was deposited by rivers flowing into the Atlantic Ocean millions of years ago which, over time, were stripped of salt. Without salt, which binds clay particles together, these soils can be structurally unstable when subjected to stresses or changes in moisture content. Trees may contribute to the destabilization of SMCS as their roots draw water out of the soil and can cause it to shrink, and have been implicated in building foundation damage caused by shrinking and settling SMCS in Ottawa.

In the late 1990s, in an effort to reduce potential conflicts between trees, soils and building foundations in areas of SMCS, Ottawa developed and adopted the *Planting in Areas of Sensitive Marine Clay Policy*. This policy places a restriction on planting "high water demand trees" within less than "a distance equal to their height at maturity" near buildings and rights-of-way.

This policy is supported by the *Trees and Foundations Strategy in Areas of Sensitive Marine Clay* (2005) which outlines a four-phase assessment process to address claims of tree-caused foundation damage in SMCS areas. This process includes a requirement for a geotechnical report to confirm the nature of the soils, a site assessment and review, and implementation of foundation damage mitigation measures, as appropriate. While this strategy recognizes that trees can be a

contributing factor to foundation damage in clay soils, it also recognizes that it is not sufficient, nor accurate, to focus only on the tree when investigating foundation damage claims.

The marine clay planting policy has severely constrained the planting of trees in newer communities built in SMCS areas. With the benefits of large-statured canopy trees and urban forests becoming increasingly recognized, the City and its partners are looking for ways to better integrate trees, particularly large-statured trees, into SMCS areas. Geotechnical engineers and soil scientists agree that some marine clay soils may be less "sensitive" than others, and that more research is required to better understand the relationship between trees, marine clay soils, and foundation damage. In response to these considerations, collaborative work is ongoing among several City Departments, with the support of the development industry, to review the SMCS policy. Changes that allow for more flexibility have already begun to be implemented. This work is being undertaken in conjunction with the implementation of the Building Better and Smarter Suburbs (BBSS) initiative for greenfield developments and updates to supporting guidance documents (described in Section 4.2.3).

Greenspace Master Plan

Ottawa's Greenspace Master Plan (GMP) was finalized in 2006. This comprehensive planning document summarizes existing greenspaces across the urban area, considers opportunities for the protection of existing greenspaces (both natural areas and more formally landscaped open spaces), and explores opportunities for connectivity between these spaces. Data from the UNAEES study (also completed in 2006) were used to inform the natural areas mapping in the urban area (as defined at that time). Key recommendations from the GMP form objectives and policy for urban greenspace in Section 2.4.5 of the Official Plan.

Secondary Plans and Community Design Plans

Secondary Plans and Community Design Plans tailor the city-wide principles and policies of the Official Plan to the unique biophysical and social characteristics and planned land uses of a particular community or neighbourhood. These plans are approved by Council and developed based on technical studies and in consultation with the community, landowners, local businesses, school boards and other interested parties.

Secondary Plans and Community Design Plans play a key role in urban forest planning by:

- confirming the identification and preservation of wooded natural areas, valued groupings of trees, and other greenspaces (such as parks), and

- requiring provision of space for the integration of trees in other components of these communities (such as along pathways, boulevards, arterial roads).

Zoning

Under the provincial *Planning Act* (1990), Section 34, zoning by-laws can be used to protect defined natural features (e.g., wetlands, woodlands) and prescribe setbacks (typically from the lot line). Zoning is prescriptive and tends to be applied broadly to blocks of land, and therefore can be used for assigning a broad land use, and limiting the extent of cover of the given land use, as well as the extent of land to be set aside for landscaping. However, zoning is not used for more site-specific design components, such as the integration of individual or small groups of trees.

In Ottawa, the two zoning categories that are most closely aligned with urban forest protection and enhancement are Environmental Protection (EP) and Parks and Open Space (O1). EP zoning captures designated significant natural areas and features, and includes some of the most heavily treed areas. In O1, where maximum permitted lot coverage is 20%, trees and natural areas can also be readily accommodated. Residential, Institutional (Minor and Major), Mixed Use / Commercial Zones, Industrial Zones, and Transportation Zones are not explicitly supportive of accommodating urban forest assets. However, most of these zoning types require minimum yard setbacks and landscaped areas, and these requirements have been used in Ottawa to support tree protection and/or establishment.

Plans for subdivision, condominium and site plan

Some of the greatest opportunities for site-specific controls related to tree protection exist through the subdivision, condominium and site plan process whereby, according to the provincial *Planning Act* (1990), Section 41, tree protection and landscaping requirements can be specified. In Ottawa, typical requirements of site plans, through the Landscape Plan, include: street tree plantings (generally one per lot), some form of vegetative buffer between the front of the building and the lot line (which may include trees or shrubs), and lot line tree plantings, including at least one canopy tree per 10 metres along each side and rear lot line. Typical requirements of the subdivision process in Ottawa include:

street tree plantings (generally one per lot) and plantings in new parks and around storm water management facilities that will be dedicated to the City. When the right trees are provided with adequate growing conditions these plantings, cumulatively, support the integration of the urban forest into employment, commercial and residential developments.

In addition, all applications for subdivision, condominium and site plan approval in Ottawa's urban area require a Landscape Plan to show the requirements described above. Proposed developments affecting vegetation cover on the site require also a Tree Conservation Report (TCR). In cases where a significant natural area may also be impacted, an Environmental Impact Statement (EIS) that addresses potential impacts to the ecological feature and its functions (and also includes a TCR) is required. EIS and TCR are discussed further in Section 4.2.3.

Committee of Adjustment

Tree conservation issues can also arise at the Committee of Adjustment, where development applications requesting minor variances from zoning by-laws and consent for the creation of new lots are considered. In Ottawa, such applications are reviewed by community members and City staff as part of a public process and are decided upon by Committee members, taking into consideration the comments of City staff, technical agencies and the public. There is no requirement to provide information related to trees as part of this process. The Committee of Adjustment's mandate does not include consideration of trees. Therefore trees are only considered if community members and/or City staff raise them as an issue. Nonetheless, the Committee of Adjustment has, in some cases, been used effectively by community groups and willing developers as a forum for reaching consensus on tree conservation issues.

Outside of the site plan process

For developments outside the purview of the *Planning Act* and where only a Building Permit is required, such as some types of construction or infill, implementing tree preservation and/or replacement can be difficult.

To address this issue, the City has implemented a process, launched in May 2016, to require that all Building Permits submitted for infill developments (single, semi-detached, duplexes and triplexes) include a Tree Disclosure Information form prepared by an Arborist along with a refundable tree deposit, to be refunded once a new tree has been established. These forms must be reviewed promptly, as the City is required to respond to most Building Permit requests within 10 working days and permits cannot be delayed for reasons related to tree information disclosure. This is

because under the *Building Code Act* tree by-laws are not applicable law. Nonetheless, this process provides opportunities to suggest small changes to a proposed project that could result in tree retention, or at least to require replacement where a tree needs to be removed. In Ottawa's urban areas, where there will be ever-increasing pressure for intensification, even these small-scale opportunities can help achieve broader urban forestry objectives.

Capital projects, which include medium to large-sized municipal projects for new infrastructure or upgrades to existing infrastructure, and public realm development projects undertaken by the City, are also generally outside the purview of the *Planning Act.* In Ottawa, TCRs may be requested internally for such projects, but such reports are not consistently required.

4.2.2. Tree by-laws and their implementation

The City of Ottawa currently has two by-laws that specifically regulate activities related to trees: the Municipal Trees and Natural Areas Protection By-law (No. 2006-279) which applies to City-owned lands, and the Urban Tree Conservation By-law (UTCB) (No. 2009-200), which applies to private property in the urban area. Both by-laws are described in more detail below. Ottawa's Road Activity by-law (No. 2003-445) also has a specific section regulating activities around trees on both municipal and private lands to ensure protection and/or replacement where required. The City is in the process of developing a Site Alteration By-law that will regulate grading activities (including topsoil removal) and the placement of fill – two activities that can both have a direct impact on trees and natural areas.

Municipal Trees and Natural Areas Protection By-law

Ottawa's Municipal Trees and Natural Areas Protection By-law was developed to address some of the threats to trees on lands owned by the City, including those related to development, encroachments from existing adjacent land uses, and activities such as vandalism. It regulates the injury or destruction of trees of any size and any species located on municipal lands, including trees along City rights-of-way, in municipal parks, and trees in City-owned natural areas.

City-owned trees and/or natural areas must be identified through the required reports and/or plans for most developments on private lands and for development, infrastructure and utility projects on public lands. City Forestry staff in the Public Works Department are responsible for commenting on these projects to ensure that trees on municipal lands are protected or compensated for in compliance with the requirements of this by-law. City Forestry staff are also tasked with addressing all

claims and complaints related to trees on municipal lands, and other aspects of implementation.

City Forestry staff have a process in place for obtaining replacement trees on public lands that has generally been effective. Staff require either replacement planting(s) and/or monetary compensation when any trees on City lands are approved for removal. When trees on City lands are removed without a permit (in contravention of the by-law) or irreparably injured with or without a permit, the City requires that the cost of removal and replacement be provided as well as the appraised value of the injured tree. A fine may also be imposed. Trees are valued in accordance with the latest edition of the Council of Tree and Landscape Appraisers (CTLA) Guide for Plant Appraisal, or at a value determined by the Director. If trees are proposed to be installed as part of a broader landscape plan, this is taken into consideration as part of the overall compensation requirements.

Urban Tree Conservation By-law (UTCB)

Ottawa's Urban Tree Conservation By-law (UTCB) applies to trees on private lands and has two distinct components:

1. Regulation of all trees (at least 10 centimetres DBH) on lots one hectare in area or greater within the urban area and urban expansion areas (except for condominiums and multi-residential lots), referred to as the "large property" component; and

2. Regulation of "distinctive" trees (trees of at least 50 centimetre DBH) on lots up to one hectare in size and larger lots zoned for condominiums and/or multi-residential uses, referred to as the "distinctive tree" component.

This by-law was developed with the intent of: (a) preventing pre-emptive tree removals on larger properties in anticipation of development, and (b) regulating the removal of large ("distinctive") trees. A Tree Conservation Report (TCR) (discussed in more detail in Section 4.2.3) is required as part of a permit application for the "large property" (greater than 1 hectare) component of the by-law, and for proposed Site Plans or Plans of Subdivision on lots of any size where trees may be affected. The requirement for a TCR on all Site Plans or Plans of Subdivisions, but only permit applications where the lots are greater than one hectare, occasionally creates confusion among applicants. For applications under the "distinctive tree" component of the by-law, a relatively simple Arborist report is required. As discussed in Section 4.2.1, a Tree Disclosure Form is required to be submitted with building permit applications for infill development providing an important opportunity for tree retention in infill situations. For both components of the by-law,

the regulation applies to all species of trees, and replacement trees may be required as a condition of permitting.

An update report on the Urban Tree Conservation By-law was recently submitted by City staff to the Environment Committee, summarizing the available data related to inquiries and permits since 2009 when the by-law was enacted (City of Ottawa, 2016). Findings of this report include:

- The number of inquiries received (through the City's 311 call centre) has decreased substantially since 2010 and 2011 (which staff attribute to efforts made to educate the community about the by-law);

- The number of permits issued annually for "distinctive tree" applications have ranged from 376 to 526 across the urban area, and vary significantly by Ward;

- About 90% of "distinctive tree" permits requested are issued; and

- The number of permits issued for "large property" applications have ranged from 22, in the first year the by-law was implemented, to 162, and have varied from year to year, with significantly more applications being reviewed since 2012.

Site Alteration by-law

The City is in the process of developing a Site Alteration by-law, with the intent of bringing it forward to Council in 2017. A main focus for this by-law will be to define how alterations can be undertaken in accordance with policy directions of the Official Plan to ensure no negative impacts on drainage, natural features, soil and water quality, neighbouring properties, and public health and safety. Such a by-law would apply to activities typically associated with development that involve the clearing and grading of land, including the removal of topsoil and the placing of fill.

4.2.3. Guidelines and specifications

The City of Ottawa has numerous guidelines and specifications pertaining to the protection of existing trees and wooded natural areas and to tree establishment on both municipal and private lands. These include:

- guidelines for Environmental Impact Statements (EIS) and Tree Conservation Reports (TCR) intended to guide reporting required for proposed development on private lands in relation to natural areas and trees outside of natural areas, respectively;

guidelines that focus on neighbourhood and site design and include guidance related to wooded natural area and tree conservation, and tree establishment, for:

  - mainstreet and infill developments (primarily in the urban core), and
  - greenfield developments (primarily outside the Greenbelt and in the urban expansion areas); and

- specifications intended for contractors working on City-led projects that provide site-specific guidance on tree protection and establishment that is consistent with City policies and guidelines.

While EIS and TCR are typically only required for developer-led projects which the City reviews, both studies are also encouraged for capital projects. The other guidelines and specifications are applicable to both developer-led and City-led (capital) projects. These are discussed in more detail in this section.

Environmental Impact Statement (EIS) guidelines

An Environmental Impact Statement (EIS) is required when development or site alteration is proposed within or adjacent to environmentally designated lands or other features of Ottawa's natural heritage system. The guidelines recognize three types of EIS: detailed (typically for large-scale developments), scoped (typically for smaller scale developments such as lot severances), and Urban Natural Feature-specific. In addition to identifying potential impacts to designated features, the EIS must consider potential natural linkages that should be protected and restoration and enhancement measures. The guidelines do not recommend minimum buffers but provide specific direction for determining Critical Root Zones (CRZ) for individual tree protection.

An EIS may incorporate TCR requirements or refer to an associated TCR where site investigations reveal potential negative impacts to areas / trees regulated by the City's tree by-laws, and may need to identify compensation tree plantings to obtain a permit to remove regulated trees. This approach appears to work well in Ottawa.

Tree Conservation Report (TCR) guidelines

Ottawa's TCR Guidelines are nested within the City's Urban Tree Conservation By-law as Schedule A. The purpose of the TCR is to retain and protect existing vegetation in new developments and to show a "design with nature" approach to planning and engineering. TCRs are required for all plans of subdivision, site plan

control applications, common elements condominium applications, and vacant land condominium applications where trees with at least 10 centimetre DBH occur. A TCR that has been approved by Foresters in Planning provides the technical basis for a tree permit, which is required through the planning process and under the Urban Tree Conservation By-law. As noted above, where the site has significant natural areas, an EIS that includes TCR requirements is required.

Guidelines for mainstreet and infill developments

Ottawa has more than a dozen urban design guidelines intended for different types and aspects of development within the city's urban core area. Examples include urban design guidelines, developed since 2006, for main streets, arterial roads, low-rise infill housing, high-rise housing, drive-through facilities, and gas stations. The City's *Park and Pathway Development Manual* also provides guidance related to tree retention and establishment as part of park development or re-development. Many of these guidelines recognize the aesthetic, environmental and health benefits provided by trees in urban areas, and include guidance related to tree protection and establishment.

Tree preservation guidance found in these documents includes: prioritizing protection of trees on streetscapes, incorporation of existing significant natural features, and integrating mature trees by allowing variable front yard setbacks, minimizing grade changes and preserving permeable surfaces. Tree planting and establishment guidance found in these documents includes: minimum boulevard widths and spacing for tree planting, minimum widths for landscape strips and distances for tree spacing, species selection and coordination with underground utilities, use of trees and shrubs for screening, and use of continuous planting pits. Additional guidance as it relates specifically to capital projects is described in Section 4.3.5.

Having specific direction related to the retention and establishment of trees in the guidelines for various types of infill and mainstreet development demonstrates the City's recognition of the importance of the urban forest. However, in practice having this guidance in so many places makes it challenging for proponents, contractors and staff to implement consistently, and for staff to update when needed. In addition, little guidance is provided for the potential use of engineered tree planting solutions in hardscapes. These multiple design guidelines also need to be updated to address current design challenges, such as the introduction of cycle tracks in existing urban streetscapes, where their presence competes for limited space with street trees and sidewalks.

Guidelines for greenfield developments

Primary guidance for greenfield developments is found in the recently approved *Building Better and Smarter Suburbs: Strategic Directions and Action Plan* (BBSS) (2015). There are also *Urban Design Guidelines for Greenfield Neighbourhoods* (2007) which are currently being updated (to be called the *Urban Design Manual for New Neighbourhoods*) and the *Street Tree Manual for Greenfield Neighbourhoods*, which is currently in draft form and must be updated and finalized. These documents are meant to assist with the preparation of Secondary Plans, Community Design Plans, and Plans of Subdivision, and are to be referenced when updates to the Official Plan and Zoning By-laws are considered.

BBSS is a major initiative intended to improve efficiencies and livability in new suburban subdivisions. Its Action Plan includes direction specifically related to trees, including the following.

- Incorporating existing trees, woodlands and hedgerows in parks, open spaces and school sites wherever possible, including improving retention of healthy trees and treed areas in new neighbourhoods.

- Finalizing design options that will consolidate utilities (and other design considerations such as snow removal and traffic calming) in new rights-of-way cross-sections in order to provide greater space for trees, including consideration of street tree species recommended in the draft Street Tree Manual for Greenfield Neighbourhoods.

- Working to better support tree planting and establishment for plans of subdivisions in SMCS areas by:

    - having geotechnical assessments include more precise parameters for determining the type (plasticity and sensitivity) of the clay soils;

    - considering expanding the tree species list and reducing minimum setbacks between trees and building foundations in the SMCS Policy (described in Section 4.2.1) where the clay soils are deemed to be less sensitive; and

    - considering the use of soil cells and/or root barriers to mitigate risks to foundations that may be increased in SMCS areas.

- Reviewing options for giving developers credit for retaining and/or transplanting mature trees in new plans of subdivision.

BBSS working groups have been developed to implement this direction and develop strategies for, among other things, improved tree retention and establishment in rights-of-way, park typologies, and plans of subdivision in greenfield developments.

The *Urban Design Manual for New Neighbourhoods* is being developed to advance various strategic directions and action plans flowing from the BBSS initiative, and is intended to consolidate the key directions from a broader range of policy documents and studies. It is anticipated that this manual will include comprehensive guidance on design elements in greenfield developments, including trees.

To address the unique challenges of establishing and sustaining trees in rights-of-way, the City has also developed, and is continuing to revise, a *Street Tree Manual for Greenfield Neighbourhoods* (in draft form at the time of UFMP development), which is intended to apply to all new communities in Ottawa.

The City's *Park and Pathway Development Manual* (2012) provides guidance related to park development in greenfield areas, and includes support for the preservation of existing trees with standards for establishment of multi-use pathways outside of tree Critical Root Zones and requirements for park tree preservation plans. This manual is being updated to ensure consistency with the BBSS initiative.

Specifications

The City has developed a number of specifications related to tree protection and establishment that are provided to contractors (retained for City-led projects). These specifications are used for capital projects and are maintained and overseen by the Infrastructure Services Department. They include: general specifications for construction activities around trees, field practices and compliance with tree by-laws (D-014), specific measures for tree protection (F-8011), requirements for plantings related to hedgerows, nursery stock and reforestation (F-8047), and provisions for an extended warranty period for plantings (F-8024) which can be used for plantings valued at more than $200,000. No city-wide details for "hardscape" planting solutions (such as open planters or soil structural engineered solutions) currently exist – these are developed on a case-by-case basis for individual projects.

4.2.4. Opportunities for improving planning for the urban forest

Improved implementation of existing policies through internal outreach and engagement

Ottawa's Official Plan is among the growing number of municipal Official Plans that explicitly recognizes the role of the urban forest in helping communities remain sustainable, including mitigating and adapting to the impacts associated with climate change. It includes direction and policies that are generally supportive of urban forest protection, establishment and enhancement, both within and outside of wooded natural areas. It also states where compensation is required when approved development requires the removal of trees. These policies are appropriate for Ottawa to help protect and enhance its valued green infrastructure, while also being flexible and balanced enough to accommodate the range of intensified land uses needed to meet Ottawa's growth and community design objectives.

However, the City has some challenges related to consistent implementation of urban forest policies and multi-departmental coordination on tree-related issues. There also appear to be gaps in the understanding of existing urban forest policies and practices among City staff and others who do not deal with tree-related issues as a core part of their work. This is a common challenge in municipalities, and is compounded in Ottawa due to both its physical size and the size of its administration. The solution to this challenge lies in establishing more formal lines of communication and for City staff directly involved in urban forestry to undertake internal outreach and education to improve awareness and implementation. Specific guidance is provided in Recommendations #2 and #6.

No specific recommendation is provided for minor updates to the Official Plan which may be needed in relation to implementation of the UFMP (such as possible changes to the tree canopy cover target in relation to updated analyses to be undertaken) and which can be undertaken as required by City staff. The only substantive policy update needed is related to the significant woodlands policies in the urban area, as discussed below.

Updates to significant woodlands policies in the Official Plan

With respect to wooded natural areas in Ottawa's urban area, the City is in keeping with current best practices as it has undertaken a comprehensive technical study to identify and evaluate urban natural areas based on ecological criteria (Muncaster and Brunton, 2005; Muncaster and Brunton, 2006). However, Ottawa's Official Plan does not specifically refer to any features as "significant woodlands" within its urban area or include specific criteria for identification of such features. The Province and

the City have identified the lack of specific criteria for significant woodlands in the urban area as a gap in Ottawa's Official Plan that needs to be addressed. A review of these policies, supported by this Plan, to address this gap is underway.

City staff also have the challenge of working within a current policy framework which essentially requires the City to acquire privately owned candidate Urban Natural Features (outside of the urban expansion areas) or allow them to be developed in part or in whole (subject to a Tree Conservation Report in compliance with the City's guidelines and by-laws). Given the current lack of funding to continue outright acquisition of such features, as has been done in the past, the review of the significant woodlands policies presents an opportunity to explore other alternatives to securement of these wooded areas. Specific guidance is provided in Recommendations #7 and #14.

Improved implementation of existing planning tools through enforcement and education

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), the City of Ottawa's current status for the indicators of *tree protection policy development and enforcement* (Criterion M11) and w*ooded natural area retention and protection policy development and enforcement* (Criterion M12) is "moderate". This status reflects the fact that policies are in place to protect public trees and wooded natural areas that are generally in-line with best practices, but are not consistently enforced. It is anticipated that the significant woodlands policy updates currently in progress will bring these policies in-line with best practices.

Although the City of Ottawa has policies and planning tools that are supportive of urban forest protection, establishment and enhancement, City staff's ability to follow up on approved plans to verify if forest and/or tree protection has been implemented "on the ground" as approved is limited. This limitation is particularly apparent as a significant proportion of existing urban forestry staff time and related resources are currently allocated to management of EAB-infested ash trees on municipal lands. However, it is anticipated that within a few years, once the bulk of the EAB-related activities have been undertaken, some staff resources can be re-aligned towards improved enforcement of the City's existing urban forest policies, guidelines and by-laws. Specific guidance is provided in Recommendation #10.

There could also be an opportunity for the Committee of Adjustment and City Planners to take a more active role in: (a) requiring information about trees on site as part of their applications, (b) working with City Forestry staff to ensure proposals are in conformance with existing policies and by-laws related to trees, and (c) considering opportunities for tree protection and/or establishment. Communication

about the City's urban forest policies, by-laws and guidelines, and their implementation between City staff and the Committee of Adjustment and City Committee of Adjustment Planners is a task specified under Recommendation #6.

Review and update the City's tree by-laws

Together, the Municipal Trees and Natural Areas Protection By-law, which applies to City lands, and the Urban Tree Conservation By-law (UTCB), which applies to private property in the urban area, provide comprehensive regulatory coverage of the urban forest in Ottawa's urban area. The Site Alteration By-law, currently being developed, will provide an additional regulatory tool to help ensure that trees are identified and considered through the site alteration and development process. However, there are a number of ways Ottawa's tree by-laws, and their implementation, could be improved.

The scope of the Municipal Trees and Natural Areas Protection by-law is already very comprehensive, as it regulates all trees on all City-owned lands. However, there are some opportunities for improvement, as outlined below.

- The technical loopholes in the language of the current by-law, which have prevented enforcement in some cases, should be reviewed and eliminated in consultation with City legal counsel.

- Although the current approach to compensation works reasonably well, the by-law should allow for a range of appropriate approaches suited to different scenarios in the Ottawa context (rather than prescribing at least a 1:1 replacement of 70 mm caliper trees). Tree compensation need not (and should not) take a "one size fits all" approach. Approaches should be based on, at a minimum, a "no net loss" approach in terms of long-term tree canopy cover, and should be formalized and included in City-wide guidance for tree compensation (see Recommendation #14).

- Currently, TCRs may be requested for some capital projects, but are not required for all such projects. Such a requirement would ensure that opportunities for retention of existing trees and for tree establishment are consistently explored at the outset of these projects when it is most feasible to adjust plans to accommodate trees and tree preservation.

- Staff in Forestry Services should better coordinate with reviewers in other departments so that comments related to trees are integrated, particularly on sites where trees on both City and private lands must be considered.

Specific guidance related to the Review of the Municipal Trees and Natural Areas By-law is provided in Recommendation #8.

Ottawa's UTCB, like other private tree by-laws in Ontario, has been tailored to address local municipal issues and concerns with consideration for the available resources. Given the time elapsed since the UTCB was first enacted and the increasing growth pressure in the urban area, its review is warranted. Areas identified for consideration and potential improvement include the following:

- *Simplify the application of "large property" component of the by-law.* Under the current by-law TCRs are required for all site plans and plans of subdivision, irrespective of property size, but the UTCB only applies to those that are more than one hectare. The process would be simplified if the current large property component of the by-law applied to all site plans and plans of subdivision, irrespective of size.

- *Consider a heritage tree component.* Heritage trees are defined in different ways, and may be formally designated under the *Ontario Heritage Act*, but generally include trees which are of particular historic, environmental, cultural and/or social value in a given community. Defining such trees, and more stringent regulation of such trees under the UTCB, should be considered.

- *Ability to request deposits for trees being protected.* Currently under the "large property" component of the UTCB, the City can request securities for planted trees, but not for trees identified for protection. Securities can help ensure that trees are protected as specified in a TCR and/or EIS.

- *Ability to require compensation.* In both the "large property" and "distinctive tree" portions of the by-law, replacement of trees permitted to be removed is allowed but not required. Given the increasing pressure on Ottawa's urban forest and the City's target of maintaining and expanding its canopy cover, this by-law should require compensation for all trees approved for removal using approaches that are appropriate and reasonable for Ottawa (see Recommendation #14).

- *Review of the size threshold for "distinctive trees".* Although smaller DBHs were originally considered, the 50 centimetre DBH threshold was agreed to in 2009 in recognition of the size of the City's urban area and the significant additional resources that would be required to regulate a private tree by-law with a lower tree size threshold. This leaves a number of relatively mature trees unregulated. However, it is important to recognize that although the UTCB may deter the illegal removal of regulated trees, it cannot be used to stop removals proposed

in accordance with the by-law. In practice, a private tree by-law: (a) provides a mechanism for outreach and education (that can sometimes result in tree conservation), and (b) provides a legal basis for considering tree conservation as well as compensation for trees approved for removal. As such, a proposed change to the current by-law that reduces the 50 centimetre DBH threshold for "distinctive trees" should consider the anticipated additional resource requirements in relation to the potential benefits of making this by-law more restrictive, and in relation to other urban forest management priorities in need of additional resources.

Ottawa's TCR guidelines, currently appended to the City's UTCB as Schedule A, include all the basic requirements of a tree inventory and preservation report. However, these guidelines would benefit from a review and update in relation to relevant precedents and best practices. Such a review, which would need to be undertaken as part of the UTCB review, would help ensure the provision of more consistent and high quality Tree Conservation Reports. In addition, TCRs are currently required for almost all development applications on private lands, but not for capital projects on City lands. A requirement for TCRs for both public and municipal projects would ensure that opportunities for tree conservation and establishment can be considered early on in the project planning process, and that a more consistent approach to tree assessment and preservation is implemented throughout Ottawa.

Specific guidance related to the UTCB review and update is provided in Recommendation #8.

Better "on-the-ground" enforcement of both tree by-laws (see Recommendation #10), and better coordination with City of Ottawa By-law Services to ensure the appropriate information is collected to support charges being laid when needed (see Recommendation #6) would also improve implementation and compliance.

Although many municipalities have by-laws to regulate tree removal, few have developed approaches to tracking the effectiveness of their by-laws. In Ottawa, feedback from the public on the staff report on the UTCB conveyed appreciation for the work done to date, but also dissatisfaction with the way the metrics were reported and a desire for more specific data to be reported more frequently. Reporting on the status of the UTCB once per calendar year (current City practice) is reasonable and facilitates year-to-year comparisons. A cost-effective mechanism to track actual numbers (and diameters) of trees retained and removed, as well as those planted, should be considered (as noted in Recommendation #10) if resources permit.

Site Alteration By-law

An increasing number of municipalities are developing and enacting site alteration by-laws, in recognition that these by-laws can be used to ensure that existing trees are documented and that opportunities for conservation and establishment are explored through the development process. In Ottawa, a Site Alteration by-law should be developed to complement and work in conjunction with established tree by-laws and to ensure that proposed grading does not negatively impact any protected wooded areas in adjacent lands. No specific recommendation related to this by-law is provided in this Plan, but it is recognized as a related initiative that is in progress.

Updates to and consolidation of existing tree protection and planting guidelines for infill development, including hardscapes

Currently, guidance for tree retention and establishment in infill developments is included in more than a dozen different guidelines, while guidance and details for hardscape planting solutions (such as open planters or soil structural engineered solutions) are developed on a case-by-case basis for individual projects. While some of the guidance provided is innovative, progressive and consistent with best practices, having the guidance dispersed among various policies and guidelines makes it challenging to manage, update and use. The current guidelines also lack comprehensive guidance (including specifications) related to integrating trees in hardscapes that would be useful for infill and downtown settings.

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), the City is given a "moderate" status for *growing site suitability* (Criterion M8) as appropriate species are considered and a range of guidelines are in place, but municipality-wide guidelines for the improvement of planting site conditions and selection of suitable species are not yet in place.

Harmonization of guidelines and specifications for tree protection and establishment for infill developments and hardscapes in a dedicated document would not negate the need for community specific design guidelines, but would greatly simplify the tree establishment-related guidance by referencing a single resource document. It would also allow for the innovative and progressive policies related to tree planting and establishment in the various guidelines described above to be consolidated in one central resource for ease of reference, review, and updating. Specific guidance is provided in Recommendation #9.

Notably, as a part of the development of City-wide technical standards for engineered tree planting solutions, City staff will need to resolve what funding will

be used for City capital projects versus development projects, who will be responsible for the maintenance of the engineered solutions, how to integrate these solutions with access for utilities, and what the approval process for these installations will be.

Updates to and consolidation of existing tree protection and planting guidelines for greenfield developments

A number of initiatives are already underway to update guidelines related to tree protection and planting in greenfield developments. Under the umbrella of the Building Better and Smarter Suburbs (BBSS) initiative, the *Urban Design Manual for New Neighbourhoods* (an update to the greenfield design guidelines) is being developed and is intended to consolidate the key directions from a range of policy documents and studies. The City has also recently developed, and is revising, the *Street Tree Manual for Greenfield Neighbourhoods* and is also working on related revisions to its *Planting in Sensitive Marine Clay Soils (SMCS) Policy*.

As part of the process to ensure internal harmonization and consistency with best practices, all of the City's standards and specifications related to tree protection and establishment for greenfield developments should be consolidated in the *Street Tree Manual for Greenfield Neighbourhoods*, which will provide technical support to the *Urban Design Manual for New Neighbourhoods*. The consolidated guidance should include existing streetscape standards to be considered through the infrastructure standards review, the new right-of-way cross-sections to be developed through the BBSS review, and specifications and details for tree planting in conventional settings (such as planting pits, trenches and other softscapes).

The widespread presence of marine clay soils in Ottawa, particularly in new development areas, means that SMCS areas will continue to be an issue that requires the ongoing cooperation of the development industry, residents purchasing homes, and the City to ensure tree planting and tree maintenance practices support development of a mature forest cover in these communities. Guidance should integrate new information from partnerships in research and monitoring as it becomes available, including input from advisors in Building Code Services and external geotechnical engineers.

The final *Street Tree Manual for Greenfield Neighbourhoods* should inform tree protection and establishment for greenfield development undertaken by private proponents, contractors working on capital projects, and Forestry Services. This manual should also be made available to community groups, members of the public and other stakeholders to inform activities such as community-based planting or tree establishment on private lands. This will facilitate development review, ensure

more consistent City-wide approaches are implemented, and result in more successful tree protection and establishment in Ottawa.

Specific guidance is provided in Recommendation #9.

4.3. Maintaining and growing the urban forest

Trees in the urban forest require a long-term commitment to management and care to sustain and improve tree longevity, to reduce tree-related risk, and to ensure that urban forest benefits are provided equitably across the city. Ongoing urban forest maintenance activities undertaken on City lands include tree inspection, pruning, removal, fertilization, risk mitigation and establishment (including watering, mulching and pruning newly planted trees). These activities are largely undertaken or overseen by the City's Forestry units, although some other departments are also involved and both Hydro One and Hydro Ottawa undertake regular pruning of trees on public and private lands along their corridors.

The City of Ottawa, its partners and other stakeholders also undertake a range of programs and initiatives to grow the urban forest. Trees are planted in the urban area as part of various Forestry-led operating programs, as part of municipal capital projects, and through planning requirements for development (described further in Section 4.3.5). Trees are also planted through community-supported and community-led efforts in the City's natural areas and on private lands (described further in Section 4.4).

4.3.1. Street and park tree maintenance

Maintenance of municipally-owned and managed trees in Ottawa is guided by the City's 'Trees and Forests Maintenance Program' and associated 'Trees and Forests Maintenance Quality Standards'. The program outlines the general approach to maintenance of the urban forest, while the quality standards establish the target levels of service for different types of trees. The general operating principle of the 'Trees and Forests Maintenance Program' is to take a lifecycle approach to tree maintenance.

Maintenance of established street and park trees

The Forestry units are responsible for the maintenance of trees located along City streets and within City parks throughout the urban area. Currently approximately 161,000 such trees have been inventoried, and approximately 100,000 more are expected to be added as the City's urban and rural parks inventories are completed.

Ottawa's established street trees are maintained through a combination of cyclical and reactive maintenance. The targeted level of service is to undertake inspection and, if necessary, maintenance on a seven-year cycle for most established street trees and actively-managed park trees. Since the cyclical approach to street and park tree maintenance began over 2009-2010, one full tree pruning cycle was pending completion at the time of UFMP development. Currently, street tree pruning and tree removals (along with replacements) are undertaken by City Forestry Staff or by external contractors.

Upon completion of the urban, rural and park tree inventory, the pruning program will be reviewed to ensure that annual neighbourhood-based tree maintenance plans are relatively balanced in terms of required resource expenditures and trees pruned. It is anticipated that additional resources will be required to sustain the seven-year maintenance cycle for established trees.

Trees that are considered more "at risk" are targeted for inspection (and maintenance when required) more frequently than every seven years. These include trees in hard surfaces, trees with structural support systems (such as cabling or bracing), and trees vulnerable to pests and diseases (such as ash and elm). To address and mitigate the potential effects of trees on Sensitive Marine Clay Soils (SMCS) and building foundations, Forestry also inspects and prunes trees in some SMCS areas on a more frequent basis than other street trees, and adds them to the summer watering program. In addition, maintenance in response to public service requests (typically made using the ServiceOttawa/311 system) is undertaken on a priority basis and as resources permit. In 2015, Forestry received over 17,000 service requests including requests for tree inspection, by-law enforcement, park tree maintenance and other actions. There is a service backlog for both street and park trees.

Maintenance of newly planted trees

Trees planted for less than three growing seasons are considered newly planted trees, and receive a different level of service than established trees. Trees planted by the City on municipal lands are watered on a regular basis, and are mulched in their first and third years. They are also structurally pruned once following completion of the three-year watering and establishment period by City of Ottawa nursery staff. They are then transitioned to the seven-year maintenance pruning cycle for established trees. However, this proactive approach is not currently in place for all newly planted trees to be assumed by the City across the urban area.

Street and park trees in new developments and capital projects planted by contractors become the management responsibility of the City upon assumption.

Newly planted trees are covered by a two-year warranty period following the initial planting, and developers are responsible for maintenance and replacement within this period. At the end of the warranty period, these trees are to be inspected prior to assumption and a report (an F2 Inspection Report) which confirms that all trees are present and healthy is to be completed.

Currently, for greenfield developments, the developer's Landscape Architect must complete the F2 Report and submit it to the inspection staff in Planning for review. For City projects, the form is to be completed by the contractor's Landscape Architect, who submits the report to Forestry to input the data into the tree inventory. Although staff from Forestry are not regularly involved in the inspection of trees before they are planted, a process for performing quality assurance inspections and approving plant material by Forestry has been developed and is being finalized.

Most trees planted in new subdivisions are not added to the inventory or brought into Forestry's lifecycle maintenance programs until the subdivision is inspected by Forestry Inspectors as a part of the lifecycle maintenance program, and that can occur years after construction. This gap in inspection and maintenance between the end of the warranty period and entry into the tree inventory may allow poor structure or otherwise poor tree conditions to develop, creating future management challenges and potentially resulting in increased maintenance costs.

Urban tree products

Urban wood waste is primarily generated through the removal and pruning of trees as part of general urban forest maintenance. In the past, Ottawa's waste wood has been used for purposes such as landfill cover, compost, and mulch. Suitable waste wood has also been provided to private contractors to be processed into fuelwood, thereby reducing disposal and waste management costs for the City. More recently, the advent of EAB has significantly increased the volume of waste wood generated in Ottawa, especially as ash-dominated woodlands are managed to remove EAB-infested trees. In response, the City has engaged a local company to accept all of the City's ash logs through a competitive bidding process. This relationship reduces the City's wood waste management costs and enables ash wood to be utilized for purposes beyond fuelwood, chips or mulch. For example, the City will utilize local ash lumber in the construction of future Light Rail Transit (LRT) stations.

The City has also recently begun to explore opportunities and processes to repurpose valuable urban wood and make it available to local artisans, schools and community groups. However, there is currently no strategy or process in place to formalize and guide these activities.

Fruit and nuts from urban trees are also urban tree products, and collection and distribution of food from trees can be seen as another form of waste diversion. The City has some agreements in place for organizations or individuals to harvest fruit and nuts from City-owned trees. However, there is no City strategy in place for the collection and distribution of food resources from urban trees.

4.3.2. City-owned woodland management

The City currently owns over 2,100 hectares of woodlands in its urban area, including designated Urban Natural Features (discussed in Section 4.2.1). The ecological assessment of Ottawa's urban natural areas undertaken in 2005 and 2006 (the UNAEES) identified a number of management issues which continue to present challenges for City staff. These include:

- The need for invasive species management in many of these areas due to the presence of garlic mustard, dog strangling vine (black swallow-wort), European highbush cranberry, Manitoba maple, and glossy and black buckthorn;

- encroachments from adjacent land uses (e.g., dumping of yard waste, expansion of mown lawns, dumping of other waste); and

- informal trail creation which negatively impacts indigenous flora and habitats, and can lead to erosion.

Tree maintenance and management within City-owned woodlands is undertaken by Forestry units, primarily in woodlands with formal public access. This work is currently focused on tree risk management and emerald ash borer (EAB)/ash tree management, as described below:

- Tree risk management in City-managed urban woodlands is primarily undertaken on a service request basis. There is currently no formal process in Ottawa for the inspection of trees along woodland edges, trails or within woodlands for indicators of tree risk, except in relation to ash trees.

- EAB and ash tree management in woodlands is undertaken through the 'Woodlot Rehabilitation Program'. Ash trees in woodland areas are not injected due to cost, logistics and other constraints to feasibility of treatment. Since 2013, ash trees in numerous woodlands have been removed and a number of woodlands are being rehabilitated through invasive species control, seeding and tree replanting. Reforestation plans have been developed for many woodlands where ash made up a significant component of the canopy, but buckthorn and other

invasive plant species continue to be a challenge in some woodlands as they fill the gaps created by the removed ash trees.

Some invasive species management has been undertaken in conjunction with post-EAB woodland restoration efforts or on an otherwise reactive basis. The City's capacity to plan for and manage its woodlands has been constrained due to the efforts and resources required for EAB management.

A Forested Areas Maintenance Strategy (FAMS) to address these challenges is being developed by the Forest Management unit. The objective of the FAMS is to maintain and improve the health and condition of City-owned woodlands/forests in Ottawa's urban and rural areas. It is expected to identify approaches for managing existing threats such as invasive plants, climate change and human influences, and for undertaking forest maintenance operations such as pruning, thinning, hazard tree removal, maintenance of naturalization plantings, and forest inspection and monitoring.

4.3.3. Risk management of City-owned trees

In addition to the limited risk management of City-owned urban woodlands (see Section 4.3.2), Forestry is responsible for the inspection and maintenance of street and park trees to assess the level of potential risk posed to persons or property and, if identified, reduce the likelihood of tree failure and target impact.

The majority of Forestry Field Operations staff have received integrated tree risk assessment training provided by Arboriculture Canada Training and Education, and some Forestry staff are the ISA Tree Risk Assessor Qualified (TRAQ). Street and park tree risk management is primarily undertaken as part of cyclical tree inspections through the pruning cycle (described in Section 4.3.1) and resident service requests. The City's street and park tree inventory (described in Section 4.1.2), which is continually being expanded, does not currently include a risk assessment or risk rating for inventoried trees. When risk issues are identified by Forestry Inspectors or tree maintenance crews, mitigation measures (which may include pruning, removal or installation of structural supports) are prescribed and implemented on a priority basis. There are currently approximately 680 City-owned trees with existing structural support systems such as cabling or bracing to be inspected annually.

In Ottawa, the potential risks associated with planting trees in areas of Sensitive Marine Clay Soil (SMCS) because they may be a contributing factor in foundation damage are currently addressed through a special policy for planting in SMCS

areas. These policies (described in Section 4.2.1) are currently being reviewed to better support the integration of trees in new developments in SMCS areas.

4.3.4. Urban forest pests and diseases

Many pests and diseases can impact the health of trees in the urban forest, but only a few of them impact the tree so severely that it results in the tree becoming a hazard and/or being killed. Emerald ash borer (*Agrilus planipennis* Fairmaire) (EAB) is one such pest which is sweeping across eastern North America, and has resulted in the near total loss of the ash trees in Ottawa and elsewhere. In Ottawa it is estimated that they represented 20% to 25% of the urban forest canopy, with a significant representation among both street and park trees and in woodlands. By 2015, over 24,500 ash trees on City-lands had been removed by the City and over 2,000 had been selected for treatment. This urgent management response has cost over $29 million since implementation of the City's EAB management strategy in 2009. In addition, thousands more ash have been removed from private and other public properties, with a minority being given treatment, further contributing to the city-wide loss of this species.

Ottawa's approach to management of EAB on its lands, as in many municipalities, has been to focus on proactive and reactive removals (and replacement with other trees) for street and park trees, and to undertake targeted removals in City-owned woodlands (discussed in Section 4.3.3). Selected ash street trees identified for retention have been receiving annual injections with TreeAzin, a systemic insecticide intended to control EAB. To date, retention efforts have been fairly successful, with a small number of the injected ash trees succumbing to EAB mortality each year.

Currently, most EAB-infested City-managed ash street trees have been removed from the urban area, and efforts are now focused on management of suburban and rural ash trees along roadways, in actively-managed parks, and in City-managed wooded areas. The City has also worked with the NCC and Canadian Forest Service to introduce natural predatory wasps to control EAB, and is reviewing other EAB control options as part of its ongoing and adaptive EAB management program.

Urban forest pests and diseases other than EAB are managed on a case-by-case basis, with appropriate responses determined upon assessment of the pest or disease issue. Many cases are resolved passively, while others may necessitate tree pruning or removal. Active control methods such as pesticide application are only used in response to significant urban forest health issues and under targeted programs, such as the City's EAB and Dutch elm disease (DED) management efforts. Where Butternut (*Juglans cinerea*) trees on City lands infected by the

Butternut canker represent a hazard, proposed management activities must go through a permit process approved by the Ministry of Natural Resources and Forestry because this tree species is listed as provincially endangered.

As a member of the Regional Forest Health Network (RFHN), the City works collaboratively with other groups and agencies to address forest health issues of regional significance.

4.3.5. Tree establishment

The bulk of the City's current activities related to tree establishment focus on lands that are already, or are to be, owned by the City.

Municipal tree planting programs

Tens of thousands of trees are established each year on municipal lands, including streets and parks, through various Forestry-led programs. These programs include:

- Lifecycle renewal (as part of routine maintenance)
- EAB management (described in Sections 4.3.2 and Section 4.3.4)
- Trees in Trust (planted by the City within the road allowance fronting the homeowner's property on their request with a commitment by the homeowner to water it for the first three years)
- Commemorative Tree Planting (within a City park, requested and paid for by one or more community member)
- Schoolyard Tree Planting Grant Program (provides grants to schools or other interest groups for tree planting projects on school grounds)
- Community planting projects (partners the City and community members to reforest or naturalize areas in parks, City facilities such as stormwater management ponds, or other suitable greenspaces), and
- Other programs (support may be given to individuals or community groups, such as Scouts Canada, for tree planting on City lands upon request)

In an effort to increase the number of trees planted, the City has also launched a sponsorship campaign for tree planting on municipal lands under the Community

Champions Program. These sponsored trees will contribute towards the overall goal of planting 1 million trees for 2017 and beyond.

Two programs that supported tree planting on private lands and were administered by the City are no longer in place. These were the TREE (Tree, Reforestation and Environmental Enhancement) and the Urban Tree Island programs.

- The TREE program, which operated between 2007 and 2010 as a time-limited initiative, offered trees to residents on a first-come first-served basis at no charge to the homeowner. Residents typically planted the trees they received through this program in backyards in the urban area.

- The Urban Tree Island program, started in 1996 by the former Regional Municipality of Ottawa-Carleton, enabled Forestry staff to investigate opportunities to plant trees on private properties adjacent to road rights-of-way, if the property owner committed to maintaining the tree in its planted location.

These programs will be considered through Recommendation #13.

Tree planting and establishment through capital projects

Trees are also planted in Ottawa as part of City capital projects, such as roadway reconstruction. Parks may be developed by the City as capital projects, or by developers as part of new developments. While developer-driven plans are subject to review by Planning staff and must conform to the applicable policies and guidelines for tree retention and planting (as discussed in Section 4.2), tree planting for capital projects is guided by the applicable design guidelines, technical manuals, and/or construction details. An overview of the City's guidelines and specifications is provided in Section 4.2.3. Guidelines and specifications particularly relevant to tree establishment for capital projects include:

- The *Road Corridor Planning and Design Guidelines: Urban and Village Collectors, Rural Arterials and Collectors* (2008) which provide general guidance for streetscape design, as well as typical plan views and cross sections for various right-of-way (ROW) configurations. Specific guidance includes: consideration of a 'back row' of trees as a major design objective, even if planting on private property adjacent to the ROW is necessary; planting trees in deep continuous soil trenches in highly urban contexts without green boulevards; and the need to coordinate with utilities (including Hydro Ottawa) and infrastructure.
- The *Park and Pathway Development Manual* (2012), which is currently being updated, provides design and technical guidance for City-built and developer front-ended or built park projects. The manual establishes a 30% tree canopy

cover target for all park typologies, and a 20% naturalization target for District and Community Parks. It also requires indigenous species be planted in parklands adjacent to natural features.

- *Downtown Moves: Transforming Ottawa's Streets* (2013) is a comprehensive urban design and transportation study that (among other things) identifies ways to improve the streetscapes in Ottawa's Central Business District. Strategies include: developing an updated set of urban tree details and specifications for use in standard road construction documents. This document also establishes minimum soil volume requirements and identifies soil cells (see Figure 10) and structural soils as a potential solution along highly urbanized roads.

Figure 10: Installation of Silva Cell structural soil cells to provide adequate soil volume for trees along Gladstone Avenue. Image source: Douglas Associates Landscape Architects, 2015 (drcla.ca).

- Ottawa's Infrastructure Services Department maintains specifications and standard detail drawings outlining requirements for construction of infrastructure

to be owned and maintained by the City which are added to contract tenders, as appropriate. Most tree planting-related detail drawings were updated in 2014 or 2015 and generally reflect currently-recognized best management practices. No detail drawings are available for structural soil or soil cell options. A few technical details in the specifications (such as requirements for fertilization without a soil chemical analysis and use of corrugated plastic pipes as tree guards) are inconsistent with best practices.

- The Complete Streets Implementation Framework has been developed by the City to ensure that opportunities to incorporate Complete Streets elements (including trees) are considered at the outset of capital projects, as well as through the subsequent planning and design process.

In addition to major capital projects such as road reconstructions and downtown revitalization initiatives, trees are also planted when park infrastructure is replaced. Contractors are retained by the Parks, Recreation and Cultural Services Department and Forestry staff are circulated on park plans to comment on tree species selection and locations.

Procurement of nursery stock and species selection

The City either purchases trees for Forestry-led programs through a competitive tender process (which are planted by Forestry and/or their program partners), or has contractors purchase (and install) trees under City supervision. Capital projects are supervised by Infrastructure Services staff, while municipal operations are generally supervised by Forestry staff.

When trees are purchased for Forestry programs, City staff has an opportunity to assess and control the quality of tree stock at the City's holding nursery, where trees supplied by wholesale nurseries are held prior to planting. Staff also occasionally visit wholesale nurseries to inspect stock prior to procurement. However, when stock is procured and planted by contractors it is more difficult to control the quality of what is planted.

The City has also been increasingly committed to obtaining indigenous stock that is, where possible, sourced from local or other known sources. Starting in 2009 the City required indigenous maple tree stock, and since 2015 the City has had a seed source requirement for indigenous stock for all tree species. The City has been working with the Forest Gene Conservation Association (FGCA) to set appropriate seed zone requirements, and in April 2015, reaffirmed that nurseries submitting bids to provide maple trees must be recognized by the Maple Leaves Forever

Foundation as providing trees from certified Canadian sources and grown locally from seed of known genetic sources.

The City has also been planting novel or less-frequently used species from more southern zones on a trial basis in various locations across the city in recognition of the fact that these trees may be better suited to adapting to climate change conditions than some of the indigenous trees from local seed zones.

4.3.6. Opportunities for improving urban forest maintenance and growth

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), the City is considered to have a "good" status with respect to *tree establishment and implementation* (Criterion M7) because tree planting is guided by municipality-wide goals, with some post-planting establishment care. However, to have an "optimal" status the City would require a comprehensive tree establishment plan guided by a canopy cover assessment that is sufficient to meet canopy cover objectives. This gap is to be addressed in part through Recommendation #4 for a comprehensive canopy cover assessment, and through the recommendations for improving both young tree maintenance and establishment referred to in this section.

Sustaining current levels of street and park tree lifecycle pruning

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), for *maintenance of publicly-owned intensively-managed trees* (Criterion M9) Ottawa has been given a "good" rather than an "optimal" status ranking because all publicly-owned street trees are included in a seven-year inspection / maintenance cycle, but park trees have yet to be integrated into this system.

The City's seven-year cycle for pruning street and park trees is consistent with best practices for urban forest management. The more frequent inspection cycles for certain categories of trees (such as for trees in SMCS areas - particularly where foundation claims have been made, for trees with bracing or cabling, and species known to be susceptible to serious pests and diseases) is also in keeping with best practices. These inspection and pruning practices should therefore continue to be supported and implemented, even though this will require additional resources as more City trees (particularly from parks) are added to the maintenance program. Specific guidance is provided in Recommendation #15.

Improved maintenance of newly planted trees

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), for *maintenance of publicly-owned intensively-managed trees* (Criterion M9) Ottawa has also been given a "good" rather than an "optimal" status ranking because not all immature trees under City ownership are structurally pruned within the first ten years after they are planted.

Pruning a newly planted tree at least three times during the first 10 years of its life (which can be conducted from the ground using hand-operated tools such as pole pruners or hand saws) is one of the best possible investments in the future urban forest. This early investment can provide trees with good structural form which greatly reduces future likelihood of failure and associated risk to people and property, and reduces the need for arboricultural maintenance as the trees mature.

Currently, trees planted by City staff are structurally pruned once following completion of the three-year watering and establishment period, and then transitioned to the seven-year maintenance pruning cycle. However, in new developments or as part of capital projects, depending on the position of the neighbourhood in the pruning cycle, a newly planted tree may go seven years or longer without pruning, and then another seven until its next pruning.

Newly planted trees should also be mulched at least twice within the first three years following planting, and watered as needed. Currently, newly planted trees are generally mulched at the time of planting and in the third year, which is generally consistent with best practices.

It may be impractical to incorporate an improved young tree pruning cycle into the general lifecycle maintenance pruning cycle in Ottawa, as young tree pruning does not require the use of specialized equipment such as aerial lifts or wood chippers. Instead, annual planting lists and the street tree inventory should be used to plan young tree pruning, which can be carried out by in-house arborists, contractors or trained nursery staff, as is currently the case. Suggestions to address this gap are provided in Recommendation #16.

Supporting tree establishment in greenfield developments: process for assumption

Currently, trees planted in new subdivision communities are maintained by the developer for two growing seasons prior to acceptance by the City and are not incorporated into the 'Trees and Forests Maintenance Program' until they are entered into the tree inventory. This results in a potentially significant maintenance

backlog for such trees and results in the City occasionally assuming trees in poor condition.

In addition, City staff with expertise in assessing the condition of planted trees are not currently involved in the inspection process. Prior to assumption of the subdivision, the trees are inspected by the developer's Landscape Architect who submits forms to confirm their condition. City construction technicians then complete an overall site inspection. Forestry staff are not regularly involved in the tree inspection, but have developed a process to do so that is yet to be finalized and implemented.

Some recommended options to address these gaps are provided below.

- A process should be considered that requires developers to submit tree inventory data in a format compatible with the City's tree inventory management systems. This would ensure that newly-planted trees are included in the City's tree inventory and maintenance planning shortly following assumption. Such a process would also require Forestry staff to undertake quality assurance inspections of new tree plantings early on in the process.

- The City's internal process for assumption of trees should be finalized and implemented, and (if not already) trees should be added to the City's tree inventory and lifecycle maintenance program based upon these inspections and/or from developer-submitted data.

Specific guidance is provided in Recommendations #11.

Improved utilization of wood and food from urban trees

The thousands of tonnes of wood waste generated annually in Ottawa represent a significant resource. While the City's wood waste utilization efforts have been effective in diverting a significant volume of materials to various uses, there are opportunities to further enhance this aspect of urban forest management. For example, higher-value wood products, such as hardwood logs, can be transferred to local artisans, industries or interested community groups. The use of urban wood in municipal infrastructure projects, whether large or small scale, can also be increased. In addition, some trees generate a different kind of tree product: food. Efforts are being made by volunteers across Ottawa to divert fruit and nuts from becoming waste. The City has some agreements in place for the collection of fruit and nuts from its urban trees. Specific suggestions related to this are provided in Recommendation #17.

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), *urban wood and green waste/residue, food utilization* (Criterion M15) is currently considered to be "moderate" recognizing ongoing efforts by the City to utilize urban wood waste, as well as identifying opportunities to develop a more strategic approach to the utilization of wood and food from urban trees.

More comprehensive management of City-owned woodlands

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), Criterion V6 for *publicly-owned wooded natural areas* management is currently considered "good" because although the City has information on a number of these features (from the 2005 and 2006 Urban Natural Areas assessment work), it is somewhat dated, does not include all of the City's urban woodlands, and focuses on the ecological attributes of these features rather than their management needs as public natural areas. A more current and comprehensive strategy for management of the City's woodlands is absent.

The Forested Areas Maintenance Strategy (FAMS) is being developed by Forestry staff, and is intended to fill this gap. The FAMS will build on current management efforts related to City-owned woodlands in the urban area that have focused on EAB management through the 'Woodlot Rehabilitation Program' (and some related restoration), basic risk management along formal trails, and service request responses. A primary objective of the FAMS should be to support indigenous biological diversity so that natural areas are as intrinsically resilient to natural and anthropogenic stressors as possible. However, even in municipalities with well-developed urban forestry programs, management of municipally-owned natural areas is often a challenge due to resource constraints.

Priority considerations should include how to: manage encroachments from adjacent land uses, balance appropriate public use with protection of the feature's natural attributes, undertake basic risk management and fire risk assessment (as required through the 2014 Provincial Policy Statement), and manage invasive species. Where resources allow, activities such as trail management, restoration of degraded areas (including invasive plant species management), enhancement and expansion of woodland buffers, and expanded educational/stewardship programs, should also be pursued. Some of these activities can be pursued in partnership with community groups and/or regional Conservation Authorities or non-profit organizations. Specific guidance is provided in Recommendation #12.

Improved risk management of street and park trees

Street and park tree-related risk is currently managed through a combination of proactive (inspections, lifecycle maintenance) and reactive (service notifications) measures. In the baseline assessment for the urban forest sustainability framework (see Appendix 2), Ottawa's *tree risk management* (Criterion M10) has a "moderate" ranking because limited visual assessments are undertaken fairly regularly, but follow-up inspections are not regularly scheduled and mitigation measures are not always implemented promptly. While this approach conforms to common urban forestry practices, and it is recognized that it is not possible to eliminate risk from the urban forest, improvements can be made to Ottawa's approach and processes for tree risk management.

The City should continue to implement its proactive and reactive street and park tree risk management programs, but should do so in the context of a formal risk management policy. A formalized tree risk management policy would ensure that the effective implementation of tree risk management efforts by outlining reasonable expectations (also known as the Standard of Care) and supporting the allocation of necessary resources to reduce tree-related risk, uncertainty and liability. For example, current practices such as annual inspection of City-managed trees with structural support systems and installation of structural support systems where the need is identified should be more rigorously documented. Policies should also support the ongoing investment in the installation and maintenance of structural support systems as a valid and reasonable approach to risk management that can extend the life of large-statured trees with extensive canopy in the urban area.

Forestry staff should also start to include tree risk assessment information in the SAP street and park tree database so that it can be used to help guide risk management activities. This should include a tree risk assessment rating (based on current industry standards) for field-based risk assessments, to be included as an attribute in the City's tree inventory. This would enable City Foresters to identify individual trees or groups of trees by risk rating, and to plan effective mitigation activities.

Specific guidance is provided in Recommendation #18.

Emerald ash borer (EAB) management

The City's emerald ash borer management program is guided by a strategy developed in 2008. The program has been continually adapted as the rate and location of EAB infestation has changed and as lessons have been learned from various management approaches. As most City-owned street ash trees (outside of those being treated) and park trees inside the Greenbelt have been removed, the focus is shifting towards ash management in wooded natural areas, urban areas outside of the Greenbelt, and rural areas. The City's EAB management program is working well and no recommendations related to it are provided in this Plan.

A city-wide strategy for urban forest pest and disease management

While many tree pests and diseases do not pose a significant threat to the urban forest, some can affect an entire species and potentially threaten a large portion of the urban tree population. Reducing the vulnerability of Ottawa's urban forest to pests and diseases that pose significant threats requires the implementation of a range of practices. These include many that are already being performed or are recommended as part of this Plan as broader good urban forest management practices such as:

- Plant health care: site-appropriate tree species selection, young tree pruning, cyclical pruning, watering, mulching, fertilization where required;

- Improving tree habitat: appropriate soil volumes and soil quality, reducing above- and below-ground conflicts for space and resources;

- Diversifying the urban forest: establishing underutilized and new indigenous and non-invasive tree and shrub species; and

- Improving knowledge and understanding of the urban forest: having a current and comprehensive public tree inventory that is supported by regular inspections.

An integrated municipal urban forest pest and disease management strategy, which Ottawa does not currently have, can help prepare for threats specifically related to tree pests and diseases, provide guidance in terms of possible management approaches (including treatment where feasible), and help determine when action may or may not be required. It can also provide a framework for pest-specific management when action is required, as has already been completed for EAB in Ottawa. Specific guidance is provided in Recommendation #19.

Reviewing the City tree planting programs

The City's various tree planting programs for City-owned land have been in operation for many years and have not been reviewed recently. There may be opportunities for improvements and/or efficiencies in the delivery of these programs. Given the impact of EAB in Ottawa, a more proactive approach to the implementation of these programs may be appropriate with the goals of planting more trees overall and achieving better tree replacement over time. Specific guidance is provided in Recommendation #13.

Improving tree establishment adjacent to municipal rights-of-way

Currently the City does not have programs in place to support planting trees by City (or City-contracted) staff on private lands, even though this is where some of the best opportunities exist for establishing and sustaining large-statured trees. While there may be concerns about maintenance responsibilities and liability, these can be readily resolved where the landowner is willing to assume or share these responsibilities. In Ottawa, one place where this could be implemented while still ensuring benefits were being accrued to the broader community is on private property immediately adjacent to municipal road rights-of-way, where space permits. This can reduce competition between trees and infrastructure, and give trees access to larger soil volumes while contributing more benefits to the streetscape and community.

This opportunity was recognized through the former Regional Municipality of Ottawa-Carleton's Urban Tree Island program, which was discontinued following amalgamation. Restoration of this program or a similar initiative could be particularly effective along city streets where traditional (i.e., in the right-of-way) opportunities are limited or unavailable, and where engineered solutions such as soil cells are not feasible or forthcoming. Specific guidance is provided in Recommendation #13.

Procurement of better quality tree nursery stock

The development of long-term nursery stock procurement agreements can be beneficial to both local nurseries and municipalities, as nurseries are given some longer term security and municipalities can better control the quality of the stock being planted. Therefore, Ottawa should investigate opportunities to establish longer-term tree nursery procurement agreements with local tree nurseries to improve planted stock quality and to enable better pre-planting inspection of delivered stock.

The City's other practices, such as in-nursery, pre-planting stock inspection should continue, as they are consistent with recognized urban forestry best practices and contribute to the establishment of higher-quality trees. The City should also continue to work with the FGCA to source locally-procured indigenous trees that are biologically appropriate for the local environment and testing trees from slightly more southern locations to determine if they demonstrate more resilience to climate change conditions over the next few decades.

Specific guidance is provided in Recommendation #21.

The City is consistent with best practices with respect to supporting the use of indigenous tree species as it generally requires locally adapted and indigenous species for stock purchased for City lands, or lands to be assumed by the City. Many of the City's guidelines also encourage the use of such species, although the extent to which these guidelines are implemented is not known. Consequently, the City's current status for native vegetation (Criterion M14) is "moderate". No specific recommendations related to indigenous species are included in this Plan, other than they should be promoted as part of broader urban forest outreach and engagement for plantings on private lands.

Improving tree species diversity at the neighbourhood level

Street and park tree establishment through all City tree planting programs should seek to increase species diversity to improve resilience to stressors such pests and diseases or climate change.

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), the City is currently given a "moderate" status for species diversity (Criterion V4) based on city street tree diversity analyses (see Appendix 1) whereby no single species represents more than 10% of the population, no genus represents more than 20% of the population, and no family represents more than 30%. This is based on work by Santamour (1990) who identified the "10-20-30" rule as an appropriate urban forest diversity target. The "optimal" level for species diversity requires that an entire jurisdiction's urban forest (not just the street trees) adheres to the "10-20-30" rule, and that within each neighbourhood, no single species represents more than 5% of the population, no genus represents more than 10% of the population, and no family represents more than 15%.

Neighbourhood-level analysis of the city street tree inventory collected to date (provided in Appendix 1) should be used to develop neighbourhood-based tree species lists and planting plans for operations-based maintenance plantings and capital projects, thereby supporting the achievement of street and park tree

diversity targets. The diversity analyses should be repeated upon completion of the street and actively-managed park tree inventories, and should be repeated at the four-year Plan review period to assess progress.

Specific guidance is provided in Recommendation #20.

A more consistent city-wide approach to tree compensation

The principle and practice of compensating for trees removed as a result of development-related activities is increasingly being recognized by various municipalities as a primary mechanism to accommodate development while still ensuring urban forestry objectives related to canopy cover are being met. Compensation is generally supported by the *Planning Act*, and in many Ontario municipalities with active urban forestry management programs, compensation for trees approved for removal as part of the planning process is simply required as a matter of policy and/or practice.

Ottawa's current policies, by-laws and guidelines support replacement (or compensation) for trees approved for removal from private lands, and require it for municipal trees removed because of development (through the Municipal Trees and Natural Areas By-law) in the form of stem-for-stem tree replacement and/or financial compensation. This approach results in variable success in securing replacements for trees removed through the planning process and, for removals proposed on private lands, requires significant staff time to negotiate compensation with every development applicant.

Developing tree compensation guidelines that would apply to approved removals on both municipal and private lands would facilitate the implementation of a more transparent and consistent range of approaches, while also supporting a no-net-loss approach to tree canopy cover in the city. These guidelines should, however, include enough flexibility to be reasonably applied to different site-specific scenarios. Examples of approaches are summarized in Table 3.

Specific guidance is provided in Recommendation #14.

Policies and guidelines that support tree compensation should not be considered a "green light" for wholesale removal of trees for development projects. It takes decades for trees to mature and start to make substantial contributions to the urban forest canopy. Therefore, retention of existing healthy and large-statured trees should always be the primary planning consideration.

Table 3: Overview of approaches to tree removal compensation.

Compensation Method	Description of Method	Pros	Cons	Example Municipalities
Aggregate Caliper	Area of removed tree's stem at DBH is replaced by equal combined caliper of planted trees.	Relatively easy to calculate and implement. Large number of trees are typically planted.	May be costly if large number of trees are removed. Does not account for condition of removed trees.	Town of Ajax, ON City of Burlington, ON
Amenity Value Compensation (e.g., CTLA Trunk Formula Method)	A standard formula is used to appraise the value of a tree. Compensation equal to that value is paid to municipality for tree's removal.	Defensible. Widely accepted as a reasonable method. Well-suited to individual trees.	Poorly suited to woodland or forest valuation. Assessments are subject to interpretation and bias.	Town of Ajax, ON (large trees) Town of Oakville, ON (Town trees) Town of New Tecumseth, ON (all trees) City of Toronto, ON (City trees) York Region (Region trees) **Ottawa, ON (City trees)**
Cash-in-lieu	A sum is paid to the municipality to compensate for tree removal and fund tree establishment.	Easy to calculate and implement if standard formula for determining replacement cost is used.	May not always result in tree establishment. Rarely accounts for true value of tree(s) being removed.	Town of Ajax, ON City of Toronto, ON City of Guelph, ON
Leaf Area Replacement	The leaf area of removed tree(s) is calculated using a standard formula (Nowak, 1996). Equivalent leaf area is replaced with new trees.	Benefits lost by removing leaf area are replaced. Ensures increase in leaf area and canopy cover as planted trees grow.	May be costly if large number of trees are removed, and require additional land.	Town of Oakville, ON (Town trees)

Table 3 cont'd: Overview of approaches to tree removal compensation.

Compensation Method	Description of Method	Pros	Cons	Example Municipalities
Stems per Unit Area Replacement	A number of trees are planted per unit area (e.g., stems/hectare).	Applicable to woodlands, forests and plantations.	Not applicable to individual trees or low-density sites.	Unknown
Canopy Cover Replacement	The area of the current canopy cover is replaced. Suited to natural / naturalized area compensation.	Well-suited to plantations or forests where the trees are very densely planted. Allows for a more diverse stand in terms of species and structure to be established.	Will not result in immediate canopy replacement – takes at least 15 years. Requires active management of regeneration. Costly.	City of Guelph, ON (1:1 area replacement)
Tree Replacement	A ratio of replacement trees must be established to compensate for injury or removal (e.g., 3:1 replacement to removal ratio.) Typically allows cash-in-lieu if trees cannot be planted on-site.	Easy to calculate and implement. May result in increased leaf area and canopy over time, if planted trees survive.	May be costly. May not adequately replace lost canopy, leaf area or benefits.	Halton Region (defined ratio based on size of tree removed) Mississauga (defined ratio based on size of tree removed) Toronto, ON (3:1) Guelph, ON (3:1) **Ottawa, ON (City trees)**

4.4. Urban forest outreach, education, stewardship and partnerships

Outreach, education, and stewardship are critical parts of urban forest management because the City only has direct control over the urban forest on City lands, whereas the majority of the urban forest and opportunities for establishing trees occur on lands owned by others. It is only when Ottawa's urban forest and the benefits it provides are genuinely recognized by all residents, decision-makers and stakeholders that this Plan can be fully implemented.

Outreach, education and engagement on urban forestry issues between different departments within the City, and with City management and Councillors are addressed in Section 4.1.

4.4.1. Outreach and education

City's website and social media

Social media is an efficient and cost effective mechanism for education and outreach. Ottawa's urban forestry's home page (Trees and Community Forests) includes a good range of useful and informative content, but could be made more engaging. Information is posted under the topics of protection, planting, pruning, foundation damage (related to Sensitive Marine Clay Soils areas), infill development and watering. Information is primarily focused on technical requirements associated with planning and development such as information related to the City's tree by-laws, tree disclosure forms to be submitted with building permits, and how to protect trees during construction.

Ottawa is among the more progressive municipalities in having its street tree inventory available online through geoOttawa, and by providing data to the public on request through the Open Data Ottawa site. However, these excellent sources of information are not easy to locate or well-advertised by the City. For example, on the geoOttawa site the inventory is difficult to find at the bottom of the dropdown list of "other layers" under "miscellaneous" and referred to there as "forestry".

No other social media tools are currently being leveraged to promote the urban forest in Ottawa.

Other informal outreach

City staff in Planning educate developers about the City's tree-related policies, regulations and guidelines as part of their review of Environmental Impact Statements and Tree Conservation Reports in the development review process and as a part of the implementation of the "large property" component of the Urban Conservation Tree By-law (UTCB) (see Section 4.2.2). Forestry staff educate landowners, developers and City staff from other departments through their review of project plans and enforcement of the Municipal Trees and Natural Areas By-law, as well as the "distinctive tree" component of the UTCB.

In addition, Forestry staff work with community associations, business improvement associations, Scouts and Guides, and others as requested on a range of tree planting initiatives on City lands (described in more detail in Section 4.4.2). When resources permit, Forestry staff also provide:

- supervision for volunteers carrying out informal invasive species removals in natural areas;

- assistance to neighbourhood groups with street tree inventories by loaning equipment and providing some basic training in its use; and

- presentations on current issues relating to the urban forest at schools, meetings of the Ottawa Horticulture Society or similar events.

4.4.2. Community engagement in stewardship

City-sponsored programs

The City currently supports volunteer-based groups and not-for-profit organizations. Programs related to planting trees in the urban area are listed below. While these programs are not all implemented by Forestry, Forestry staff play an important role in reviewing applications and assisting in their implementation, as described below.

- The Schoolyard Tree Planting Grant Program: The City provides financial support for the provision of trees for projects on school properties. Grants of up to $10,000 are awarded in a given year and planting projects must be completed within 18 months. Forestry staff administer this program by evaluating and approving grant applications, performing site visits, and providing advice to applicants. Forestry staff also provide support for project management and

coordinate the tree procurement and tree installation for those projects seeking trees.

- Community Environmental Projects Grant Program (CEPGP): While the CEPGP doesn't specifically mention urban forestry, some projects submitted to this grant program are tree related. In these cases Forestry staff provide support by reviewing the applications and by working with the successful applicants. Some examples of this type of program are: tree inventories in City parks (Glebe Community Association, Stonebridge Community Association, Cardinal Creek Community Association), mechanical invasive species control (Rockcliffe Residents Association), and creating new planting opportunities in hard surface areas (Action Sandy Hill).

- Adopt-a-Park, Road or Gateway Program: This program encourages community groups to become engaged in the care and maintenance of parks and roadways. Partnerships are established between the City and community groups and individuals. The main focus is on park and streetscape cleanups but also includes tree related activities. In these cases, the applicants are referred to Forestry staff for support. Forestry also provides mulch to adoptees on request.

These City programs in the urban area play an important role in the engagement of local individuals and community groups in urban forest stewardship, but are all geared towards activities on City lands.

In addition, the Rideau Valley, Mississippi Valley and South Nation Conservation Authorities (who are funded in part by the City) also engage residents to plant trees and shrubs along watercourses in the urban and rural areas through the City Stream Watch Program. The City also engages rural landowners in tree establishment through the Green Acres Rural Reforestation Program in partnership with the Conservation Authorities, LandOwner Resource Centre and other partners.

Community-led initiatives

A number of neighbourhood groups are engaged in advancing urban forest goals in Ottawa. The following is not intended to be an exhaustive list but rather to showcase examples that highlight the stewardship efforts of some groups.

- Ecology Ottawa: Ecology Ottawa is a not-for-profit organization with no formal ties to the City that has, among other initiatives, a “Tree Ottawa” campaign focusing on the urban forest. Activities have included a petition supporting this Plan that has garnered over 10,000 signatures to date and an “Adopt-a-Tree” initiative whereby citizens are encouraged to identify a tree and/or planting sites

in the City using the Open Tree Map tool on their website. Tree Ottawa has had urban forest projects with various community associations (Blackburn Hamlet, Cardinal Creek, Convent Glen / Orléans Wood, General Burns, Kanata Lakes, Leslie Park, Lowertown and Orlando Park) and schools. They have also partnered with the City to plant one million trees to celebrate Canada's sesquicentennial. Through this partnership, Tree Ottawa has committed to planting 50% of the trees.

- Ottawa Stewardship Council (OSC): The OSC promotes collaboration among stakeholders within the City of Ottawa to "maintain a healthy environment". The OSC does this through educational programs, needs analyses, networking, and the promotion of best management practices. Activities include tree planting, habitat restoration, inventories, invasive species removal, trail network assessment and marking, the development and distribution of conservation and restoration literature, and building connections and partnerships with local Councillors, schools and community groups. The OSC has partnered with the City and community associations in the stewardship of specific urban natural areas including Kemp Woods and Chapman Mills West. The OSC has committed to focus on the stewardship of urban natural areas in Ottawa for the next five years.

- Hidden Harvest Ottawa: This local organization is dedicated to harvesting food growing on City and privately-owned trees in the City of Ottawa and putting it to good use in the community.

- Community Associations: Many community associations across the city have formed "tree committees" to work on urban forestry issues in their neighborhoods and in collaboration with other associations to work at a wider level. For example, Big Trees of Kitchissippi consists of eight community associations and two citizens' groups in Kitchissippi Ward with a focus on the conservation of large trees. One specific initiative is the Champlain Oaks Project in the Champlain Park area (independent of the Champlain Park Community Association). The group has been active in monitoring the impact of development on the trees in the community, raising public awareness and providing input to Council and Staff.

4.4.3. Partnerships

As described above, the City currently has active partnerships on various urban forestry initiatives with the regional Conservation Authorities (Rideau Valley, Mississippi Valley and South Nation), the Forest Gene Conservation Association (FGCA), the LandOwner Resource Centre, Ecology Ottawa (Tree Ottawa), Hidden

Harvest Ottawa, the Ottawa Stewardship Council, and various community groups. While the partnerships with the Conservation Authorities are formalized, the other partnerships are more informal in nature.

Utilities (such as Hydro Ottawa) play a significant role in urban forest management due to the regular tree pruning which they undertake as part of their line clearing practices, as well as the need for the City to coordinate with them on below-ground requirements for trees near utilities. Currently, Forestry staff sit on the Utility Coordinating Committee and utility projects are circulated to Forestry staff for review prior to approval, but there is no requirement that utilities consult with Forestry when their activities involve trees.

On a regional level, City staff liaise with the NCC and other government agencies (such as the Canadian Food Inspection Agency and the Conservation Authorities) on a fairly regular basis. Collaboration with the NCC is good and the Conservation Authorities are active and long-standing partners in urban forestry. Forestry staff also participate in a Community Forest Managers group for Eastern Ontario that includes Conservation Authorities who meet annually to share ideas and experiences.

On matters relating specifically to forest health, the City is a member of the Regional Forest Health Network (RFHN) an initiative of the Eastern Ontario Model Forest that has brought together 20 organizations and agencies in eastern Ontario, western Quebec and northern New York State. The RFHN works with scientists to bring consistent messaging to landowners and the general public about specific threats to forest health and the importance of a strategic response to such threats.

The City also has some communication about urban forestry with Lanark County and the City of Gatineau, and communicate regularly with urban forestry colleagues in Montreal, particularly around issues associated with marine clay soils. Forestry staff also take advantage of the Canadian Urban Forest Network (CANUFNET) listserv to share ideas with other urban forestry professionals.

4.4.4. Incentives

Currently, the City of Ottawa offers a number of direct funding incentives to schools and community groups to establish trees on public lands (as described in Section 4.4.2). Current funding for urban forest initiatives from other sources is available through organizations such as the Ontario Trillium Foundation and Tree Canada, which offer grants of variable sizes to schools and community groups. Environment Canada and the Ontario Ministry of Natural Resources and Forestry also offer tax

rebates / subsidies to primarily rural landowners. A summary of current sources is provided in Appendix 4.

In Ottawa, however, there are few incentives for private landowners to identify and implement opportunities for tree conservation or establishment on their lands in the urban area outside of the planning process (described in Section 4.2). One exception is that the City currently offers to plant a tree for front yard areas within the municipal road right-of-way upon request (described in Section 4.4.2). Ottawa's *Building Better and Smarter Suburbs* (2015) report and Action Plan direct the City to review options for providing developers credit for retaining and/or transplanting mature trees in new plans of subdivision.

4.4.5. Opportunities for improving outreach, education, stewardship and partnerships

Recent social marketing research conducted in the City of Toronto, and elsewhere, has found that one fundamental barrier to fostering stewardship is the growing detachment most people have from nature in urban society. This is also well documented, particularly in relation to youth, in *Last Child in the Woods* and *The Nature Principle* – two books by author Richard Louv. Breaking this barrier not only contributes to human health but also provides an opportunity for the community to contribute to the sustainability and expansion of the urban forest. Opportunities to overcome this barrier in Ottawa that are considered both cost-effective and appropriate for Ottawa's context are identified in this section.

Currently there is no specific City staff member responsible for coordinating and facilitating all existing and requested outreach, engagement and stewardship related to the urban forest; this responsibility is shared among multiple staff in several departments. Improving and expanding the City's efforts in this area would be greatly enhanced with the creation of a position focused on urban forestry outreach and stewardship. Guidance for such a position is provided in Recommendation #22.

Expanding outreach and education

It is evident from the interest in this Plan (described in Section 3.2) and the presence of numerous community organizations active in urban forestry (described in Section 4.4.2) that some groups in the city are already well-engaged. However, many people who live and work in Ottawa remain poorly informed about the importance of the urban forest as a cornerstone of community health and sustainability, and about the range of initiatives that have already been, or will be, implemented to support the vision and objectives of this Plan. Without this

understanding there will be limited support and investment in urban forestry initiatives. One of the most cost effective ways to expand outreach and engagement is to develop and implement a strategy that leverages a range of tools available to the municipality, and targets specific groups who can have a significant impact on the urban forest.

Tools that can be leveraged through such a strategy in Ottawa include: the City's and partners' websites and social media; advertising in venues available to the City at little or no charge (such as public libraries and community centres); and in-person educational events targeted to residents, large private and industrial landowners, and tree care and landscaping professionals.

- Municipal websites represent a cost-effective tool for sharing a wide range of information related to a municipality's urban forest and natural heritage in general. While Ottawa's website currently contains a range of useful information, it could be better organized, more engaging, and include more materials targeting residents. Information could include upcoming community planting events with partners, planned EAB management activities in Community Forests, and images and/or short video clips showing basic tree care. Partners' websites can also be leveraged to provide and promote information.

- Ottawa has already invested in making basic location and tree data from its public tree inventory available to the public. However, the information is poorly advertised and hard to find on the City's website. This tool has excellent outreach potential and should be better advertised, and incorporated into outreach activities.

- The City should increase the use of social media (such as Facebook, Twitter and Instagram) to promote urban forest news and events.

- While websites and social media are a cost-effective way of sharing information, other traditional methods can also be effective. Posters in community centres and flyers highlighting current issues facing the urban forest or seasonal information about tree care can be sent out with other municipal mailing such as tax or hydro bills.

- In-person events can provide a higher level of engagement and allow for information sharing. Examples of activities that require limited time

commitments include: tree tours[5] and heritage tree workshops[6]. For community groups interested in making a greater commitment to understanding their local urban forest, there is the Neighbourwoods program. These could be led by local experts and/or non-governmental partners with support from Forestry staff.

- The Neighbourwoods program was developed by Andy Kenney and Danijela Puric-Mladenovic at the Faculty of Forestry, University of Toronto. The philosophy of Neighbourwoods is that the neighbourhood is a logical "management unit" and that the private and public trees in the neighbourhood should be managed as a functioning ecosystem. Neighbourhood groups are encouraged to develop a stewardship strategy for their community based on a detailed census of the trees, with an emphasis on their species, size, location and condition. A critical aspect of this census is that the data are collected by volunteers in the community. Some interest in this model has been expressed by some community groups in Ottawa.

Guidance related to development of an outreach and engagement strategy is provided in Recommendation #23. Specific guidance related to implementing Neighbourwoods programs in Ottawa is provided in Recommendation #25.

Stewardship of Urban Natural Areas

There is a great need for education on the appropriate public use and stewardship of these features, particularly in regards to largely unintended abuses such as yard waste dumping, excessive "fort" development, encroachment from adjacent yards and gardens, vegetation damage and removal, and mountain bike structures.

Urban Natural Areas Environmental Evaluation Study Addendum, 2006

Expanding stewardship on public and private lands

The City acknowledges the importance of building partnerships with organizations, agencies, businesses, community groups and individuals to advance its urban forestry objectives. The Forestry units, with support from other City departments, are already engaged with a number of these groups

[5] See LEAF, 2016. Tree Tours. Available online at: http://www.yourleaf.org/tree-tours.
[6] See OUFC, 2016. Heritage Trees. Available online at: http://www.oufc.org/heritage-trees/.

but currently finds resources for engagement and stewardship severely constrained by demands related to EAB management.

In the baseline assessment for the urban forest sustainability framework (see Appendix 2), citizen involvement and neighbourhood action related (Criterion C5) is currently considered to be "moderate" as some neighbourhood groups are engaged in advancing urban forest goals, but with little or no overall coordination with or direction by the municipality or its partnering organizations. Furthermore, most of the efforts target City lands, leaving opportunities on private or other lands overlooked.

Many models exist for the increasing the hands-on stewardship of citizens in urban forestry. Two models which are cost-effective, not mutually exclusive, and which could work in Ottawa are highlighted here for consideration.

- Outreach programs that foster stewardship on private property, especially in residential back yards where there tend to be good opportunities for establishing large-statured trees, are essential if the objectives of urban forest management are to be met. Local Enhancement and Appreciation of Forests (LEAF), a non-governmental organization based in the City of Toronto, focuses (among other things) on supporting proper tree establishment in residential backyards through education and hands-on technical support. LEAF also leads tree tours, offers courses in young tree pruning, and works with the City to implement Adopt-a-Tree programs. LEAF managed for more than a decade by obtaining its own funding through various sources, however the City of Toronto has recently recognized the success of their model, and has begun to extend funding to expand its program. Ottawa could consider partnering with a comparable non-governmental organization based on this model.

- For residents who want to extend their stewardship beyond their backyards, the City should consider opportunities for them to assist with young tree care on City lands, which has been identified as a high priority in this Plan (see Section 4.3). A number of cities in the United States have developed "Citizen Forester" programs. The structure of these programs varies but the basic concept involves the City providing volunteers with educational opportunities in urban forestry in return for a commitment to become engaged in urban forest stewardship programs. In some cases, individuals who have gained more experience and taken more advanced courses are identified as team leaders to help deliver the Citizen Forester program and assist other volunteers in carrying out stewardship activities. Notably, LEAF also offers this type of training in Toronto. Ottawa could consider offering or sponsoring this type of program to help implement young tree pruning on City lands.

Ottawa's Neighbourhood Toolkit provides project management guidance that would be valuable to community groups wishing to embark on a neighbourhood urban forestry stewardship program.

The nature and extent of existing urban forest and potential plantable areas on large private and institutional lands in Ottawa's urban area is poorly understood. However, this is where significant opportunities typically exist for both protection of existing trees / natural areas and establishment of trees / natural areas. With the growing recognition of links between treed greenspaces and human health, more institutions and landowners may be interested in sustaining and/or expanding tree cover on their lands, particularly where it may offer direct health benefits (such as shade, cooling, mental relaxation) to people who work on, visit or live at those properties. Specific guidance is provided in Recommendation #26.

In addition to residents and large landowners, professionals in the tree care and landscaping industries also have tremendous potential to influence the urban forest on lands across the city, as they are the ones implementing the work that affects the current and future urban forest on a daily basis. If they have a better understanding of the relevant policies, by-laws and guidelines that are in place, as well as the City's vision and objectives for the urban forest, they can help implement this vision by complying with the framework, and can also educate their clients. Specific guidance is provided in Recommendation #26.

Building on existing and developing new partnerships

Building on existing and developing new relationships with local agencies, organizations and businesses on urban forest initiatives is the cornerstone of urban forest stewardship. These relationships will be unique to each municipality, but common sources of partnerships include non-governmental non-profit organizations, schools, and businesses or industries. Many non-governmental organizations have volunteer programs and experience in fundraising that can be drawn upon. Schools are often keen to be involved, particularly if activities can support their existing curricula. Businesses can be interested in these partnerships as well, particularly if they are given recognition for their activities, and can accomplish goals that support their corporate vision or objectives.
In most municipalities where there are staff dedicated to urban forest and natural heritage management, it is recognized that a multi-departmental and multi-disciplinary approach is required. Building partnerships outside the municipal government is also critical for taking advantage of the range of stewardship programs that are available, many of which require a non-governmental

organization to take the lead (see Appendix 4). Specific guidance for Ottawa is included in Recommendation #2.

In recognition of the importance of partnerships across jurisdictions in supporting urban forest initiatives, the baseline assessment for the urban forest sustainability framework (see Appendix 2) includes four criteria related to cooperation and coordination at various levels and with various external partners.

- *Involvement of large private and institutional land holders* (Criterion C2) is considered "low" because large private landholders are generally uninformed about urban forest issues and opportunities (excluding the NCC which manages its own urban forest). This gap is addressed in Recommendations #23 and #26.

- *Utilities Cooperation* (Criterion C3) is considered "good" because utilities are included in informal municipal teams that communicate regularly and collaborate on a project-specific basis, but communications and coordination on urban forest issues could be improved and formalized. This is addressed in Recommendation #2.

- *Green Industry Cooperation* (Criterion C4), which refers to the tree care and landscaping industry, is considered "moderate" as there is some cooperation and general awareness and acceptance of municipality-wide goals and objectives. However, this awareness and cooperation could be improved. This gap is addressed in Recommendations #23 and #26.

- *Regional Collaboration* (Criterion C7) is currently considered "good" because collaboration with the NCC is regular and ongoing, the City has well-established partnerships with the three regional Conservation Authorities, and communication on urban forest issues with nearby municipalities (particularly Montreal) is good. Opportunities for improvement include exploring additional partnerships with the Conservation Authorities that would benefit trees and natural areas in the urban area, and more regular information sharing with other comparable municipalities. This opportunity is addressed in Recommendation #2.

Incentives

The City currently provides funding and/or support for community tree planting initiatives on City lands and on school grounds, but does not offer any direct or indirect incentives to support tree retention or establishment on private lands in the urban area (residential, industrial, institutional or commercial).

Incentives directed towards tree retention or establishment on private lands can include a range of options. Some examples of incentives for consideration in Ottawa include:

- recognition of substantial stewardship efforts through incentives such as an awards program or naming rights for public parks and open spaces, community centres, trails and public gardens;

- partnering with organizations that offer assistance with tree establishment (such as provision of the tree and planting assistance) on residential, institutional, commercial, and/or industrial properties;

- offering a tax credit or rebate for maintaining a certain proportion of a property in permeable surface and/or treed to manage stormwater (examples include the Cities of Guelph, Mississauga and Waterloo); and

- providing tax credits for conserving and maintaining treed areas on private property in the urban area.

The *Building Better and Smarter Suburbs* report and Action Plan suggests that the City should, in consultation with the development community, review options for giving developers credit for retaining and/or transplanting mature trees in new developments. However, encouraging transplanting of mature trees is not recommended as it is costly, difficult to undertake, requires special maintenance, and has a lower success rate. Mechanisms that should be considered through the planning process to encourage tree retention include:

- giving developers credit for retaining mature trees in new developments;

- retaining securities for trees identified for preservation through the site plan process, with deposits returned construction is complete and trees have been successfully protected (as suggested in Recommendation #8); and

- accepting wooded natural areas in private ownership as part of the parkland dedication for development sites (which could be considered through Recommendation #7).

Guidance related to identifying and implementing incentives for Ottawa is provided in Recommendation #24. Additional suggestions may be brought forward by members of the internal or external Urban Forest Working Groups, as suggested in Recommendation #2.

5. Recommendations

This section of *Putting Down Roots for the Future* outlines 26 Recommendations. The Recommendations are based upon the UFMP guiding principles, objectives and targets, consideration of input from City staff, other stakeholders and members of the public, assessments of the current status of the urban forest management and planning framework in Ottawa, and identified opportunities for improvement based on best practices. The Recommendation framework is outlined below:

Recommendation #: Provides the Recommendation number and title. Recommendations are organized to correspond to the order of relevant sections in the Plan.
Related UFMP Objectives(s): Identifies the UFMP objectives to be supported by implementation of the Recommendation.
Sustainability Criteria: Identifies the related criterion or criteria for urban forest sustainability outlined in Appendix 2.
Management Period: Identifies in which of the five four-year Management Periods the Recommendation is to be implemented.
Purpose: Describes the underlying purpose for implementation of the Recommendation.
Current Practices: Briefly reviews current practices relevant to the Recommendation in Ottawa.
Best Practices: Highlights selected practices or precedents relevant to the Recommendation and appropriate for the City of Ottawa.
Lead(s) for Implementation: Identifies the lead City department(s), agency or other party responsible for implementation of the Recommendation.
Implementation Guidance: Provides guidance for implementation of the Recommendation based on current and best practices.
Time for Completion: Provides an estimated time for completion of the Recommendation. "Ongoing" denotes a change in practices which should be carried forward indefinitely.
Prerequisite Recommendations: Identifies Recommendations (if any) that must be completed in order to implement this Recommendation.
Risk: Describes the potential risk(s) associated with not implementing the Recommendation.
External Partner(s): Identifies external (non-City) partners where appropriate.
Resources Required: Identifies if it is expected that the Recommendation can be implemented by allocating existing resources OR if additional resources will be required.
Target: Identifies a measurable or qualitative target to determine successful implementation of the Recommendation, where appropriate.

Table 4, below, presents a summary of the 26 Recommendations by topic area. Table 5 organizes the recommendations by management period. The list of recommendations in Table 5 for the first management period provides an outline for the first four-year management plan. Both tables indicate the lead City staff unit; NSEP is Natural Systems and Environmental Protection within the Planning, Infrastructure and Economic Development Department and FMU is the Forest Management Unit within the Public Works and Environmental Services Department. A comprehensive summary of the Recommendations can be found in Appendix 5.

Table 4: Summary of recommendations by topic area.

#	Description	Lead	Mgmt. Period
Urban forest management program structure and administration			
1	Adaptive management	NSEP	All
2	Internal & External Working groups	NSEP	1
3	Urban Forest Inventory Collection & Maintenance	FMU	1
4	Urban Forest Canopy Study	NSEP	1
5	Asset Management	NSEP/ FMU	All
Planning for the urban forest			
6	Improve policy implementation through internal outreach and engagement	NSEP	All
7	Significant Woodlands	NSEP	1
8	Review of Tree By-laws: a. Municipal Tree By-law b. Urban Tree Conservation By-law c. Heritage Tree By-law	 FMU NSEP NSEP	1
9	Tree Planting and Establishment Guidelines: a. Greenfield Areas (Street Tree Manual) b. Existing Conditions c. Urban Hardscapes	 NSEP FMU FMU	1
10	Outreach, enforcement, and monitoring of policies and by-laws	NSEP/ FMU	2
Maintaining and growing the urban forest			
11	Assumption of trees in new developments	FMU	1
12	Forested Areas Maintenance Strategy	FMU	1
13	Review City tree planting programs	FMU	1
14	Tree Compensation Guidelines	NSEP	1
15	Review lifecycle maintenance program	FMU	2
16	Assess maintenance for newly planted trees	FMU	2
17	Urban tree product utilization strategy	FMU	2
18	Assess tree risk management – City trees	FMU	2
19	Pest and Disease management strategy	NSEP/	2

#	Description	Lead	Mgmt. Period
		FMU	
20	Neighbourhood planting plans	FMU	2
21	Tree nursery stock growing contracts	FMU	2
Urban forest outreach, education, stewardship and partnerships			
22	Expand Community Engagement, public education	FMU	1
23	Outreach and engagement strategy	FMU	1
24	Incentives for tree conservation	NSEP	1
25	Neighbourhood stewardship plans	FMU	2
26	Outreach to tree care, landscaping, private and institutional landowners	FMU	2

Table 5: Summary of recommendations by management period.

#	Description	Lead	Mgmt. Period
Management Period 1 (2018-2021)			
1	Adaptive management	NSEP	All
2	Internal & External Working groups	NSEP	1
3	Urban Forest Inventory Collection & Maintenance	FMU	1
4	Urban Forest Canopy Study	NSEP	1
5	Asset Management	NSEP/ FMU	All
6	Improve policy implementation through internal outreach and engagement	NSEP	All
7	Significant Woodlands	NSEP	1
8	Review of Tree By-laws: a. Municipal Tree By-law b. Urban Tree Conservation By-law c. Heritage Tree By-law	 FMU NSEP NSEP	1
9	Tree Planting and Establishment Guidelines: a. Greenfield Areas (Street Tree Manual) b. Existing Conditions c. Urban Hardscapes	 NSEP FMU FMU	1
11	Assumption of trees in new developments	FMU	1
12	Forested Areas Maintenance Strategy	FMU	1
13	Review City tree planting programs	FMU	1
14	Tree Compensation Guidelines	NSEP	1
22	Expand Community Engagement, public education	FMU	1
23	Outreach and engagement strategy	FMU	1
24	Incentives for tree conservation	NSEP	1

Management Period 2 (2022-2025)			
1	Adaptive management	NSEP	All
5	Asset Management	NSEP/ FMU	All
6	Improve policy implementation through internal outreach and engagement	NSEP	All
10	Outreach, enforcement, and monitoring of policies and by-laws	NSEP/ FMU	2
15	Review lifecycle maintenance program	FMU	2
16	Assess maintenance for newly planted trees	FMU	2
17	Urban tree product utilization strategy	FMU	2
18	Assess tree risk management – City trees	FMU	2
19	Pest and Disease management strategy	NSEP/ FMU	2
20	Neighbourhood planting plans	FMU	2
25	Neighbourhood stewardship plans	FMU	2
21	Tree nursery stock growing contracts	FMU	2
26	Outreach to tree care, landscaping, private and institutional landowners	FMU	2

5.1. Urban forest management program structure and administration

Recommendation #1: Undertake active adaptive management through a formal Urban Forest Management Plan review process

Related UFMP Objectives(s): All UFMP objectives
Sustainability Criteria: All sustainability criteria
Management Period: All five management periods (2018-2037)
Purpose: To ensure that *Putting Down Roots for the Future* remains a functional Plan throughout the planning horizon of 20 years and that Plan vision, objectives and targets are met, Criteria are achieved at a Good or Optimal level, and Recommendations are implemented.
Current Practices: No Urban Forest Management Plan in place.
Best Practices: Many other jurisdictions have developed and are implementing Urban Forest Management Plans with built-in review periods to enable active adaptive management. Some examples of plans completed in larger urban areas in Canada include the Cities of Toronto, Mississauga, Halifax and Vancouver. The periodic plan review process, in conjunction with the Criteria and Indicators framework, is described in Kenney, van Wassenaer and Satel (2011) and van Wassenaer *et al.* (2012).

Lead(s) for Implementation: City – Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection and Public Works and Environmental Services Department - Forest Management Unit
Implementation Guidance:

- Undertake Criteria and Indicators-based assessment of urban forest management program every four years (2021, 2025, 2029, 2033 and 2037).
- Develop four-year and annual operating plans as described in the UFMP, including new Recommendations if necessary.
- Reallocate priorities to Recommendations as necessary to reflect changing circumstances, values, resources, etc.
- Consider consulting with stakeholders, through the City of Ottawa Environmental Stewardship Advisory Committee or the Urban Forestry Working Groups (Recommendation #2), to inform C&I assessment, priority-setting and development of new Recommendations.

Time for Completion: 2 months, once every four years
Prerequisite Recommendations: Recommendation #2 (Internal and External Urban Forestry Working Groups)
Risk: UFMP will become static and outdated, opportunities to improve urban forest management program and achieve urban forest sustainability will be missed, and resources will not be allocated efficiently.
External Partner(s): External (Interagency) Urban Forestry Working Group
Resources Required: Existing resources to be allocated.
Target: Criteria and Indicators assessment updated at beginning of every new management period; 4-year Management Plan developed with new/updated/revised Recommendations (as required).

Recommendation #2: Establish Internal (Interdepartmental) and External (Interagency) Urban Forestry Working Groups

Related UFMP Objectives(s): All UFMP objectives
Sustainability Criteria: C1, C7
Management Period: 1st Management Period (2018-2021)
Purpose: To implement an ongoing mechanism to facilitate communication on urban forestry issues between staff in different City departments and to promote cooperation among staff to work together to achieve urban forest objectives. To facilitate cooperation and information exchange between the City and external stakeholders, encouraging collaboration to achieve urban forest objectives.
Current Practices: Responsibility for implementation of Ottawa's urban forest program is primarily shared between two municipal departments – Planning, Infrastructure and Economic Development Department (Natural Systems and Environmental Protection) and Public Works and Environmental Services

Department (Forest Management Unit). Coordination between them on urban forest plan review and issues currently occurs on a fairly regular but informal basis. Additionally, the City has several project-based Technical Advisory Committees that include representatives external to the City departments. However, there is no dedicated urban forestry working group that brings together City staff and external stakeholders to discuss current and ongoing urban forestry issues.

Best Practices: Many municipalities (particularly large ones) struggle with the integration required for effective implementation of policies related to tree retention and establishment. Approaches for addressing this challenge vary depending on municipal structure and processes. Several municipalities have addressed this issue through creation of interdepartmental / interagency urban forest working groups that bring together staff from different departments whose work directly affects trees. For example, in the City of Mississauga, an urban forest working team of key staff from planning, parks, engineering and transportation departments was established and scheduled to meet bi-monthly to discuss and resolve urban forest-related issues. UFMPs for the Town of Oakville and Saanich, B.C., among others, recommend proactive and formalized collaboration.

Lead(s) for Implementation: Planning, Infrastructure and Economic Development Department, Natural Systems and Environmental Protection and Public Works and Environmental Services Department, Forest Management Unit

Implementation Guidance:

Internal Working Group -

- Core working group members to include appropriate staff from Planning, Infrastructure and Economic Development Department; Public Works and Environmental Services Department; Recreation, Culture and Facility Services Department; Ottawa Public Health.
- Staff from other departments to be included in working group sessions as needed to address specific issues.
- Core working group should determine meeting frequency and duration in Terms of Reference, to be developed upon group establishment.
- Participants should discuss current and upcoming departmental and interdepartmental issues related to urban forestry to inform other departments which may be involved, to outline anticipated challenges, and to seek collaborative solutions.
- Working group should liaise with external Interagency Urban Forestry Working Group on a twice-annual basis to exchange information on working group activities, status of UFMP implementation, etc.
- Working group should liaise with Environmental Stewardship Advisory Committee on an annual basis to exchange information on working group activities, activities of external Interagency Urban Forestry Working Group, status of UFMP implementation, etc.

External Working Group –

- Working group to be facilitated by one staff member each from Planning, Infrastructure and Economic Development Department; Public Works and Environmental Services Department.
- Working group members to include one representative each from a range of external stakeholder groups including:
  - Federation of Citizens' Associations of Ottawa (FCA-FAC)
  - Local environmental organizations (e.g., Ecology Ottawa, Ottawa Stewardship Council, Greenspace Alliance, etc.)
  - National Capital Commission (NCC)
  - Local School Boards
  - Hydro Ottawa
  - Greater Ottawa Home Builders' Association (GOHBA)
  - Regional Conservation Authorities (one representative from each of RVCA, MVCA, SNCA)
  - Other selected industries with an interest in urban forest issues
- Working group to develop a Terms of Reference which will determine matters such as how meetings will be organized, the frequency of meetings, etc.
- Participants should discuss current issues related to urban forestry, exchange information about activities, outline anticipated challenges, and seek collaborative solutions.
- Working group should liaise with the Interdepartmental Urban Forestry Working Group to exchange information

Time for Completion: Not applicable

Prerequisite Recommendations: None

Risk: Opportunities for communication between staff on urban forestry issues may be lost. Opportunities to address issues and achieve urban forestry objectives through improved and collaborative policies and practices may be lost. Ongoing 'silo' effect whereby City departments and stakeholders work in isolation, do not exchange information and best practices, have competing objectives or contradictory practices, and compete for and do not pool resources.

External Partner(s): External (Interagency) Urban Forestry Working Group, Environmental Stewardship Advisory Committee

Resources Required: Existing resources to be allocated.

Target: Internal (Interdepartmental) Urban Forestry Working Group and External (Interagency) Urban Forest Working Group are established. Groups meet quarterly (at minimum), liaise with each other on twice-annual basis, and liaise with Environmental Stewardship Advisory Committee on annual basis.

Recommendation #3: Develop an urban forest inventory collection and maintenance plan

Related UFMP Objectives(s): #3 – Improve knowledge, #4 – Community engagement, #7 – Manage Proactively
Sustainability Criteria: V5, V7, C5, M1, M16
Management Period: 1st Management Period (2018-2021)
Purpose: To develop a formal process to collect and maintain tree inventory in up-to-date and usable condition and to avoid inventory obsolescence. To improve quality of tree inventory data collection. To increase utility of tree inventory as a public engagement and education tool. To improve knowledge of privately-owned portion of the urban forest.
Current Practices: The City of Ottawa uses five different computerised systems to manage different aspects of the urban forest, including the tree inventory, development applications, and other information. Efforts are being made to enhance the interoperability and cross-platform communication between systems, where appropriate. No strategy to actively manage or regularly update the street and park tree inventory, although efforts are made to keep the inventory up-to-date through daily operations.
Best Practices: Few jurisdictions have implemented publicly-available tree inventory maintenance plans, and strategies must be based on local circumstances and needs. A Tree Inventory Management Plan was developed for the Toronto District School Board (TDSB) (Ambrosii, 2004) and outlines strategies to keep the Board's tree inventory current and up-to-date.
Lead(s) for Implementation: City – Public Works and Environmental Services Department, Forest Management Unit
Implementation Guidance:

- Develop plan to ensure tree inventory is updated to reflect new, maintained and removed trees on a regular basis.
- Ensure GIS, SAP and other asset management system compatibility.
- Continue to provide up-to-date tree inventory data on the City's OpenData spatial data catalogue and geoOttawa online mapping service
- As new technology and needs are developed, investigate new options for improving access to inventory data.
- Investigate opportunities to integrate public participatory GIS (PPGIS) functionality to allow hosting of user-generated tree inventory content (on private property only).
- Facilitate batch uploading of neighbourhood-level data (e.g., Neighbour-woods) to public GIS.
- Do not enable public modification of City tree inventory.
- Coordinate with Infrastructure Services Department and geomatics staff.
- May require Information Technology consultant or software engineer support.

Time for Completion: Ongoing
Prerequisite Recommendations: None, but should be undertaken following completion of street and park tree inventory (ongoing initiative).
Risk: Tree inventory will become obsolete, will contain increasingly inaccurate data, and will cease to accurately inform urban forest management. Potential failure to identify poor-condition or high-risk trees for priority management. Potential missed opportunity to engage public in urban forestry.
External Partner(s): None
Resources Required: Additional resources required to complete the tree inventory (consultant) and inventory maintenance (staffing). FTE and/or consultant funding request will be brought forward through the 2018 Draft Budget process.
Target: Tree inventory maintenance plan developed and implemented. Tree inventory/asset management system equipment records updated to reflect 95% of tree planting, maintenance and removals within 1 year of initiation. Public tree inventory input functionality on geoOttawa or other supported platform.

Recommendation #4: Undertake comprehensive urban forest canopy study and develop a tree planting prioritization tool

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #3 – Improve knowledge, #4 – Community engagement, #5 – Resilient, diverse and functional urban forest, #7 – Manage proactively
Sustainability Criteria: V1, M3, M7, M8, M16
Management Period: 1st Management Period (2018-2021)
Purpose: To establish appropriate urban forest canopy cover targets for Ottawa's urban area based upon accurate assessment of existing and potential canopy cover. To develop a tool to assist in prioritization of tree establishment efforts to achieve specific objectives.
Current Practices: A preliminary canopy cover assessment completed in 2014 determined that urban forest canopy cover in Ottawa is approximately 25%. There is currently no assessment of potential canopy cover and no strategy in place to establish canopy cover goals or to identify opportunities to achieve them.
Best Practices: Numerous communities have undertaken comprehensive urban forest canopy studies and/or developed tree planting prioritization tools. Examples include the Peel Region, Mississauga, Cambridge, Calgary, Indianapolis, and many others. Such studies can map canopy cover at different scales (such as by ward or neighbourhood), and can also include planting prioritization tools to focus tree establishment to support selected urban forest benefits (such as air quality improvement or natural heritage feature connectivity). These tools can also allow project partners and members of the public to identify potential planting areas

based on a range of tree planting priorities. For example, Columbus, Ohio, allows partners to track new tree plantings and explore the ecosystem services provided and supported by their planting efforts. Such projects allow municipalities and partners to maximize opportunities to enhance the urban forest canopy and serve as successful community engagement tools. Related tools, such as i-Tree Eco, can also quantify the value of urban forest benefits based on plot-based field sampling and modeling and extrapolation of data. Numerous communities across North America, such as Toronto, Oakville, York Region, Peel Region and others, have undertaken i-Tree Eco-based urban forest studies to generate jurisdiction-wide data and valuations of urban forest benefits.

Lead(s) for Implementation: City – Planning, Infrastructure and Economic Development Department, Natural Systems and Environmental Protection

Implementation Guidance:

- Use the latest available aerial imagery to determine current urban forest canopy cover in the urban area on a variety of appropriate scales, such as by neighbourhood and ward.
- Requires minimum 1 metre, leaf-on aerial imagery, preferably collected in year of study commencement. LiDAR data significantly increases quality of analysis.
- Determine maximum Potential Canopy Cover (PCC) by identifying existing urban forest canopy, non-forest vegetation suitable for planting, vegetated areas unsuitable for planting (e.g., active sports fields, agricultural lands, etc.), and other non-vegetated, non-plantable land uses.
- Use geospatial data to determine Possible Planting Area (percentage) using parcel-level metrics and identify vulnerabilities and opportunities for tree establishment. Include realistic assumptions about tree planting rates and actual potential cover of available and plantable land parcels.
- Utilize forthcoming Urban Heat Island mapping and embedded data layers (being developed by Kingston Public Health for City of Ottawa, to be available 2017) as data source.
- Include tools to calculate potential canopy gains or losses based on different tree planting scenarios, including consideration for canopy goals by land-use type or other scale, tree growth rates, plantable areas, and other factors.
- Consider making parts of the tree planting prioritization tool publicly available online.
- Include tools to identify tree planting areas, at appropriate scales, in relation to weighted priorities such as urban heat island mitigation, energy savings, water quality improvement, equitable canopy cover / urban forest benefits equity, vulnerable populations, public health, carbon storage/sequestration, and others.
- Mechanisms to track change in urban forest canopy cover and effects of implemented actions should be developed through the study.

- Will require coordination with Forestry, Ottawa Public Health, Community and Social Services (Affordable Housing), and should also engage Infrastructure Services Department.
- Assess value of i-Tree Eco or similar urban forest study to contribute "on the ground" data to this assessment tool.

Time for Completion: 1 years
Prerequisite Recommendations: None
Risk: Failure to establish appropriate urban forest canopy cover target. Tree planting and establishment undertaken without understanding of objectives to be achieved or benefits to be supported. Failure to capitalize on opportunities for successful and long-term tree establishment. Failure to measure the effects of tree planting on urban heat islands and health equity.
External Partner(s): Consultant, regional Conservation Authorities (MVCA, RVCA, SRCA), Community Associations, National Capital Commission, various other external stakeholders
Resources Required: Additional resources required (secured through 2017 City Budget)
Target: Urban forest canopy cover study completed and tree planting prioritization tool developed and in use by City and stakeholders.

Recommendation #5: Integrate urban forest resources in the City's Asset Management Program

Related UFMP Objectives(s): #1 – Urban forest sustainability, #3 – Improve knowledge, #4 – Community engagement, #7 - Manage proactively
Sustainability Criteria: V1, M16
Management Period: All Management Periods (2018-2037)
Purpose: To develop and implement methods that integrate urban forest resources into the City's Comprehensive Asset Management program. To recognize the benefits the urban forest provides and its contribution to municipal service delivery and sustainability goals. This will entail methodologies to improve the inventory, condition assessment and valuation of urban forest resources, to guide the development and funding of asset management plans for forestry resources.
Current Practices: The City's Comprehensive Asset Management Policy and Strategy (2012) includes the intent to integrate natural assets as part of continuous improvement. Street trees were included in the 2017 State of the Asset Report, although methodologies for valuation and condition assessment need further development. Ottawa is participating in a peer learning project of the Federation of Canadian Municipalities to integrate sustainability into asset management planning and implementation.

Best Practices: Natural assets such as forests and wetlands and green infrastructure are increasingly being integrated into municipal asset management plans. Examples include the Region of York's Green Infrastructure Asset Management Plan and the Town of Gibsons (British Columbia) Eco-Asset Strategy. Other recent reports have placed an economic value on the services provided by the greenspaces in the National Capital Region[7] and the Toronto Greenbelt. Projects such as the Natural Municipal Natural Assets Initiative and the Natural Capital Lab are developing methodologies to more consistently understand the value of natural assets and the services they provide through a series of pilots across Canada. The Credit Valley Conservation Authority and others are examining the costs and benefits of investing in natural assets as a complementary approach to grey infrastructure.

Lead(s) for Implementation: City - Planning, Infrastructure and Economic Development Department, Natural Systems and Environmental Protection Unit; Public Works and Environmental Services Department, Forest Management Unit; and Planning, Infrastructure and Economic Development Department, Asset Management Branch.

Implementation Guidance:

- Review best practices in the valuation of urban forest resources with the aim to develop practical and cost-effective approaches to guide the City's comprehensive asset management program and the management and protection of forest resources.
- Improve the methodology for tracking the state of urban forest resources, including the urban forest inventory, condition assessment, valuation and risk assessment.
- Consider methods beyond tree replacement costs that value urban forest benefits and how these increase with time and tree maturity. These can include, for example, air and water quality protection, carbon storage, urban heat island mitigation, biodiversity protection, stormwater management, flood protection and tourism.
- The Forest Area Maintenance Strategy (Recommendation #12) and the Tree Lifecycle Maintenance Plan (Recommendation #15) build on the forest asset inventory and clearly define levels of service.
- Consider approaches to integrate trees on private property over time.
- Explore ways to build a business case that demonstrates the costs and benefits of protecting, restoring and enhancing urban forest resources.

[7] The NCC and David Suzuki Foundation 2016 report *Natural Capital: The Economic Value of the National Capital Commission's Green Network* values the NCC greenspace at $332 million per year.

- Adopt asset management best practices when developing risk assessment, and life cycle costing tools and defining levels of service for urban forest resource protection and management.
- Explore how forest resource value and condition can inform other asset management plans and service outcomes within the City's Asset Management Program and guide capital planning and investment decisions. For example, how does the urban forest canopy contribute to stormwater management and reduce risks to infrastructure or property from flooding? How do street trees mitigate the urban heat island effect and contribute to complete street transportation objectives?
- Communicate the value of urban forest resources and the services they provide to staff, Councillors and the public.

Time for Completion: Ongoing
Prerequisite Recommendations: None initially, but this will benefit from Recommendation #3 (tree inventory collection and maintenance – ongoing) and Recommendation #4 (urban forest canopy cover study).
Risk: The value of urban forest resources and their contribution to municipal services and benefits are not reflected in the City's primary business approach for asset management planning, risk analysis and decision making.
External Partner(s): None
Resources Required: Existing resources to be allocated initially to liaise with Asset Management group to start the process. Additional resources may be required over time to implement valuation of urban forest resource.
Target: Options for integration of urban forest resources into the City's Asset Management Program.

5.2. Planning for the urban forest

Recommendation #6: Improve implementation of the Official Plan policies through internal outreach and engagement

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #4 – Community engagement
Sustainability Criteria: M11, M12
Management Period: All Management Periods (2018-2037)
Purpose: Expand awareness among City staff and other stakeholders who make decisions that affect the existing and future urban forest about the policies that are in place, mechanisms for implementing them, and how these policies also help implement other City-wide strategies and plans.
Current Practices: Responsibility for implementation of Ottawa's urban forest program is primarily shared between two municipal departments – Planning,

Infrastructure and Economic Development Department (Development Review unit and Natural Systems and Environmental Protection unit) and Public Works and Environmental Services Department (mainly the Forestry units). Coordination between these and other groups (such as Infrastructure Services and Surface Water Management and Environmental Monitoring) on urban forest issues currently occurs on an informal basis.

Best Practices: Many municipalities (particularly large ones), struggle with the multi-departmental integration required for effective implementation of policies related to tree retention and establishment. Approaches for addressing this challenge vary depending on municipal structure and processes. In the City of Mississauga a two-pronged approach was identified whereby Forestry staff (a) would attend pre-established plan review meetings in other departments on a regular basis, and (b) create an internal urban forest working team of key staff from planning, parks, engineering and transportation to discuss and resolve urban forest-related issues.

Lead(s) for Implementation: City – Planning, Infrastructure and Economic Development Department, Natural Systems and Environmental Protection and Public Works and Environmental Services Department, Forest Management Unit

Implementation Guidance:

- Engage with a broader spectrum of internal and some external stakeholders involved in planning decisions that impact trees, to educate them about the existing urban forest policies and possible approaches for implementing them, as well as the vision and objectives of the UFMP.
- Outreach should include presentations to Councillors and Senior Management.
- Stakeholders should include selected staff from: Planning; Legal Department; By-law Services; Infrastructure Services; Recreation, Cultural and Facilities Services Department; Ottawa Public Health; Community and Social Services (Affordable Housing); large landowners; the Committee of Adjustment; regional Conservation Authorities; Greater Ottawa Home Builders Association and the development community.
- Tools should include a presentation and short handout, which should be provided as part of an ongoing annual series of workshops or "lunch and learns" with the various target audiences.
- Communication should include updates related to the status of the UFMP every four years in conjunction with broader Plan review.
- Messaging should include:
    - the need to implement the City's existing urban forest policies and by-laws more comprehensively and consistently through improved multi-departmental communication and coordination;
    - references to the vision and direction provided in the City's Greenspace Master Plan (2006);

- links between the implementation of urban forest policies and other aligned City-wide strategies and plans such as those addressing climate change, energy use and human health challenges;
- an overview of the various planning tools already in place that can be used to help implement the various urban forest policies at different planning levels (such as through Secondary and Community Design Plans, Plans of Subdivision, Zoning, Site Plan Control); and
- emphasis on shifts that could be made using existing staff and existing resources.

Time for Completion: Ongoing
Prerequisite Recommendations: None
Risk: Existing policies not implemented consistently and opportunities for tree retention and establishment are overlooked.
External Partner(s): Regional Conservation Authorities, Committee of Adjustment, Greater Ottawa Home Builders' Association and development community
Resources Required: Existing resources to be allocated.
Target: A greater cross section of City staff at all levels, as well as Councillors and other key stakeholders, are more aware and supportive of policies and practices that support urban forest sustainability.

Recommendation #7: Update significant woodland policies in the urban area

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment
Sustainability Criteria: M12
Management Period: 1st Management Period (2018-2021)
Purpose: Update and revise Ottawa's Official Plan policies to ensure consistency with Provincial requirements for significant woodland identification and protection.
Current Practices: At this time, significant woodlands are not specifically identified as such in the urban area, although Urban Natural Feature and Significant Wetland designations likely capture most of what would also be considered significant woodland, and are included in the City's natural heritage system (NHS). The City is considering a range of approaches that are appropriate for Ottawa and meet the Province's requirements and to ensure conformity with the *Provincial Policy Statement* (2014).
Best Practices: The Provincial Policy Statement (2014) now requires municipalities in Ecoregions 6E and 7E to identify an NHS, including significant woodlands which

are identified using criteria developed according to provincial guidelines[8]. The approaches to achieving this have varied among municipalities, but have typically involved the development of criteria for significant woodlands based on minimum size thresholds and other ecological functional criteria[9]. In terms of policy approaches, most municipalities have remained consistent with the *Provincial Policy Statement* and do not allow development within a significant woodland or its adjacent lands "*unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions*" (Policy 2.1.5). A few municipalities with elevated concerns about natural woodland and overall canopy cover loss have gone beyond the *Provincial Policy Statement*, do not allow development within confirmed significant woodlands, and treat them similar to Provincially Significant Wetlands.

Lead(s) for Implementation: City – Planning, Infrastructure and Economic Development Department, Natural Systems and Environmental Protection

Implementation Guidance:

As part of the significant woodlands review that is currently underway, the City should consider:

- appropriate criteria for significant woodland identification that align with provincial guidance (with potentially different criteria for areas with different levels of canopy cover);
- whether or not, based on the established criteria, excluding a wooded area identified as significant from the urban boundary is an effective mechanism to protect the feature;
- what an appropriate "trigger distance" for an EIS should be where development is proposed within or adjacent to a significant woodland in the urban area;
- tools and/or incentives for ensuring the securement of significant woodlands on private lands, including the acceptance of such features for parkland dedication;
- a process for buffer determination, including their minimum width and other design guidelines for protected significant woodlands in the urban area;
- policies that ensure a clear distinction between: (1) the process for protection of significant woodlands (which requires application of the "no negative impacts" test as in the Provincial Policy Statement), and (2) the process for integration of

[8] The current guidance for significant woodlands criteria is found in the Natural Heritage Reference Manual (2010), and is quite general. However, the Province has indicated that more specific criteria are forthcoming.

[9] Functional criteria such as the extent of woodland interior, proximity to other habitats, linkage functions, diversity, uncommon characteristics, and relatively high economic or social value are aligned with those set out in the Province's Natural Heritage Reference Manual (2010).

treed assets outside of significant woodlands (which requires conformity to the City's Tree Conservation Report guidelines and applicable tree by-laws); and
- approaches used by other Ontario municipalities to secure significant woodlands and/or enhance significant woodlands (and other significant natural areas) through development review, transportation, and parks planning processes.

Time for Completion: 2 years
Prerequisite Recommendations: None
Risk: Inadequate protection for significant woodlands in the urban area, and resultant loss of tree canopy cover and ecosystem services.
External Partner(s): Province of Ontario, Conservation Authorities (where wooded natural areas overlap with their regulated areas; e.g., forested wetlands and valleylands), Greater Ottawa Home Builders' Association (GOHBA) and development community, and other stakeholders.
Resources Required: Existing resources to be allocated.
Target: Updated policies completed, included in an Official Plan Amendment, and approved.

Recommendation #8: Review and Update the City's Tree By-laws

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #4 – Community engagement
Sustainability Criteria: V5, V7, M11, M12
Management Period: 1st Management Period (2018-2021)
Purpose:
1. Improve the effectiveness of the Urban Tree Conservation By-law (UTCB)
2. Review and implement opportunities to strengthen the Municipal Trees and Natural Areas Protection By-law
3. Investigate the need for a Heritage Tree By-law, program or registry in Ottawa

Current Practices:
1. The City's current UTCB regulates all trees on lots greater than one hectare and trees of 50 cm DBH and above on properties of one hectare and smaller. The current by-law does not provide specific protection for heritage trees, and allows for but does not require any specific compensation for trees approved for removal. It also does not include prescribed fines for infractions.
2. Ottawa's Municipal Trees by-law covers all trees on all City lands. However, it could be strengthened by: closing the technical loopholes in the language of the current by-law (which have prevented enforcement in some cases), allowing for a range of appropriate compensation approaches suited to different scenarios based on a no net loss approach, requiring Tree Conservation Reports for all capital projects, and ensuring City comments from various departments are well-coordinated.

3. Ottawa does not currently have a heritage tree by-law, program, or registry.

Best Practices:

1. Of the lower and single-tier municipalities in Ontario that regulate individual trees, the size classes that are regulated range from 15 to 76 centimetres DBH and above, although most of the municipalities regulate trees between 20 to 40 centimetres DBH and larger. For example, the City of Toronto regulates the removal of trees of at least 30 cm DBH. The use of letters of credit or deposits is often overlooked for trees being protected but can be an effective incentive for helping to ensure tree protection. This has been explored, and in some cases implemented, in municipalities such as Guelph, Ajax, Kingston, and Mississauga. Tree preservation guidance documents that should be considered in the review and update of the TCR guidelines include those from the City of Toronto, Region of York, City of Markham, Town of Oakville and Town of Richmond Hill.
2. Ottawa's Municipal Trees by-law is one of the most comprehensive in its scope, and has been used successfully to obtain 1:1 compensation for City-owned trees to be removed as well as financial compensation in some cases. The recommendations for improvement are specific to Ottawa's by-law and have been identified based on the background review and input from various stakeholders, including City staff.
3. A number of municipalities also specifically include heritage trees in their by-laws, but define "heritage tree" differently. In some municipalities, heritage trees are simply equated to large diameter trees. In other municipalities a special designation is applied to certain trees because of their species, size, or location. In the City of Toronto "heritage trees" include those designated under the Ontario Heritage Act, and those recognized by the Trees Ontario process. Under their current tree by-laws these trees can only be removed with Council authorization or upon order of the Ontario Municipal Board.

Lead(s) for Implementation: City **–** Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection, Public Works and Environmental Services Department - Forest Management Unit, Legal Services, and By-law and Regulatory Services

Implementation Guidance:

1. The Urban Tree Conservation By-law review should consider:

- Expanding the scope of the by-law so that the "large property" component of the by-law applies to all Site Plans and Plans of Subdivision, irrespective of property size;
- Options for incorporating a heritage tree component into this by-law;
- Collection of securities for trees to be protected;
- Requiring compensation for all regulated trees approved for removal, ideally using approaches selected from a City-wide compensation guideline document (see Recommendation #23);
- Potentially reducing the 50 centimetre DBH threshold for "distinctive trees" to a smaller diameter (such as 20 or 30 centimetre DBH) with consideration for the

City resource implications and the potential benefits of making this by-law more restrictive (with reference to the monitoring data as per Recommendation #7, if available);
- Prescribing set fines for easier and more consistent enforcement; and
- Revising the current Tree Conservation Report (TCR) guidelines to be more comprehensive and consistent with relevant precedents and best practices.
- Practices should be revised so that:
  - Comments related to each development application are coordinated through a single Planner or Forester in Planning;
  - TCRs are consistently required for capital projects; and
  - Where compensation trees cannot be accommodated on the subject property, that cash-in-lieu be provided and directed towards Forestry's tree planting account.

2. The Municipal Trees and Natural Areas Protection By-law review should consider:
- Closing any legal loopholes or technical ambiguity in the by-law that may hamper its enforcement; and
- Reviewing the prescribed approach to compensation to ensure that it is flexible enough to address the range of scenarios typical in Ottawa and ensures a no net loss or a net gain approach in terms of long-term tree canopy cover.
- Practices should be revised so that:
  - Comments on municipal trees are coordinated with those from Planning related to trees on private lands (and with other departments as appropriate) prior to being provided to the proponent;
  - Tree Conservation Reports are required for capital projects; and
  - The approach to compensation is formalized and incorporated into City-wide tree compensation guidelines (see Recommendation #23).

3. The investigation into the need for a heritage tree by-law/program/registry should consider:
- How other municipalities protect and retain heritage trees;
- If the challenges related to retaining and protecting "heritage" trees can be met through a revision to and inclusion in the Urban Tree Conservation By-law.

Time for Completion: 1 to 2 years
Prerequisite Recommendations: None
Risk: Missed opportunities for better protecting and enhancing the urban forest, including important heritage components, on both public and private lands.
External Partner(s): Greater Ottawa Home Builders' Association (GOHBA) and development community, Internal and External Urban Forest Working Groups, community groups, local arborists and contractors
Resources Required: Existing resources to be allocated (for undertaking review). Additional resources may be required (for implementation of any changes to the tree by-laws).

Target: Review existing tree by-laws to improve their ability to support the City's urban forest objectives on public and private lands.

Recommendation #9: Develop new and update and consolidate existing guidelines, standards and specifications for tree planting and establishment

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #5 – Resilient, diverse and functional urban forest
Sustainability Criteria: M7, M8
Management Period: 1st Management Period (2018-2021)
Purpose: To ensure that tree planting and establishment is undertaken using consistent, high-quality standards and specifications for;
1. Greenfield areas - To ensure latest best practices and research outlined in draft *Street Tree Manual for Greenfield Neighbourhoods* are implemented in new developments in Ottawa, particularly in Sensitive Marine Clay Soils (SMCS) areas, to increase urban forest canopy in new developments.
2. Existing urban conditions - To ensure successful tree planting and establishment in urban areas, including along streets and in parks and greenspaces. To ensure consistent and correct application of municipal tree planting specifications and standards in all City operations and City-led projects.
3. Urban hardscapes - To reduce future tree and infrastructure maintenance challenges associated with inconsistent design and construction of hardscape tree planting solutions. To provide a resource for effective private land tree planting and establishment.
Current Practices: Tree planting in the urban area of Ottawa is guided by a number of design guidelines, technical manuals and construction details. These may contain contradictory or outdated information, resulting in missed opportunities for successful tree establishment. Three documents provide higher-level guidance for greenfield developments in Ottawa. These include *Urban Design Guidelines for Greenfield Neighbourhoods (UDG)* (2007), the draft *Street Tree Manual for Greenfield Neighbourhoods*, and *Building Better and Smarter Suburbs: Strategic Directions and Action Plan (BBSS)* (2015). The UDG are currently being reviewed and updated, and will reference the *Street Tree Manual* for guidance around tree planting and establishment in greenfield neighbourhoods. BBSS will inform updates to the City's SMCS policy and the draft *Street Tree Manual*, which are both currently also under review. The City of Ottawa does not currently have standards or specifications for tree planting and establishment in urban hardscapes.
Best Practices: The Town of Oakville *North Oakville Urban Forest Strategic Management Plan* (2012) outlines strategies for increasing urban forest cover in future greenfield developments, such as minimum soil volumes, innovative tree

planting solutions, and other guidelines. Recent work by GOHBA will inform the assessment of SMCS and associated tree planting practices and requirements. In 2013, the City of Toronto developed the "Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual" which identifies three specific construction methods for engineered tree solutions in hardscapes, including 1) a pavement bridge system, 2) a soil cell system, and 3) an open planter system, and which identifies opportunities for hybrid solutions and retrofits using elements of these systems. This manual is considered a leading-edge best practices document and should be used to inform the development of similar specifications and standard details for tree planting in Ottawa's hardscapes. Toronto's comprehensive *Streetscape Manual* also outlines numerous approaches for integration of trees into the urban streetscape, and the *Design Guidelines for 'Greening' Surface Parking Lots* provide specific strategies to integrate green infrastructure elements into those landscapes. The City of Guelph's *Streetscape Manual, Built Form Standards, & Conceptual Design for St. George's Square* also provide comprehensive guidance for integration of trees into streetscape and urban design.

Lead(s) for Implementation: City – Planning, Infrastructure and Economic Development Department and Public Works and Environmental Services Department - Forest Management Unit

Implementation Guidance:

- Define criteria for success of tree planting and establishment and to review and update existing standards and specifications for tree planting and establishment.
- Develop new standards and specifications for engineered tree planting solutions in urban hardscapes areas, based on consideration of best practices such as structural cells, root paths, structural soils, open planters, continuous soil trenches, bridged pavements, etc.
- Integrate tree planting and establishment solutions with City's 'complete streets' and 'green streets' policies and implementation framework. Use them to inform development and capital projects, such as road reconstructions and retrofits.
- For engineered tree planting solutions, determine:
  - Asset ownership of engineered tree planting solutions;
  - Funding for City capital projects and development projects utilizing engineered tree planting solutions;
  - Ongoing operational needs, maintenance and rehabilitation/lifecycle of engineered tree planting solution;
  - Utility integration within engineered tree planting solutions; and
  - Approval process for engineered tree planting solutions.
- To be undertaken in conjunction with the City's infrastructure standards review (currently ongoing), *Building Better and Smarter Suburbs* (BBSS) working group, and the review and update of *Urban Design Guidelines for Greenfield Neighbourhoods* and can be facilitated by Internal Urban Forest Working Group (see Recommendation #2).

- Consolidate guidelines and standards from all other applicable City policies and Design and Planning guidelines and review and revise to ensure internal consistency and conformance with currently recognized best practices for tree planting and establishment.
- Compile standards and specifications to serve as resource document available to multiple users including City Departments, developers and consultants, and private landowners to guide consistent application of municipal standards.
- Consider low impact design (LID) opportunities for tree establishment in existing urban conditions.
- Consider opportunities to include fruit and nut trees in City tree planting projects in parks and greenspaces.
- Coordinate updates and finalization of *Street Tree Manual* with the BBSS work and updates to the Sensitive Marine Clay Soils policy, and reference the *Street Tree Manual* as a technical guidance document in forthcoming *Urban Design Manual for New Neighbourhoods*.
- Ensure *Street Tree Manual* guidance for new species, setbacks between street trees and utilities and other infrastructure, tree spacing and planting densities, planting solutions for Sensitive Marine Clay Soils, recommended soil volumes, and other factors are considered.

Time for Completion: 2 years
Prerequisite Recommendations: None
Risk: Ongoing and inconsistent implementation of sub-standard tree planting and establishment practices in urban hardscapes and infill areas. Future tree and infrastructure maintenance challenges in non-standardized tree planting sites across City. Reduced rates of successful tree establishment and increased tree replacement frequency and cost. Missed opportunity to apply best practices to increase urban forest canopy in Sensitive Marine Clay Soil areas.
External Partner(s): Consultants, including professional engineers, landscape architects, geotechnical consultants, and arborists; Greater Ottawa Home Builders' Association (GOHBA) and development community; Hydro Ottawa
Resources Required: Additional resources may be required. FTE and funding request will be brought forward through the 2018 Draft Budget process.
Target: Completion of *Street Tree Manual for Greenfield Neighbourhoods*, *Urban Design Manual for New Neighbourhoods,* revised and updated *Planting in Areas of Sensitive Marine Clay* policy. Design and construction standards and standards for tree planting and establishment solutions in urban hardscapes developed.

Recommendation #10: Improve outreach, enforcement and monitoring of the City's urban forest policies and by-laws

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #3 – Improve knowledge, #4 – Community engagement, #7 - Manage proactively
Sustainability Criteria: V7 and M11
Management Period: 2nd Management Period (2022-2025)
Purpose: Improve the City's ability to undertake "on the ground" education and enforcement of the City's urban forest policies and tree by-laws, and monitor how well they are being implemented.
Current Practices: As part of their daily tasks, City staff, in both Planning and Forestry, interact with a range of private landowners and contractors to ensure development plans and tree by-law permit applications conform to the City's policies, guidelines and by-laws with respect to both tree retention and planting. However, City staff's ability to follow-up on approved plans and permits to verify if forest and/or tree protection and/or planting has been implemented "on the ground" as approved through plans and permits is very limited. This is particularly the case with a significant proportion of existing urban forestry staff time and related resources being allocated to management of ash trees infested with EAB on municipal lands.
Best Practices: Many municipalities with strong urban forest policies and by-laws struggle with having adequate "boots on the ground" resources for follow-up on the implementation of their policies and by-laws. However, in municipalities such as Toronto and Mississauga, those involved in the day-to-day enforcement of municipal tree by-laws and policies assert that having some targeted enforcement helps ensure proper implementation by (a) demonstrating the municipality's commitment and (b) providing opportunities to educate landowners and contractors on site. In Ottawa, it is anticipated that in a few years, once the bulk of the EAB-related activities have been undertaken, that some staff resources can be shifted or re-aligned towards improved enforcement of the City's existing urban forest policies, guidelines and by-laws.
Lead(s) for Implementation: Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection and Public Works and Environmental Services Department - Forest Management Unit
Implementation Guidance:

- Consider shifting existing staff duties so that two Certified Arborists with urban forest planning knowledge and familiarity with tree by-laws can work with the Foresters in Planning and Forestry and By-law Services staff to enforce tree protection, replacement, compensation and other mitigation measures by following-up on permit applications being reviewed under the Municipal Trees and Natural Areas Protection By-law and the Urban Conservation Tree By-law.

- Specific tasks should include conducting site visits to screen for potential impacts to trees on both municipal and private property as part of development applications and capital projects, and to explore opportunities for tree preservation and establishment with other City staff and private proponents.
- Every site visit should be used as an opportunity to engage and educate proponents, contractors, residents, and other City staff.
- Develop and implement a practical approach for collecting quantitative data related to tracking and assessing the effectiveness of the City's current policies and tree by-laws for selected sites in the urban area (such as tracking of trees removed versus trees planted).
- Explore practical approaches for adding more quantitative data to the Urban Conservation Tree By-law reporting, and implement this approach if approved.

Time for Completion: Ongoing
Prerequisite Recommendations: None, but would benefit from revisions to public and private tree by-laws (see Recommendations #8)
Risk: Continued inability to properly evaluate the effectiveness of the City's tree by-laws, as well as the extent to which other tree-related policies are being implemented "on the ground".
External Partner(s): None
Resources Required: Additional resources may be required pending outcome of tree by-law reviews.
Target: Improved enforcement of existing urban forest policies and by-laws, and improved awareness among landowners and City staff.

5.3. Maintaining and growing the urban forest

Recommendation #11: Improve process for assumption of trees planted in new developments

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #5 – Resilient, diverse and functional urban forest
Sustainability Criteria: V5, M9, M10
Management Period: 1st Management Period (2018-2021)
Purpose: To increase the rate of successful tree establishment and reduce tree mortality rates. To maintain and improve the health and condition of City-owned street and park trees in the urban area. To reduce tree-related risk.
Current Practices: Newly planted trees are typically covered by a two year warranty period following the initial planting, and developers are responsible for maintenance and replacement within this period. At the end of the warranty period, these trees are to be inspected by the developer's Landscape Architect prior to assumption and a report (an F2 Inspection Report) which confirms that all trees are

present and healthy is to be completed and submitted to Planning. This process (a) means that Forestry staff typically do not verify the inspections prior to assumption, and (b) sometimes results in a delay between assumption of trees and their inclusion in the City's tree inventory and Lifecycle Maintenance Program. This delay may result in structural problems or otherwise poor tree condition, which are more difficult and costly to resolve as trees mature.

Best Practices: The City's tree assumption process is generally consistent with best practices, but could be improved with respect to quality control and timing. Several communities in Ontario, such as the City of Guelph, are working to overcome the challenges associated with assumption of trees planted in new subdivision developments by ensuring individuals with expertise in tree assessment conduct the inspections prior to assumption.

Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit

Implementation Guidance:

- Trees planted in developments to be assumed by the City of Ottawa should be inspected by City Forestry Inspectors and/or Landscape Architects instead of construction technicians prior to assumption.
- The existing F1/F2 process developed by City to inspect trees prior to assumption should be formalized and consistently implemented within a year of the end of the two-year warranty period.
- Trees should be added to street and park tree inventory following planting and prior to inspection through the City's lifecycle maintenance program.
- Trees can be added to the inventory through developer-provided data (with City GIS compatibility) and/or field-based tree inventory by City staff.
- Will require coordination and cooperation with GOHBA and other local developers to confirm and implement process.

Time for Completion: Ongoing

Prerequisite Recommendations: None

Risk: Potential significant delay in providing important structural pruning or other maintenance for young trees. Potential to assume ownership of poor quality tree stock in new developments, which may require replacement or significant maintenance at considerable expense to the City.

External Partner(s): Greater Ottawa Home Builders' Association (GOHBA) and development community, development community Landscape Architects and consultants.

Resources Required: Existing resources to be allocated (for administration)

Target: Trees planted in developments to be assumed by Ottawa are added to street or park tree inventory within six months of planting. Trees are inspected prior to assumption of ownership by Forestry Inspector.

Recommendation #12: Develop a Forested Areas Maintenance Strategy (FAMS)

Related UFMP Objectives(s): #1 – Urban forest sustainability, #5 – Resilient, diverse and functional urban forest, #6 – Minimize risk, #7 – Manage proactively
Sustainability Criteria: V6, M10, M13
Management Period: 1st Management Period (2018-2021)
Purpose: Develop a Forested Areas Maintenance Strategy to improve the health, resilience and safety of Ottawa's City-owned woodlands. Identify woodland areas requiring management (especially following ash tree removal) and ensure successful regeneration of desirable indigenous vegetation instead of invasive species.
Current Practices: The City manages over 2,100 hectares of urban woodlands. Invasive species, encroachment, informal trail creation and tree risk are ongoing management issues. Most tree risk management is undertaken on a service request basis. There are restoration and management plans for individual woodlands where ash trees have been removed due to emerald ash borer infestation, but there is no overarching strategy to address long-term restoration needs and required resources. There is no fire risk assessment for urban woodlands.
Best Practices: The City of Mississauga is a leading example of urban natural areas management by a large municipality. The City undertook an initial assessment of its Natural Areas System in the 1990s and continues regular monitoring. The City published its Natural Heritage and Urban Forest Strategy, which addresses forest area maintenance and management in 2014.
Lead(s) for Implementation: City – Public Works and Environmental Services Department and Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection
Implementation Guidance:

- The FAMS will require basic forest assessments (considering available data from the UNAEES and updating as needed) to confirm management needs and issues, and help prioritize forests for management.

The FAMS should:

- Identify all City-managed woodlands where a significant portion of the overstory has been or will be removed for EAB management and are at risk of invasive plant species spread.
- Prioritize woodlands for management with consideration for social, economic and/or ecological value; intensity of ash tree removal; post-removal restoration efforts; susceptibility to invasion and existing populations of invasive plant species; and others.
- Include intensive and passive/less intensive management approaches.

- Include management activities to ensure successful natural regeneration of indigenous plant species and/or success of post-removal restoration plantings.
- Ensure adequate resources are allocated to long-term activities including stand monitoring, tending, supplemental planting, etc. necessary to ensure successful woodland restoration following ash tree removal.
- Include protocols for visual inspections of trees along City-sanctioned formal trails in wooded natural areas in conformance with the ANSI/ISA BMP Level I: Limited Visual Assessment on a regular basis, as well as fencing off woodlands where this is not possible (and document this approach in the City's Tree Risk Management Policy, as per Recommendation #18).
- Identify appropriate tree risk management responses, such as tree pruning and removal, temporary or permanent trail or woodland closures, directional signage, and others.
- Include a fire risk assessment for all City-owned forested areas;
- Include invasive plant management approaches and related restoration of degraded areas with appropriate indigenous species.
- Include strategies for developing partnerships to assist in forest management where possible and appropriate.

The FAMS should also consider the following on a selective basis as resources allow:

- Developing an education program that highlights the value of Ottawa's public forests, their sensitivities, and key information about them.
- Identifying and implementing opportunities for wildlife habitat enhancement and/or creation.
- Identifying and implementing opportunities for buffer enhancement and/or creation around the protected area.

Time for Completion: 1 year
Prerequisite Recommendations: None
Risk: Continued degradation of City-owned woodlands, as well as increasing risk of personal injury associated with public use of unmanaged areas. Potential failure to ensure successful regeneration of desirable indigenous vegetation. Possible colonization of managed woodland areas by invasive plant species and associated loss of social, economic and/or ecological value.
External Partner(s): Regional conservation authorities (RVCA, MVCA, SNCA), NCC, federal government, Ontario Ministry of Natural Resources and Forests (MNRF), community groups, local residents, and other potential stewards
Resources Required: Existing resources to be allocated (strategy development). Additional resources may be required (implementation).
Target: Completed Forested Areas Maintenance Strategy and adequate resources available for implementation.

Recommendation #13: Review City tree planting programs

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment
Sustainability Criteria: M8
Management Period: 1st Management Period (2018-2021)
Purpose: To review City of Ottawa tree planting programs to ensure that these programs are meet resident demand and the objective of increasing urban tree canopy. To utilize opportunities to plant trees on private lands adjacent to municipal rights-of-way if suitable locations cannot be provided within municipal road right-of-way.
Current Practices: The City operates various tree planting programs for City-owned land, including Trees in Trust, the Commemorative Tree Program, the Parks and Streetscapes Tree Planting Program, and the Schoolyard Tree Planting Grant Programs. The City plants trees within the municipal road right-of-way and in parks but does not provide direct assistance for tree planting on private lands adjacent to roadways. Past programs enabled Forestry staff to investigate opportunities to plant trees on private properties adjacent to road rights-of-way, if the property owner consented and committed to maintaining the tree in its planted location.
Best Practices: Municipalities have many different types of tree planting programs for municipally-owned land. Few municipalities directly plant trees on private properties. However, the City of Oshawa supports this approach through its "City Trees By-law" if suitable planting spaces are not available on municipal property, provided that the property owner assumes maintenance responsibility. The cities of Toronto and Markham, Town of Ajax and York Region, provide support for LEAF's Backyard Tree Planting Program. The Town of New Tecumseth supports the planting of one hardwood tree per property through a capped rebate for eligible purchases.
Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit
Implementation Guidance:

- Review existing tree planting programs with a focus on replacement statistics, size of replacement trees, homeowner uptake, equitable access across the urban area, survival rates, etc.
- Work towards a proactive approach to implementing tree planting programs, possibly with the assistance of local community associations.
- For City tree planting on private property:
  - City to develop policy regarding ownership of planted tree, sharing and assignment of maintenance responsibilities, and ownership of liability.
  - All planting must be undertaken with property owner consent.
  - Property owners should be required to commit to maintaining or, at minimum, retaining planted trees for specified duration.

Time for Completion: Ongoing operations
Prerequisite Recommendations: None
Risk: Risk of missed opportunities to replace trees in a timely manner in mature neighbourhoods. Potential missed opportunity to establish trees in optimal growing environments and enhance the urban forest on streetscapes.
External Partner(s): City of Ottawa residents and other private property owners, Hydro Ottawa
Resources Required: Additional resources may be required. FTE and funding request will be brought forward through the 2018 Draft Budget process.
Target: A suite of City tree planting programs with a proactive tree replacement strategy to continue growing Ottawa's urban forest.

Recommendation #14: Develop city-wide tree compensation guidelines

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #5 – Resilient, diverse and functional urban forest, and #7 – Manage proactively
Sustainability Criteria: M7, M11, M12
Management Period: 1st Management Period (2018-2021)
Purpose: To help achieve a no net loss approach to tree cover removal related to development. To streamline the tree compensation process and have a tool for applying it more consistently city-wide.
Current Practices: Ottawa's current policies, UTCB and guidelines allow for and support replacement (or compensation) for trees approved for removal from private lands, but do not require it. This is also true for capital projects. Compensation for municipal trees removed because of development adjacent to municipal lands is required (through the Municipal Trees and Natural Areas By-law) in the form of stem-for-stem tree replacement(s) and, occasionally, financial compensation.
Best Practices: A growing number of municipalities in southern Ontario are requiring compensation for trees approved for removal on both municipal and private lands as a tool to sustain their tree canopy cover. The Cities of Toronto and Mississauga generally require per stem compensation at a ratio of 3:1, but may also accept naturalization plantings depending on the site conditions. The Town of Oakville requires a Canopy Cover Plan for proposed developments in its north end greenfield areas outside of protected natural heritage system components. This Plan requires developers to meet established targets for different land uses (e.g., 20% for employment/industrial and residential lands, 50% for parkland, 15% for commercial lands, etc.). Oakville's plan also provides incentive for retaining existing trees by allowing their current canopy to be counted at 1.5 times current size.

Lead(s) for Implementation: City – Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection
Implementation Guidance:
These guidelines should:

- Establish a minimum standard of "no net loss" with respect to tree canopy cover, and have a long-term objective of "net gain";
- Provide a range of options that would be applied to different development scenarios (e.g., individual large tree removals versus forested area removals);
- Include a range of methods to be considered such as aggregate caliper, stems per unit area replacement, canopy cover replacement, ratio tree replacement, and amenity value compensation, as well as cash-in-lieu;
- Provide guidance that is clear and supports a transparent and consistent approach for all projects;
- Consider tree canopy contributions through the landscape planning process in new developments;
- Be developed in consultation with the development community and local environmental organizations; and
- Be used by the Forestry staff in Public Works to provide options for tree compensation on municipal lands.

Time for Completion: 1 year
Prerequisite Recommendations: None, but should be done in conjunction with Recommendations 7 and 8, significant woodlands and review of tree by-laws.
Risk: Incremental loss of the urban forest without adequate replacement or consideration for opportunities for expansion.
External Partner(s): Greater Ottawa Home Builders' Association (GOHBA) and development community, Community Associations
Resources Required: Existing resources to be allocated.
Target: Tree compensation guidelines completed, approved, and utilized.

Recommendation #15: Review the 7-year tree lifecycle maintenance program in the urban area

Related UFMP Objectives(s): #6 – Minimize risk, #7 – Manage proactively
Sustainability Criteria: V5, M9, M10
Management Period: 2nd Management Period (2022-2025)
Purpose: To maintain and improve the health and condition of City-owned street and park trees in the urban and rural areas. To reduce tree-related risk.
Current Practices: The City implements a 7-year inspection and pruning cycle for street and actively-managed park trees in the urban area under the 'Trees and Forests Maintenance Program'.

Best Practices: A 7-year pruning cycle is generally consistent with arboricultural and urban forestry best practices, and is comparable to the cycle implemented or targeted for implementation by many Canadian and American jurisdictions, such as Burlington, Halifax, New York, Toronto, and many others. The pruning cycle should be regularly assessed and adjusted, if required, based on the tree inventory and maintenance needs.
Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit
Implementation Guidance:

- Upon completion of street and park tree inventory, review inventory to determine resources required to maintain 7-year street and park tree lifecycle maintenance pruning program.
- Continue to implement existing practices in support of 7-year street and park tree lifecycle maintenance pruning program on a neighbourhood level.
- Allocate adequate resources to maintain or exceed minimum 7-year tree maintenance cycle.

Time for Completion: 6 months (review), ongoing (implementation)
Prerequisite Recommendations: None, but should be undertaken following completion of street and park tree inventory (ongoing initiative).
Risk: If not maintained on cyclical basis, trees will decline in condition and value and tree-related risk potential will increase. More costly reactive management will be required to maintain trees.
External Partner(s): None
Resources Required: Existing resources to be allocated (for evaluation). Additional resources may be required (for implementation).
Target: All street and park trees in urban area are inspected on a 7-year cycle in accordance with current approved level of service and are maintained as required based upon inspection results, on an ongoing basis.

Recommendation #16: Assess maintenance levels of service for newly planted street and park trees

Related UFMP Objectives(s): #5 – Resilient, diverse and functional urban forest, #6 – Minimize risk, #7 – Manage proactively
Sustainability Criteria: V5, M7, M9, M10
Management Period: 2nd Management Period (2022-2025)
Purpose: To increase the rate of successful tree establishment and reduce tree mortality rates. To maintain and improve the health and condition of City-owned street trees in the urban and rural areas. To reduce tree-related risk.
Current Practices: Newly-planted caliper trees are structurally pruned (at most) twice within the first 10 years, and are mulched in years 1 and 3 following planting.

In new developments, young tree maintenance is not specified and trees are assumed if they are considered acceptable upon inspection during the pre-assumption tree inspection process.

Best Practices: Significant improvements in long-term structural integrity and tree health/survival can be achieved through more frequent pruning, mulching and watering. For example, York Region increased the number of satisfactory or good trees by over 60% in 12 years through increased young tree maintenance. York Region has also recently implemented a young tree structural pruning program, whereby all newly-planted trees will be pruned a minimum of 3 times within the first 10 years following planting. Through its UFMP, the Town of Milton will enhance requirements for pre-assumption tree maintenance to ensure trees are in good health and condition prior to assumption, and will require developers to increase maintenance frequency and intensity prior to Town assumption of trees.

Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit

Implementation Guidance:

- Establish benchmark for current mortality and structural failure rates and track mortality and structural failure to set program targets and track progress.
- Consider developing structural pruning (training) cycle of three pruning rounds in first 10 years after planting, ideally every three years, for trees planted through Forestry's programs and capital projects.
- Increase tree maintenance requirements during pre-assumption warranty period to include structural pruning, mulching and watering through enhanced development standards and specifications.
- Focus on development of strong central leaders, good branch spacing, branch-to-trunk diameter ratios, and prevention of included bark.
- May require changes to City warranty standards and specifications for newly-planted trees.

Time for Completion: Ongoing

Prerequisite Recommendations: None, but should be undertaken following completion of street and park tree inventory (in progress).

Risk: Lower rates of successful tree establishment and higher rates of tree mortality, resulting in increased replacement rates and cost. Expenditure of resources on failed tree plantings. Potential development of poor tree structure in mature trees, which can lead to increased risk of failure and property damage or injury.

External Partner(s): Greater Ottawa Home Builders' Association (GOHBA) and development community

Resources Required: Additional resources may be required.

Target: All newly planted street and park caliper-size trees, including in new developments, are inspected and maintained to industry best practices for pruning, mulching, and watering.

Recommendation #17: Develop an urban tree product utilization strategy

Related UFMP Objectives(s): #1 – Urban forest sustainability, #4 – Community engagement
Sustainability Criteria: M15
Management Period: 2nd Management Period (2022-2025)
Purpose: To reduce the cost and environmental impact of urban forest management. To support local economy and engage community in urban forest stewardship. To promote utilization of urban tree food (i.e., fruit and nuts) and divert it from becoming waste.
Current Practices: The City has found multiple uses for some types of urban wood waste. Uses include firewood, landfill cover, mulch and lumber. However, the approach to wood waste utilization is relatively *ad hoc* and opportunities to increase the rate of urban wood waste utilization are available. The City has partnerships with some individuals and organizations to collect food (fruit and nuts) from trees on a relatively small scale.
Best Practices: The City of Toronto, City of Mississauga, and Toronto and Region Conservation Authority (TRCA) are emerging as leaders in urban wood waste utilization. Toronto's Urban Wood Initiative serves as a model program, and includes the regularly-updated Urban Wood Directory. Mississauga and the TRCA recently opened the Tree and Wood Recovery Centre to enhance access to urban wood. "Chicago's Urban Forest Research and Opportunity Identification" (Illinois Urban Wood, 2009) identifies many opportunities for urban wood utilization.
Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit
Implementation Guidance:
Strategy should:

- Identify sources of wood waste suitable for higher-value usage beyond existing programs
- Explore opportunities for partnerships with local businesses and other groups with an interest in urban wood utilization and access to food from urban trees,
- Identify suitable locations for storage and transfer of wood to end-users as efficiently and cost-effectively as possible,
- Develop a process for pre-registration of interested end-users of urban wood waste, and
- Consider opportunities to coordinate the safe collection of food from City-owned fruit and nut trees.

Time for Completion: 1 year
Prerequisite Recommendations: None

Risk: Loss of potentially valuable wood products. Wasted food products from trees. Missed opportunity to engage pubic and demonstrate sustainable forest management.
External Partner(s): Ottawa Woodworkers Association, Ottawa City Woodshop, My Urban Workshop, Ottawa Tool Library, Hidden Harvest, consultant, others.
Resources Required: Existing resources to be allocated.
Target: Urban tree product utilization strategy is developed and implemented.

Recommendation #18: Enhance tree risk management for City-managed trees

Related UFMP Objectives(s): #3 – Improve knowledge, #6 – Minimize risk, #7 – Manage proactively
Sustainability Criteria: V5, M9, M10, M13
Management Period: 2nd Management Period (2022-2025)
Purpose: To reduce incidence and severity of tree-related risk. To improve overall urban forest health and condition. To increase efficiency and effectiveness of urban forest maintenance operations.
Current Practices: Street and park tree risk management is undertaken through regular tree inspections (on 7-year cycle) and on a per-request basis. On Sensitive Marine Clay Soils (SMCS), trees are inspected and pruned more frequently to reduce water demand. The City has a four-phase process to address tree risk to building foundations in SMCS areas.
Best Practices: In most jurisdictions, tree risk is managed through a combination of proactive and reactive approaches, such as cyclical pruning and request-based inspections. A clear policy outlining tree risk inspection and management standards ensures that adequate resources are allocated to tree risk management. Many jurisdictions in the United Kingdom maintain formal tree risk management plans and policies. These are less common in Canada, although the Town of Oakville and the City of Surrey have developed such strategies and/or policies.
Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit
Implementation Guidance:

- Develop Tree Risk Management Policy to clearly frame scope and outline responsibilities, goals and a standard of care statement; set thresholds for acceptable and unacceptable levels of risk and uncertainty; establish minimum training and qualifications of tree risk assessors and managers; set frequency of assessments for trees of different categories; review management options to mitigate risk; establish record-keeping protocols for risk assessments and management activities; identify strategy funding and/or partnerships, and set program assessment and monitoring protocols.

- Policy should formalize existing tree risk management programs and procedures, with appropriate revisions.
- Should identify and support implementation of current industry standards and best practices, including ANSI A300/ISA Tree Risk Assessment standard and Best Management Practices (as revised from time to time).
- Should consider street and park trees and trees along City-sanctioned formal trails in actively-managed urban natural areas.
- Should identify areas and individual trees posing high level of risk.
- Should explore options beyond tree removal to mitigate risk wherever feasible.
- Coordinate with Legal Operations and Support Services Branch to review policy liability implications and Natural Systems and Environmental Protection unit for natural areas identification.

Time for Completion: 6 months
Prerequisite Recommendations: None, but should be undertaken following completion of street and park tree inventory (in progress)
Risk: Potential increase of, and failure to adequately manage, tree-related risk.
External Partner(s): Consultant, Hydro Ottawa
Resources Required: Additional resources may be required.
Target: Tree risk management policy developed, approved, and implemented.

Recommendation #19: Develop city-wide urban forest pest and disease management strategy

Related UFMP Objectives(s): #1 – Urban forest sustainability, #5 – Resilient, diverse and functional urban forest, #6 – Minimize risk, #7 – Manage proactively
Sustainability Criteria: V3, V6, M9, M13, M14
Management Period: 2nd Management Period (2022-2025)
Purpose: To guide city-wide implementation of invasive plant, pest and pathogen management in the urban forest.
Current Practices: The City manages urban forest pests and diseases on a largely reactive basis, and its capacity has been constrained by EAB management needs. Although an EAB Strategy is currently in place, there is no city-wide strategy or management program for a range of other urban forest pests and diseases.
Best Practices: The City of Mississauga is currently developing a City-wide invasive species strategy for urban forest pests, diseases, and terrestrial plants that can negatively impact the remaining wooded areas. This strategy will identify: acceptable pest / disease thresholds (thereby identifying when action is required), preventative cultural practices (including monitoring), and suitable management approaches (including mechanical controls, biological controls and pesticide use where warranted).

Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit, Recreation, Cultural and Facilities Services Department, and Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection

Implementation Guidance:

- Plan should:
  - identify and prioritize the full range of known and potential urban forest pests / pathogens;
  - define appropriate management techniques;
  - establish thresholds for acceptable infestation;
  - explore education and collaboration opportunities possibly through a regular invasive species forum for local urban forest managers and organizations; and
  - determine appropriate resources for invasive species management.
- Determine priority sites and possible pilot / trial projects for assessment of management techniques.
- Plant Health Care (PHC) and Integrated Pest Management (IPM) should form foundation of plan.
- Will require community and stakeholder consultation.

Time for Completion: 1.5 years

Prerequisite Recommendations: None, but should consider guidance developed through Recommendation #12 – Forested Areas Maintenance Strategy (FAMS).

Risk: Establishment and spread of invasive species, compromising ecological integrity and health of urban and rural forests and their ability to provide social, economic and environmental benefits. Missing opportunities to manage a serious pest or disease proactively can result in much greater costs and increased risk.

External Partner(s): Regional Forest Health Network (RFHN), Ontario Invasive Plant Council (OIPC), Invasive Species Centre, regional conservation authorities (RVCA, MVCA, SNCA), NCC, federal government, Ontario Ministry of Natural Resources and Forests (MNRF), community groups, and others.

Resources Required: Existing resources to be allocated (plan development). Additional resources may be required (implementation).

Target: Invasive species management plan is developed, approved and implemented.

Recommendation #20: Develop neighborhood-level planting plans

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #5 – Resilient, diverse and functional urban forest, and #7 – Manage proactively
Sustainability Criteria: V1, V2, V3, V4, M7, M8
Management Period: 2nd Management Period (2022-2025)
Purpose: To achieve urban forest diversity targets, thereby promoting a healthy and resilient urban forest.
Current Practices: Trees are planted through a variety of municipal programs. Site-level planting plans may be prepared for certain projects. Removed street and park trees are replaced with plantings in the same or comparable locations, and species selection is based on site factors, rather than formalized neighbourhood-level species diversity targets.
Best Practices: As outlined in the Criteria and Indicators, no single species should represent more than 5%; no genus more than 10%; and no family more than 15% of total tree population for optimal neighbourhood-level tree species diversity. Long-term, strategic tree planting plans should be developed to ensure adequate tree species diversity for neighbourhoods. The Halifax Regional Municipality (HRM) UFMP outlines neighbourhood-based tree species assessments and diversity targets to inform the development of planting plans. Communities in Ohio utilize the Department of Natural Resources (DNR) site classification system to assess planting sites and determine appropriate tree species.
Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit and Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection
Implementation Guidance:

- Work with Ottawa Public Health and Community and Social Services (Affordable Housing) and integrate with Ottawa Neighbourhood Study
- Utilize tree inventory analysis (see Appendix 1), urban forest canopy cover study and tree planting prioritization tool (see Recommendation #4) and planting site inventory.
- Use neighbourhood-level analysis of street and park tree inventory to develop planting plans for urban neighbourhoods based on tree species, genus and family diversity targets.
- Utilize urban forest canopy cover study and planting prioritization tool to optimize planting locations to achieve maximum urban forest benefits.
- Conduct planting site inventory to identify potential sites for tree planting and establishment in the municipal road right-of-way, high-quality sites on adjacent private lands (if Urban Tree Island/similar program re-instated), City facilities, and parks.
- Utilize modified Ohio DNR or other site classification system to describe sites.

- Consider inclusion of non-vacant sites where existing trees will require removal in foreseeable future.
- Develop plans after completion of planting site inventory to determine number of available planting sites and match to planting list.
- Maintaining an up-to-date tree inventory will ensure planting plans are developed with most current and accurate information.
- Tree species selection should be informed by inventory analysis and diversity targets, climate change adaptation, and preference for indigenous species wherever possible.
- Consider appropriate opportunities for the planting of fruit and nut trees in neighbourhoods.
- Consider pilot project of neighbourhood-level planting plans with interested Community Associations or other groups.

Time for Completion: Ongoing
Prerequisite Recommendations: Recommendation #4 (urban forest canopy cover study and tree planting prioritization tool), and completion of street and park tree inventory (ongoing initiative)
Risk: Potential missed opportunity to plan and prioritize tree planting efforts, to ensure optimal species and site pairing, and to increase efficiency of tree planting programs. Failure to achieve urban forest diversity targets and promote a healthy and resilient urban forest. Failure to provide equitable access to urban forest benefits.
External Partner(s): Community Associations
Resources Required: Existing resources to be allocated (planting plans). Additional resources required (planting site inventory).
Target: Neighbourhood-level tree planting and establishment plans are completed for urban area, diversity increases to optimal levels.

Recommendation #21: Develop tree nursery stock growing contracts

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #5 – Resilient, diverse and functional urban forest
Sustainability Criteria: V3, V4, M7
Management Period: 2nd Management Period (2021-2025)
Purpose: To enable City to source higher-quality, locally-grown native tree nursery stock, preferably developed from local seed sources. To improve tree establishment success and long-term urban forest health and condition.
Current Practices: Trees are purchased by Forestry programs through a competitive tender process or by contractors working for Forestry or other departments such as Infrastructure. Trees purchased by Forestry are kept in the City's holding nursery, where staff can inspect trees prior to planting and reject unacceptable stock. This inspection is more challenging when contractors are in

charge of purchases. Since 2015, all tree stock of indigenous species purchased by the Forest Management Unit must meet seed zone requirements outlined in City tender specifications.

Best Practices: Few jurisdictions have established long-term growing contracts with suppliers to date, mainly due to restrictions imposed by purchasing departments. However, York Region has developed nursery stock procurement agreements with some local suppliers, allowing the Region increased control over the quality of tree planting stock. A group of suburban municipalities near Chicago has been part of a contract growing agreement with a consortium of qualified nurseries since 1985. A similar initiative was successfully undertaken as part of the MillionTrees NYC program in New York City. These communities have obtained higher-quality trees and experienced significantly less tree mortality as a result.

Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit

Implementation Guidance:

- City to seek bids for supply of tree nursery stock of specified indigenous species and in specified quantities from qualified, preferably local, nurseries.
- Forestry staff should work with the Procurement Branch on contract development.
- Tree stock should be developed from seed to pre-determined quality standards, and unacceptable stock should be rejected.
- Tree seed stock should be harvested locally and from other appropriate regions to promote genetic diversity and climate change adaptation.
- Nurseries should provide third-party certification or other credible verification of genetic provenance of seed stock.
- Successful growing agreements require multiple years of advanced planning for species selection.
- Would benefit from cooperation and coordination with other City Departments for tree supply for parks or capital works plantings.

Time for Completion: Multi-year undertaking from commencement to supply, to be continued on an ongoing basis.

Prerequisite Recommendations: None, but would benefit from the development of neighbourhood-level planting plans (Recommendation #20) to inform species selection.

Risk: Potential missed opportunity to establish higher-quality, more suitable and hardier tree nursery stock.

External Partner(s): Local and other tree nurseries, Forest Gene Conservation Association (FGCA) for information

Resources Required: Existing resources to be allocated.

Target: Long-term tree growing contracts in place to grow trees to City specifications.

5.4. Urban forest outreach, education, stewardship and partnerships

Recommendation #22: Expand community engagement, public education and marketing of urban forestry

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #3 – Improve knowledge, #4 – Community engagement
Sustainability Criteria: C5 and C6
Management Period: 1st Management Period (2018-2021)
Purpose: Create a staff position focused on facilitating communication, engagement and stewardship related to the urban forest with a range of groups including schools, community groups, residents and industries.
Current Practices: Limited outreach and education is undertaken through: the City's website (Trees and Community Forests pages); interactions of City staff with landowners and developers related to implementation of the City's urban forest policies, tree by-laws and guidelines; and participation of urban forestry staff in presentations, tree planting events and community tree inventories when resources permit.
Best Practices: Municipalities with departments active in urban forestry are increasingly recognizing the importance of having various sectors of the community aware of the benefits of and engaged in urban forest stewardship. The Cities of Toronto and Mississauga both have staff dedicated to facilitating the establishment of tens of thousands of indigenous trees and shrubs on public lands annually. One or more individuals from these departments also work with their communications staff to update their urban forest website content to ensure that it is kept current and engaging.
Lead(s) for Implementation: City – Public Works and Environmental Services Department - Forest Management Unit
Implementation Guidance:

- The following tasks should be identified as priority considerations for this position:
    - Working with City Communications staff to make the urban forest pages on the website more engaging (with images, short video clips, etc.) and include more content directed to caring for trees on private lands;
    - engage with internal partners to cross promote the benefits of urban trees (i.e. Ottawa Public Health);
    - engaging proactively with neighbourhood groups, large private and institutional landowners, the tree care industry and others; and

- working with groups already engaged to implement tree establishment (including planting, watering, mulching, young tree pruning) and invasive species management in priority areas or where opportunities and interest exists.

Time for Completion: Ongoing
Prerequisite Recommendations: Would benefit from completion of urban forest canopy assessment (Recommendation #4) and input from the External Urban Forest Working Group (Recommendation #2).
Risk: Since the majority of the urban forest is on private property, achievement of the overall goals of the UFMP will be severely compromised without a proactive, innovative and sustained approach to community engagement.
External Partner(s): Regional conservation authorities, Ottawa Stewardship Council, local school boards, community associations.
Resources Required: Additional resources are required. FTE and funding request will be brought forward through the 2018 Draft Budget process.
Target: Create one full-time position focused on urban forest outreach and stewardship.

Recommendation #23: Develop and implement an urban forest outreach and engagement strategy

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #3 – Improve knowledge, #4 – Community engagement
Sustainability Criteria: C2, C4, C5, C6
Management Period: 1st Management Period (2018-2021)
Purpose: To ensure that the community (including local residents, businesses, large private property owners and institutions) is aware of the City's vision and objectives of the urban forest, and the ongoing initiatives being implemented to realize this vision.
Current Practices: There is currently no strategy or plan in place to expand outreach and engagement related to Ottawa's urban forest. It is evident from the interest in this Plan that some groups in the city are already well-engaged in urban forest issues. This Plan will provide many of the key messages to be included in marketing materials.
Best Practices: Municipalities working to provide messages related to the urban forest to the community recognize the challenge of competing with busy schedules and other advertising that is so prevalent. Both the Cities of Mississauga and Toronto have invested in marketing strategies to help get their urban forest messaging out. Examples of tools and approaches include:

- the creation of a unique, informative, engaging and visually appealing website for the City of Mississauga's tree planting program (www.onemilliontrees.ca/) with supporting hardcopy promotion (such as posters and cards) (Figure 11), and
- the branding of a strategy for expanding tree cover under the title "Every Tree Counts", and development of various tools and materials to support the strategy, including a visually appealing "Plant a Tree" poster placed in bus shelters across the City of Toronto and available online (Figure 11).

Lead(s) for Implementation: City - Public Works and Environmental Services Department - Forest Management Unit and Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection

Figure 11: Examples of high-quality branding materials for tree planting programs in Mississauga (left) and Toronto.

Implementation Guidance:

- Develop an effective marketing campaign based largely on social media but also supplemented with other targeted tools to promote urban forestry awareness and engagement to various groups across the city. Tools could include:
  - Upgrades to the urban forestry pages on the City's website to be more engaging and better organized to target certain groups (such as residents and tree care on their lands, schools and shade creation in their yards, and requirements for tree care professionals and others whose work may impact trees);
  - Information that strongly discourages the planting of invasive species and encourages the use of appropriate indigenous tree species;

  - A series of short video clips and other media on topics of interest including: the benefits provided by the urban forest and natural areas, and how to select, plant and tend various types of trees;
  - Advertising at venues and through media available to the City at little or no cost (such as community centres); and
  - Targeted in-person events or workshops on selected urban forestry topics.
- Target groups should include residents, schools, businesses, large private and industrial landowners (see Recommendation #26), and local tree care / landscaping professionals (see Recommendation #26).
- Outreach should also be circulated to City Council and Senior Management.
- Key messages to include are the direct connections between the health of the urban forest and human health, and the importance of citizens, community groups and businesses working on private property and in collaboration with the City.
- In all cases the messaging should be clear, consistent, visually appealing, and engaging.
- Investigate creating an urban tree steward program to actively engage interested citizens in urban forest monitoring and maintenance.
- Highlight alternative urban tree values, such as harvesting food.

Time for Completion: 1 year (development), implementation ongoing
Prerequisite Recommendations: Recommendation #22 (expand engagement). Development of this strategy will be a key responsibility for the new outreach and stewardship position.
Risk: The goals of the UFMP that rely on an informed and engaged public will not be met as fully as possible.
External Partner(s): Ottawa Stewardship Council, Environmental Stewardship Advisory Committee, Community Associations, Hidden Harvest, Ecology Ottawa, residents, large private and institutional landowners, local tree care and landscaping professionals.
Resources Required: Existing resources to be allocated through the new position focused on outreach and stewardship (Recommendation #22).
Target: An effective and innovative marketing strategy is in place and is being implemented. Ottawa's urban forest is broadly recognized as a cornerstone of community health and sustainability.

Recommendation #24: Identify and formalize incentives for encouraging tree conservation and establishment

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #4 – Community engagement
Sustainability Criteria: M7
Management Period: 1st Management Period (2018-2021)
Purpose: Identify and implement incentives for tree protection, tree establishment and retention of permeable surfaces on private lands that are appropriate for Ottawa.
Current Practices: The City of Ottawa offers a number of direct funding incentives to schools and community groups to establish trees on public lands, and grants from other governmental and non-governmental sources are also available. However, there are few incentives for private landowners to identify and implement opportunities for tree conservation or establishment on their lands in the urban area outside of the planning process.
Best Practices: Simple incentives implemented by a number of municipalities include recognition of stewardship efforts through mechanisms such as awards programs, recognition on the City's website, window signs, and (for substantial commitments) naming rights for public spaces or rooms in community centres.

The City of Toronto is in the process of developing a Tree Planting Strategy that, among other actions, identifies: working with local non-profit organizations already involved in tree establishment to provide subsidized trees and tree planting education/services on residential, institutional and industrial lands; and providing direct subsidies to landowners for tree planting on their properties. The City has already committed $250,000 to local non-profit organizations to support their tree establishment programs on private lands, and is expected to commit additional funds once the strategy is finalized and approved.

The City of Mississauga recently implemented a stormwater charge as a dedicated mechanism for funding stormwater management-related expenses. The charge is related to the size of property and approximate area of impervious surface on the property. However, in order to encourage more pervious area on private property, the City also simultaneously introduced a stormwater credit for multi-residential and non-residential properties. This is a renewable five year credit of up to 50% of the stormwater charge for incorporating Low Impact Development (LID) measures such as bioswales (which often include trees) and green roofs into developments.
Lead(s) for Implementation: City – Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection

Implementation Guidance:
The City of Ottawa should consider a range of potential incentives including:

- recognition of stewardship efforts on both public and private lands through incentives such as an awards program;
- City-subsidized programs that offer rebates and technical advice to residential, commercial and industrial landowners to help establish trees on their properties;
- a subsidy or credit program linked to the implementation of LIDs through development and re-development;
- providing credits to developers for retaining mature trees in new plans of subdivision or site plans;
- accepting valued wooded natural areas in private ownership as part of the parkland dedication on development sites, and;
- providing tax credits for conserving and maintaining treed areas on private property in the urban area, including consideration of a stormwater management tax credit.

Time for Completion: 2 years
Prerequisite Recommendations: None
Risk: Continued loss of opportunities for tree conservation and establishment on private lands, including expansion of hardscapes.
External Partner(s): Greater Ottawa Home Builders' Association (GOHBA) and development community
Resources Required: Existing resources to be allocated
Target: Incentives appropriate for Ottawa are identified, developed and implemented.

Recommendation #25: Promote and facilitate the development and implementation of Neighbourhood Stewardship Plans

Related UFMP Objectives(s): #1 – Urban forest sustainability, #2 – Enhance protection and establishment, #3 – Improve knowledge, #4 – Community engagement
Sustainability Criteria: C5
Management Period: 2nd Management Period (2022-2025)
Purpose: To develop urban forest stewardship expertise at the neighbourhood level and to empower citizens to undertake neighbourhood stewardship in a strategic manner.
Current Practices: The City has a number of programs that support tree planting on municipal lands, and a program that supports tree planting on school grounds, but does not have any programs that support stewardship on private lands. This is a significant gap since the majority of trees, and opportunities or planting trees, tend to occur on private lands.

Best Practices: Neighbourwoods is program developed at the Faculty of Forestry in Toronto with the objectives of (a) collecting standardized data on local urban forests, (b) allowing for tree analyses that can inform management, and (c) engaging local residents in the stewardship of their neighbourhood urban forest. Neighbourwoods programs have been implemented in several neighbourhoods in the City of Toronto, as well as in neighbourhoods elsewhere in Canada including the City of Hamilton and the City of Kingston.

Lead(s) for Implementation: City - Public Works and Environmental Services Department - Forest Management Unit and Planning, Infrastructure and Economic Development Department - Natural Systems and Environmental Protection

Implementation Guidance:

- Pilot projects should be initiated in two neighbourhoods. If successful, the program should be extended to other neighborhoods with the help of expertise gained from the pilot neighbourhoods.
- Participating neighbourhood groups would be assisted by City staff in the development of a ten-year strategy for both City-owned and private trees in their neighbourhood.
- The plan should include goals and strategies for tree establishment, tree maintenance, monitoring and tree conservation, education and communications.
- Goals and objectives should be informed by the results of a Neighbourwoods inventory carried out by volunteers. The actual goals and objectives should be set by the community, but with technical support from City staff. A mechanism should be developed to support and promote collaboration among the neighborhood urban forest stewardship committees to provide mutual support and to develop a community-of-practice.
- Consider appropriate opportunities for the planting of fruit and nut trees and coordinating the collection of food from existing fruit and nut trees in neighbourhoods.

Time for Completion: Ongoing

Prerequisite Recommendations: None but would be facilitated by the new position focused on outreach and stewardship (Recommendation #22) and informed by data from the neighbourhood-level planting plans (Recommendation #20).

Risk: Without such an approach the stewardship for much of the private lands of the urban forest in Ottawa will be reactionary and *ad-hoc*.

External Partner(s): Ottawa Stewardship Council, Neighbourhood groups and funders, Environmental Stewardship Advisory Committee, Federation of Citizens' Associations of Ottawa, Ecology Ottawa / Tree Ottawa, Hidden Harvest.

Resources Required: This is dependent on resources required for Recommendation #22 (expand engagement).

Target: At least five Neighbourwoods groups are successfully established within Ottawa’s urban area.

Recommendation #26: Expand outreach to tree care and landscaping industries and large private and institutional landowners

Related UFMP Objectives(s): #2 – Enhance protection and establishment, #3 – Improve knowledge, #4 – Community engagement
Sustainability Criteria: C2, C4
Management Period: 2nd Management Period (2022-2025)
Purpose: 1. Tree care and landscaping industries: To ensure that business owners and staff in the tree care industry (such as arborists, tree care companies, landscapers, nurseries, etc.) in Ottawa are aware of the City's urban forest policies, by-laws and guidelines, as well as ongoing initiatives (including available incentives) to sustain and expand the urban forest.
2. Large private and institutional landowners: To assess the existing and potential contribution made to the city's urban forest by large private and institutional landowners and the level of existing and potential urban forest stewardship within this sector. Ultimately to inform programs to encourage this sector to embrace and advance municipality-wide urban forest goals and objectives by implementing specific resource management plans.
Current Practices: 1. Interactions between City staff and tree care industry professionals are currently limited to the review of Arborist and Tree Conservation Reports and the inspection of nursery stock planted for the City. While these interactions present opportunities for education and information sharing, they are limited and do not include many of the tree care professionals working in Ottawa's urban area.
2. The understanding of the nature and extent of existing urban forest and potential plantable areas on large private and institutional lands in Ottawa's urban area is poor. However, significant opportunities may exist for both urban forest protection and establishment on these lands.
Best Practices: 1. Recognizing the important role tree care professionals play in implementing urban forest policies, by-laws and guidelines in a given jurisdiction, and in educating their clients, a number of municipalities have extended outreach efforts to include this group. For example, the City of Toronto and Town of Oakville both hold workshops on current urban forest topics (such as EAB management efforts, or updates to tree by-laws) targeted to tree care professionals and landscapers.
2. In many built out urban areas some of the greatest opportunities for both sustaining and expanding the urban forest occur on large private and institutional lands. In recognition of this opportunity, the City of Mississauga supports Credit Valley Conservation (CVC) in their Greening Corporate Grounds program which provides technical and planting support in exchange for a commitment to sustain the naturalized areas on their grounds. CVC works with large landowners to develop plans for tree establishment / naturalization that will (a) reduce landscaping costs,

(b) benefit employees, and (c) make corporate landscapes more diverse and attractive. In the City of Toronto, Forestry staff already work with the Toronto Region Conservation Authority (TRCA) to establish trees on industrial and institutional lands where opportunities arise, and are developing a direct subsidy program whereby interested landowners can receive technical and planting support (through a non-profit organization) for planting trees on their lands.

Lead(s) for Implementation: City - Public Works and Environmental Services Department – Forest Management Unit

Implementation Guidance:

1. Tree care and landscaping industries:

- Identify tree care companies, nurseries and similar businesses in the Ottawa area and develop a database for outreach.
- Incorporate these businesses in the development and implementation of an Outreach and Engagement Strategy (Recommendation #25).
- Outreach tools to be considered should include:
  - presentations or workshops at industry tradeshows or conferences;
  - a flyer that summarizes where they can find all of Ottawa's relevant "tree" information that could be printed and posted on the City's website, and provision of this flyer to developers and those applying for permits under the City's tree by-laws; and
  - kiosks at local landscaping and nursery retailers.

2. Large private and institutional landowners:

- Develop a database of contact information for the large private and institutional landowners in the urban area.
- The database should contain the name and location of the person responsible for the "grounds" associated with the landowner where possible.
- Include schools, universities, hospitals and other health care facilities, etc.
- Do not include the NCC in the database, as it manages its part of the city's urban forest independently. Continue existing cooperative relationship with NCC through other recommendations of this Plan.
- Once the database is populated, a voluntary survey should be developed and distributed to obtain basic existing conditions of each of the land parcels under their jurisdiction (such as approximate number of trees or size of natural area(s), and any urban forest management being undertaken), to determine if a forest management plan is already in place, and to gage interest in stewardship.
- Information for the given landowner's parcel(s) generated from the urban forest canopy study (Recommendation #4) could be provided, along with information about any incentives for stewardship that may be available (Recommendation #24), and information about the health benefits associated with trees and the urban forest.

Time for Completion: 1-2 years

Prerequisite Recommendations: None, but would be facilitated by the development of a broader Outreach and Engagement Strategy (Recommendation #23), should be linked to exploring tree nursery stock growing contracts (Recommendation #21), would also be facilitated by parcel-specific and urban-area wide data from the urban forest canopy assessment (Recommendation #4), as well as incentives for undertaking planting on private lands (Recommendation #24).
Risk: Ottawa's tree care and landscaping industry may not be aware of or promoting practices that are consistent with the City's urban forest policies, by-laws and guidelines, or with the vision and objectives of this Plan. Lost opportunities to leverage the contact these industries have with Ottawa's residents and property owners to promote the vision and objectives of this Plan. Failure to fill this gap represents a missed opportunity to advance the City's urban forest objectives with respect to both canopy cover and engagement.
External Partner(s): Local arborists, tree care professionals, landscapers and other professionals who regularly work with trees, large private and institutional landowners
Resources Required: Dependent on resources required for Recommendation #22 (expand engagement).
Target: More tree care and landscaping industry professionals who are well-informed and supportive of Ottawa's urban forest initiatives, and who share this knowledge with their clients. A report is completed that summarizes the names, location and contact information of large private and institutional landowners within the urban area. Existing and potential urban forest infrastructure is summarized and existing and planned management activities are outlined.

6. Glossary

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

Adaptation (climate change)
Actions taken to help communities and ecosystems cope with changing climate conditions. The Intergovernmental Panel on Climate Change describes adaptation as adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities.

Buffer
Zones between protected areas (typically natural areas) and the surrounding landscape which help protect the network from potentially damaging external influences (such as development) and which are essentially transitional areas.

Canopy Cover
A measure of the spatial extent or areal coverage of vegetation, typically expressed as a percentage of total land area covered by vegetation.

Carbon sequestration
The process of removing carbon dioxide (CO_2) gas from the atmosphere and storing it in solid or liquid form for a period of time. Trees, other plants and soils store carbon in their stems and roots in solid form and use it to live and grow. Unlike permanently stored carbon, sequestered carbon can be released back into the atmosphere as plants die and decay or when soils are disturbed, and can reform into carbon dioxide gas and contribute to climate change.

Critical Root Zone (CRZ)
The City of Ottawa's Municipal Trees and Natural Areas Protection By-law (2006-279) requires that the Critical Root Zone (CRZ) of a tree be protected when root damage may be caused by site works in proximity to trees to be retained. The critical root zone is established as being 10 centimetres from the trunk of a tree for every centimetre of trunk diameter. The trunk diameter is measured at a height of 1.2 metres for trees of 15 centimetres diameter and greater and at a height of 0.3 metres for trees of less than 15 centimetres diameter.

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

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

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

Greenfield development
Development taking place on formerly vacant/agricultural land usually situated within the outer reaches of an urban envelope, usually on a block-wide scale.

Green industry
A term used by the Criteria and Indicators framework (see Appendix 2) to capture businesses involved in the production, distribution and services associated with trees and ornamental plants such as landscape supplies and equipment including nurseries and garden centres. Service providers such as consulting arborists and urban foresters, landscape architects, arboricultural companies, landscaping contractors and property maintenance firms.

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

Grey infrastructure
Engineered systems, typically constructed using materials such as concrete and steel, used to manage urban stormwater. Examples of grey infrastructure include pipes, pumps, and ditches. The definition of grey infrastructure can be expanded to

include other constructed landscape elements in the urban area, particularly when compared and contrasted with green infrastructure elements which provide comparable services.

Hardscapes
Constructed landscape elements typically found in developed urban and suburban areas and characterised by low air and water permeability and composed of hard wearing materials such as wood, concrete or stone. Examples of hardscapes include roadways, sidewalks, patios, retaining walls or other landscape features that are not horticultural landscape elements (often called softscapes).

Heat Island Effect
The phenomenon whereby urban areas are significantly warmer than surrounding rural areas due to built structures and paved areas, which have a greater thermal mass and different surface radioactive properties. The temperature difference is usually greater at night, is most apparent when winds are weak, and is most noticeable during summer and winter. Urban heat islands have the potential to directly and adversely influence the health and welfare of urban populations through direct and indirect causes.

Indigenous Species
A species of flora or fauna that occurs naturally in a given geographic region and which is present through natural processes. Also commonly referred to as "native species".

Infill development
Development of vacant or under-utilized parcels within existing urban areas which are already largely developed. Infill development may involve changes in land use; for example, former commercial lands may be developed into residential sites through infill development.

Integrated Pest Management (IPM)
Aims to assess and control pest populations through a combination of early detection, cultural practices and pesticides, if required.

Invasive Species
A plant, animal or pathogen that has been introduced to an environment where it is not native and where it may become a nuisance through rapid spread and/or population growth, often to the detriment of indigenous species or ecosystem functioning.

Low Impact Development (LID)
A stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible. It comprises a set of site design approaches and small scale stormwater management practices that promote the use of natural systems for infiltration, evapotranspiration, and reuse of rainwater.

Large private and institutional landowners
Landowners with extensive properties that contribute to the urban forest by supporting individual trees, woodlands or other natural or semi-natural areas. These would include, but are not limited to; school boards, universities and colleges, hospitals, golf courses, condominiums, shopping centres, places of worship, industrial sites, etc.

Mitigation (climate change)
The use of measures that seek to avoid, reduce or delay detrimental effects to the environment. In the context of climate change, it includes actions to reduce greenhouse gas emissions.

Plant Health Care (PHC)
A coordinated approach to manage pests, diseases and invasive species, maintain an optimal growing environment, and promote good tree form and structure.

Social marketing
"Social Marketing seeks to develop and integrate marketing concepts with other approaches to influence behaviours that benefit individuals and communities for the greater social good. Social Marketing practice is guided by ethical principles. It seeks to integrate research, best practice, theory, audience and partnership insight, to inform the delivery of competition sensitive and segmented social change programmes that are effective, efficient, equitable and sustainable." - International Social Marketing Association (http://www.i-socialmarketing.org/social-marketing-definition. Last accessed September 8, 2016).

Softscapes
Living horticultural elements of a landscape, such as flowers, shrubs, trees and other plants. Softscapes also include areas of bare soil, grasses or mulches, and are characterised by greater air and water permeability than hardscapes.

Stewardship
The careful and responsible management of something entrusted to one's care.

Urban forest
In the context of this Plan, the urban forest includes all trees and tree growing habitats within Ottawa's urban boundary, including the urban expansion areas. The urban forest includes trees in parks and natural areas, along streets, and near waterways. The urban forest crosses property and jurisdictional boundaries, and includes trees on private and institutional properties and on lands managed by various public agencies, including the City of Ottawa, National Capital Commission (NCC), the Federal and Provincial governments , and Conservation Authorities.

Urban forest managers
In the municipal context: staff in various municipal departments with jurisdiction and responsibility for the planning, maintenance and other management of the portion of the urban forest under municipal ownership, control and/or jurisdiction.

Private land owners, government agencies and other stakeholders may have the primary responsibility for stewardship of the urban forest on lands outside of City ownership or control, and are also urban forest managers on those lands.

Urban forest expansion
Increasing the spatial extent of the urban forest beyond a baseline condition by establishing trees in areas where trees have not previously been planted and/or by promoting the establishment and growth of large-stature trees.

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Appendix 1 – Street tree inventory analysis summary

The ability of the urban forest to provide the many ecological, social and economic benefits sustainably is dependent upon factors addressed in this Plan. The structure and tree diversity of the forest play an important role in this long-term overall objective. Criteria V2, V3 and V4 (Appendix 2) address the structure and diversity of the urban forest. Since the benefits derived from the urban forest are the aggregate of the entire forest and not just one land-use type or land ownership category, the assessments for V2, V3 and V4 should ideally be carried out for all such categories. At the time this plan was developed the only data that were available were those in the street tree inventory. While some data were available for park trees, this dataset was not considered complete enough to provide suitable analyses. Consequently, the following analyses only refer to city street trees within the urban area of Ottawa.

DBH and RDBH

Tree diameter is often used as a proxy for age when describing stand structure or age class distribution and for establishing target distributions for optimum sustainable growth (Criterion V2). This is a fundamental relationship used in silviculture, but the science is less well developed in urban forestry. Richards (1983) proposed that "...a good age distribution for a [street tree] population stability would be about 40% trees under 20 cm diameter, 30% 20-40 cm in the early functional stage, 20% 40-60 cm functionally mature and 10% older trees with most of their functional life behind them." Ottawa's street tree inventory was examined using these criteria the results of which are shown in Table A1.1. Richard's classes are referred to here as Class I (<=20 cm DBH) Class II (21 cm to 40 cm) and so on. Table A1.1 shows this distribution across all neighbourhoods and for all street trees in the last row of the table.

The DBH analysis fails to consider the impact of the maximum diameter a particular tree species can achieve. For example, comparing the DBH of a white oak with that of an Ivory Silk Lilac would not provide a meaningful comparison of the relative ages of the two trees. A more meaningful comparison can be made by dividing the DBH of each tree in the inventory by the maximum DBH expected for the species, this is referred to as Relative Diameter at Breast Height (RDBH) and is expressed as a percent (%). For this analysis, the literature was examined to develop a table of the maximum DBH for each species. Where necessary, additional information was

derived from available tree inventory data. Trees only recorded at the genus level or of species for which no maximum DBH value could be confidently recorded were omitted from the analysis. For RDBH, the classes are as follows: Class I (<= 25%), Class II (26% to 50%), Class III (51% to 75%) and Class IV (>76%). Table A1.2 summarized RDBH classes for each of the neighbourhoods in the City and the last line shows the results for all street trees.

Species Suitability

Species suitability (Criterion V3) was assessed for each street tree in the inventory by assigning the species rating value from the Ontario Supplement to the CTLA Guide for Plant Appraisal 9th edition. The suitability classes used here are as follows: Excellent (> 0.70), Good (0.61 to 0.70), Fair (0.51 to 0.60) and Poor (<0.50). Table A1.3 summarizes suitability classes for each of the neighbourhoods in the City and the last line shows the results for all street trees.

Tree Diversity

Tables 3.4, 3.5 and 3.6 summarize the distribution of species, genera and families respectively for each neighbourhood and for all street trees (V4). To facilitate the presentation, only the top five species, genera and families are shown and the remaining trees are pooled in the "other" category. Santamour (1990) presented what is commonly referred to as the "10-20-30 rule" which suggests that no species should represent more than 10% of all trees, no genus more than 20% and no family more than 30%.

Table A1.1 Distribution of city street tree diameter at breast height (DBH) classes by neighbourhood. Any DBH class representing more or less (±5%) than the target is highlighted. Targets are shown below the DBH class title. (Class I <20 cm, Class II 21 to 40 cm, Class II 41 to 60 cm Class IV > 60 cm) See C&I criterion V2 in Appendix 2.

Neighbourhood	DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Barrhaven	**52%**	**35%**	**11%**	**2%**
Bayshore	**66%**	**17%**	**7%**	10%
Beacon Hill South - Cardinal Heights	**51%**	28%	**13%**	8%
Beaverbrook	**15%**	**49%**	**28%**	9%
Beechwood Cemetery	**33%**	**62%**	**6%**	**0%**
Bells Corners East	**79%**	**3%**	**0%**	**18%**
Bells Corners West	38%	**0%**	**47%**	15%
Billings Bridge - Alta Vista	40%	29%	23%	8%
Blackburn Hamlet	40%	34%	21%	**5%**
Borden Farm - Stewart Farm - Parkwood Hills - Fisher Glen	40%	33%	21%	6%
Braemar Park - Bel Air Heights - Copeland Park	**30%**	**18%**	**32%**	**21%**
Briar Green - Leslie Park	**33%**	**35%**	23%	9%
Bridlewood - Emerald Meadows	**58%**	**39%**	**3%**	**1%**
Britannia Village	**99%**	**0%**	**0%**	**1%**
Byward Market	**53%**	**36%**	**8%**	**3%**
Carleton Heights - Rideauview	43%	29%	19%	8%
Carlington	**29%**	29%	**28%**	14%
Carlingwood West - Glabar Park - McKellar Heights	**32%**	31%	22%	15%
Carson Grove - Carson Meadows	**54%**	**17%**	25%	**4%**
Centrepointe	**48%**	**49%**	**3%**	**0%**
Centretown	**47%**	**35%**	**11%**	6%
CFB Rockcliffe-NRC	**48%**	31%	**15%**	6%

Table A1.1 Distribution of city street tree diameter at breast height (DBH) classes by neighbourhood. Any DBH class representing more or less (±5%) than the target is highlighted. Targets are shown below the DBH class title. (Class I <20 cm, Class II 21 to 40 cm, Class II 41 to 60 cm Class IV > 60 cm) See C&I criterion V2 in Appendix 2.

Neighbourhood	DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Chapman Mills - Rideau Crest - Davidson Heights	**88%**	**12%**	**0%**	**0%**
Cityview - Skyline - Fisher Heights	38%	**36%**	16%	9%
Civic Hospital-Central Park	**47%**	29%	16%	7%
Crestview - Meadowlands	**33%**	27%	20%	**21%**
Crystal Bay ? Lakeview Park	**80%**	**0%**	**9%**	11%
Cummings	**46%**	25%	19%	10%
East Industrial	**47%**	**45%**	**6%**	**2%**
Elmvale - Eastway - Riverview - Riverview Park West	36%	**21%**	**27%**	**16%**
Emerald Woods - Sawmill Creek	**69%**	25%	**5%**	**1%**
Glebe - Dows Lake	**34%**	**36%**	18%	13%
Glen Cairn - Kanata South Business Park	**59%**	28%	**9%**	**4%**
Greenbelt	**26%**	**40%**	**27%**	7%
Greenboro East	**68%**	31%	**1%**	**0%**
Hawthorne Meadows - Sheffield Glen	**33%**	26%	**32%**	9%
Hintonburg - Mechanicsville	**48%**	**43%**	**5%**	**3%**
Hunt Club - Ottawa Airport	**56%**	27%	17%	**1%**
Hunt Club East - Western Community	43%	25%	**29%**	**2%**
Hunt Club Park	**34%**	**62%**	**4%**	**0%**
Hunt Club South Industrial	36%	**49%**	**11%**	**4%**
Hunt Club Upper -Blossom Park --– Timbermill	**82%**	**15%**	**3%**	**0%**
Hunt Club Woods - Quintarra -– Revelstoke	36%	33%	24%	7%
Iris	36%	**19%**	**27%**	**19%**

Table A1.1 Distribution of city street tree diameter at breast height (DBH) classes by neighbourhood. Any DBH class representing more or less (±5%) than the target is highlighted. Targets are shown below the DBH class title. (Class I <20 cm, Class II 21 to 40 cm, Class II 41 to 60 cm Class IV > 60 cm) See C&I criterion V2 in Appendix 2.

Neighbourhood	DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Island Park	40%	32%	**14%**	14%
Kanata Lakes - Marchwood Lakeside - Morgan's Grant - Kanata North Business	**81%**	**18%**	**1%**	**0%**
Katimavik -– Hazeldean	**57%**	**36%**	**6%**	**1%**
Laurentian	**31%**	31%	23%	**16%**
Lebreton Development	**77%**	**20%**	**1%**	**2%**
Ledbury - Heron Gate - Ridgemont -– Elmwood	**58%**	28%	**12%**	**2%**
Lindenlea - New Edinburgh	38%	**36%**	15%	11%
Lowertown	44%	**39%**	**12%**	5%
Merivale Gardens - Grenfell Glen - Pineglen - Country Place	35%	**41%**	19%	5%
Navan -– Vars	**100%**	**0%**	**0%**	**0%**
New Barrhaven -– Stonebridge	**88%**	**10%**	**1%**	**0%**
Orleans Avalon - Notting Gate - Fallingbrook - Gardenway South	**94%**	**6%**	**0%**	**0%**
Orleans Central	**91%**	**3%**	**5%**	**1%**
Orleans Chapel Hill	**69%**	**23%**	**6%**	**2%**
Orleans Chapel Hill South	**75%**	**25%**	**0%**	**0%**
Orleans Chatelaine Village	38%	33%	24%	5%
Orleans Industrial	**100%**	**0%**	**0%**	**0%**
Orleans North West	**50%**	34%	**14%**	**2%**
Orleans Queenswood Heights	43%	**39%**	15%	**3%**
Orleans Village -– Chateauneuf	**70%**	**25%**	**5%**	**0%**
Ottawa East	35%	**36%**	18%	11%
Ottawa South	**30%**	31%	21%	**17%**

Table A1.1 Distribution of city street tree diameter at breast height (DBH) classes by neighbourhood. Any DBH class representing more or less (±5%) than the target is highlighted. Targets are shown below the DBH class title. (Class I <20 cm, Class II 21 to 40 cm, Class II 41 to 60 cm Class IV > 60 cm) See C&I criterion V2 in Appendix 2.

Neighbourhood	DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Overbrook -– McArthur	39%	32%	18%	10%
Pineview	**57%**	34%	**7%**	**3%**
Playfair Park - Lynda Park - Guildwood Estates	**34%**	29%	**29%**	8%
Qualicum - Redwood Park	**35%**	31%	25%	9%
Riverside Park	**35%**	28%	**28%**	9%
Riverside South -– Leitrim	**98%**	**2%**	**0%**	**0%**
Rockcliffe - Manor Park	**28%**	32%	23%	**17%**
Rothwell Heights - Beacon Hill North	**34%**	**35%**	22%	9%
Sandy Hill - Ottawa East	35%	**41%**	16%	8%
South Keys - Heron Gate - Greenboro West	38%	**37%**	18%	6%
Stittsville	**86%**	**11%**	**2%**	**1%**
Stittsville -– Basswood	**94%**	**0%**	**0%**	6%
Tanglewood	45%	**41%**	**11%**	**3%**
Trend-Arlington	**29%**	**35%**	**27%**	9%
Vanier North	**47%**	**40%**	**8%**	5%
Vanier South	42%	31%	15%	12%
West Centertown	**54%**	**35%**	**8%**	**3%**
Westboro	41%	35%	**13%**	11%
Whitehaven - Queensway Terrace North	**28%**	33%	**30%**	9%
Woodroffe - Lincoln Heights	**31%**	**45%**	18%	6%
Woodvale - Craig Henry - Manordale - Estates of Arlington Woods	37%	**43%**	16%	**4%**
All street trees	**54%**	26%	**13%**	6%

Table A1.2 Distribution of street tree relative diameter at breast height (RDBH) classes by Neighbourhood. Any RDBH class representing more or less (±5%) than the target is highlighted. (Class I <15% of the species maximum DBH, Class II 25 to 50%, Class III 51% to 75% Class IV > 75%). Targets are shown below the RDBH class title. See C&I criterion V2 in Appendix 2.

Neighbourhood	Relative DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Barrhaven	**33%**	28%	**27%**	11%
Bayshore	**44%**	26%	19%	11%
Beacon Hill South - Cardinal Heights	**37%**	25%	22%	**16%**
Beaverbrook	**6%**	**22%**	**40%**	**31%**
Beechwood Cemetery	**6%**	**58%**	**8%**	**27%**
Bells Corners East	**56%**	**11%**	**14%**	**19%**
Bells Corners West	**22%**	**6%**	**47%**	**25%**
Billings Bridge - Alta Vista	**27%**	**23%**	**25%**	**25%**
Blackburn Hamlet	**23%**	**23%**	**30%**	**24%**
Borden Farm - Stewart Farm - Parkwood Hills - Fisher Glen	**22%**	26%	25%	**26%**
Braemar Park - Bel Air Heights - Copeland Park	**19%**	**16%**	**28%**	**37%**
Briar Green - Leslie Park	**21%**	**21%**	**28%**	**29%**
Bridlewood - Emerald Meadows	**41%**	**43%**	**13%**	**3%**
Britannia Village	**86%**	**4%**	**10%**	**0%**
Byward Market	**34%**	35%	18%	14%
Carleton Heights -– Rideauview	**30%**	**23%**	**28%**	**19%**
Carlington	**19%**	**22%**	**26%**	**33%**
Carlingwood West - Glabar Park - McKellar Heights	**21%**	**23%**	**27%**	**29%**
Carson Grove - Carson Meadows	**48%**	**21%**	17%	15%
Centrepointe	**26%**	**47%**	23%	**5%**

Table A1.2 Distribution of street tree relative diameter at breast height (RDBH) classes by Neighbourhood. Any RDBH class representing more or less (±5%) than the target is highlighted. (Class I <15% of the species maximum DBH, Class II 25 to 50%, Class III 51% to 75% Class IV > 75%). Targets are shown below the RDBH class title. See C&I criterion V2 in Appendix 2.

Neighbourhood	Relative DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Centretown	**27%**	32%	23%	**18%**
CFB Rockcliffe-NRC	**23%**	**36%**	25%	**16%**
Chapman Mills - Rideau Crest - Davidson Heights	**63%**	30%	**4%**	**3%**
Cityview - Skyline - Fisher Heights	**21%**	30%	**28%**	**20%**
Civic Hospital-Central Park	**24%**	33%	23%	**20%**
Crestview -– Meadowlands	**22%**	**20%**	25%	**34%**
Crystal Bay ? Lakeview Park	**59%**	**12%**	**14%**	14%
Cummings	**35%**	**24%**	20%	**21%**
East Industrial	**30%**	**42%**	21%	6%
Elmvale - Eastway - Riverview - Riverview Park West	**30%**	**19%**	25%	**27%**
Emerald Woods - Sawmill Creek	**46%**	**36%**	**14%**	**4%**
Glebe - Dows Lake	**17%**	28%	**25%**	**29%**
Glen Cairn - Kanata South Business Park	**45%**	**24%**	20%	10%
Greenbelt	**13%**	**23%**	**39%**	**25%**
Greenboro East	**33%**	**40%**	21%	7%
Hawthorne Meadows - Sheffield Glen	**23%**	**20%**	**25%**	**32%**
Hintonburg -– Mechanicsville	**26%**	**35%**	19%	**20%**
Hunt Club - Ottawa Airport	**27%**	34%	**28%**	11%
Hunt Club East - Western Community	**31%**	**23%**	**33%**	13%
Hunt Club Park	**17%**	**49%**	**31%**	**3%**
Hunt Club South Industrial	**24%**	**35%**	**32%**	9%

Table A1.2 Distribution of street tree relative diameter at breast height (RDBH) classes by Neighbourhood. Any RDBH class representing more or less (±5%) than the target is highlighted. (Class I <15% of the species maximum DBH, Class II 25 to 50%, Class III 51% to 75% Class IV > 75%). Targets are shown below the RDBH class title. See C&I criterion V2 in Appendix 2.

Neighbourhood	Relative DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Hunt Club Upper -Blossom Park -– Timbermill	**66%**	26%	**7%**	**1%**
Hunt Club Woods - Quintarra -– Revelstoke	**21%**	29%	**27%**	**24%**
Iris	**26%**	**14%**	24%	**36%**
Island Park	**24%**	26%	**25%**	**25%**
Kanata Lakes - Marchwood Lakeside - Morgan's Grant - Kanata North Business	**54%**	35%	**8%**	**3%**
Katimavik -– Hazeldean	**37%**	**38%**	17%	7%
Laurentian	**18%**	**23%**	**29%**	**29%**
Lebreton Development	**70%**	**24%**	**3%**	**2%**
Ledbury - Heron Gate - Ridgemont -– Elmwood	**47%**	**19%**	17%	**17%**
Lindenlea - New Edinburgh	**19%**	33%	23%	**25%**
Lowertown	**27%**	**35%**	22%	**15%**
Merivale Gardens - Grenfell Glen - Pineglen - Country Place	**21%**	29%	**33%**	**17%**
Navan -– Vars	**83%**	**17%**	**0%**	**0%**
New Barrhaven -– Stonebridge	**66%**	26%	**5%**	**3%**
Orleans Avalon - Notting Gate - Fallingbrook - Gardenway South	**62%**	30%	**8%**	**1%**
Orleans Central	**81%**	**12%**	**3%**	**4%**
Orleans Chapel Hill	**52%**	**24%**	17%	7%
Orleans Chapel Hill South	**41%**	**43%**	**12%**	**4%**
Orleans Chatelaine Village	**29%**	**24%**	**29%**	**18%**
Orleans Industrial	**100%**	**0%**	**0%**	**0%**
Orleans North West	**29%**	31%	**26%**	14%

Table A1.2 Distribution of street tree relative diameter at breast height (RDBH) classes by Neighbourhood. Any RDBH class representing more or less (±5%) than the target is highlighted. (Class I <15% of the species maximum DBH, Class II 25 to 50%, Class III 51% to 75% Class IV > 75%). Targets are shown below the RDBH class title. See C&I criterion V2 in Appendix 2.

Neighbourhood	Relative DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Orleans Queenswood Heights	**28%**	27%	**30%**	**16%**
Orleans Village –– Chateauneuf	**52%**	31%	**15%**	**2%**
Ottawa East	**17%**	**24%**	**27%**	**33%**
Ottawa South	**15%**	**24%**	**28%**	**34%**
Overbrook –– McArthur	**29%**	30%	22%	**19%**
Pineview	**48%**	**20%**	24%	8%
Playfair Park - Lynda Park - Guildwood Estates	**25%**	**21%**	24%	**30%**
Qualicum - Redwood Park	**23%**	**21%**	**29%**	**26%**
Riverside Park	**23%**	**18%**	**28%**	**30%**
Riverside South –– Leitrim	**81%**	**16%**	**3%**	**0%**
Rockcliffe - Manor Park	**17%**	27%	**26%**	**31%**
Rothwell Heights - Beacon Hill North	**21%**	27%	**28%**	**24%**
Sandy Hill - Ottawa East	**21%**	**37%**	21%	**21%**
South Keys - Heron Gate - Greenboro West	**25%**	**36%**	**29%**	10%
Stittsville	**71%**	**19%**	**7%**	**2%**
Stittsville –– Basswood	**94%**	**0%**	**0%**	6%
Tanglewood	**25%**	31%	**34%**	9%
Trend-Arlington	**18%**	**23%**	**31%**	**28%**
Vanier North	**23%**	**47%**	18%	13%
Vanier South	**22%**	**36%**	17%	**26%**
West Centertown	**28%**	34%	22%	**17%**

Table A1.2 Distribution of street tree relative diameter at breast height (RDBH) classes by Neighbourhood. Any RDBH class representing more or less (±5%) than the target is highlighted. (Class I <15% of the species maximum DBH, Class II 25 to 50%, Class III 51% to 75% Class IV > 75%). Targets are shown below the RDBH class title. See C&I criterion V2 in Appendix 2.

Neighbourhood	Relative DBH Class			
	I (40%)	II (30%)	III (20%)	IV (10%)
Westboro	**23%**	30%	24%	**23%**
Whitehaven - Queensway Terrace North	**15%**	**25%**	**31%**	**30%**
Woodroffe - Lincoln Heights	**16%**	33%	**29%**	**22%**
Woodvale - Craig Henry - Manordale - Estates of Arlington Woods	**18%**	35%	**28%**	**19%**
All street trees	**37%**	28%	19%	**16%**

Table A1.3 Distribution of street tree species suitability by neighbourhood. Values in which the combined Excellent and Good percentages are less than 75% are highlighted. See C&I criterion V3 in Appendix 2.

Neighbourhood	Excellent	Good	Fair	Poor	Excellent+Good
Barrhaven	37%	49%	10%	4%	86%
Bayshore	40%	40%	15%	5%	80%
Beacon Hill South - Cardinal Heights	33%	47%	10%	10%	80%
Beaverbrook	54%	30%	15%	2%	84%
Beechwood Cemetery	38%	63%	0%	0%	100%
Bells Corners East	64%	25%	6%	6%	89%
Bells Corners West	91%	9%	0%	0%	100%
Billings Bridge - Alta Vista	38%	52%	5%	5%	90%
Blackburn Hamlet	32%	52%	11%	5%	84%
Borden Farm - Stewart Farm - Parkwood Hills - Fisher Glen	40%	43%	11%	6%	84%
Braemar Park - Bel Air Heights - Copeland Park	45%	50%	3%	2%	95%
Briar Green - Leslie Park	39%	46%	12%	3%	85%
Bridlewood - Emerald Meadows	40%	57%	2%	1%	97%
Britannia Village	37%	55%	3%	5%	92%
Byward Market	29%	57%	5%	10%	85%
Carleton Heights - Rideauview	36%	55%	4%	5%	91%
Carlington	29%	60%	4%	6%	89%
Carlingwood West - Glabar Park - McKellar Heights	30%	60%	6%	4%	90%
Carson Grove - Carson Meadows	39%	54%	4%	3%	93%
Centrepointe	44%	45%	5%	5%	90%
Centretown	24%	63%	8%	5%	87%

Table A1.3 Distribution of street tree species suitability by neighbourhood. Values in which the combined Excellent and Good percentages are less than 75% are highlighted. See C&I criterion V3 in Appendix 2.

Neighbourhood	Excellent	Good	Fair	Poor	Excellent+Good
CFB Rockcliffe-NRC	41%	50%	6%	3%	91%
Chapman Mills - Rideau Crest - Davidson Heights	36%	57%	5%	1%	93%
Cityview - Skyline - Fisher Heights	42%	43%	10%	4%	85%
Civic Hospital-Central Park	36%	55%	6%	2%	91%
Crestview - Meadowlands	42%	40%	10%	8%	82%
Crystal Bay ? Lakeview Park	58%	17%	18%	7%	**75%**
Cummings	41%	52%	3%	4%	93%
East Industrial	21%	66%	9%	4%	87%
Elmvale - Eastway - Riverview - Riverview Park West	39%	55%	4%	3%	94%
Emerald Woods - Sawmill Creek	42%	53%	4%	1%	95%
Glebe - Dows Lake	29%	58%	10%	3%	87%
Glen Cairn - Kanata South Business Park	34%	39%	25%	3%	**73%**
Greenbelt	33%	50%	14%	4%	82%
Greenboro East	34%	51%	13%	2%	85%
Hawthorne Meadows - Sheffield Glen	39%	55%	4%	3%	93%
Hintonburg - Mechanicsville	20%	66%	8%	6%	85%
Hunt Club - Ottawa Airport	42%	50%	8%	1%	91%
Hunt Club East - Western Community	31%	64%	2%	3%	95%
Hunt Club Park	32%	64%	2%	2%	97%
Hunt Club South Industrial	34%	52%	3%	11%	86%
Hunt Club Upper -Blossom Park - Timbermill	39%	50%	8%	2%	90%
Hunt Club Woods - Quintarra - Revelstoke	37%	54%	7%	2%	91%

Table A1.3 Distribution of street tree species suitability by neighbourhood. Values in which the combined Excellent and Good percentages are less than 75% are highlighted. See C&I criterion V3 in Appendix 2.

Neighbourhood	Excellent	Good	Fair	Poor	Excellent+Good
Iris	35%	60%	2%	3%	95%
Island Park	34%	53%	8%	4%	88%
Kanata Lakes - Marchwood Lakeside - Morgan's Grant - Kanata North Business Park	39%	56%	5%	1%	94%
Katimavik - Hazeldean	41%	50%	7%	2%	91%
Laurentian	35%	54%	7%	4%	89%
Lebreton Development	23%	43%	18%	16%	**67%**
Ledbury - Heron Gate - Ridgemont - Elmwood	33%	59%	3%	4%	92%
Lindenlea - New Edinburgh	35%	50%	9%	6%	85%
Lowertown	32%	58%	5%	5%	90%
Merivale Gardens-Grenfell Glen-Pineglen-Country Pl	49%	32%	14%	5%	81%
Navan - Vars	100%	0%	0%	0%	100%
New Barrhaven - Stonebridge	40%	54%	4%	1%	94%
Orleans Avalon - Notting Gate - Fallingbrook - Gardenway South	42%	49%	8%	1%	91%
Orleans Central	50%	46%	4%	0%	96%
Orleans Chapel Hill	44%	45%	6%	5%	89%
Orleans Chapel Hill South	37%	60%	3%	1%	97%
Orleans Chatelaine Village	46%	36%	8%	10%	82%
Orleans Industrial	0%	0%	100%	0%	**0%**
Orleans North West	31%	58%	8%	2%	89%

Table A1.3 Distribution of street tree species suitability by neighbourhood. Values in which the combined Excellent and Good percentages are less than 75% are highlighted. See C&I criterion V3 in Appendix 2.

Neighbourhood	Excellent	Good	Fair	Poor	Excellent+Good
Orleans Queenswood Heights	36%	49%	13%	3%	84%
Orleans Village - Chateauneuf	43%	51%	5%	1%	94%
Ottawa East	33%	53%	8%	7%	86%
Ottawa South	30%	57%	9%	4%	87%
Overbrook - McArthur	39%	50%	6%	6%	88%
Pineview	44%	43%	10%	3%	87%
Playfair Park - Lynda Park - Guildwood Estates	33%	60%	3%	3%	94%
Qualicum - Redwood Park	38%	49%	11%	3%	86%
Riverside Park	41%	54%	3%	2%	95%
Riverside South - Leitrim	36%	54%	9%	1%	91%
Rockcliffe - Manor Park	48%	39%	10%	3%	87%
Rothwell Heights - Beacon Hill North	42%	40%	13%	5%	83%
Sandy Hill - Ottawa East	31%	57%	4%	9%	87%
South Keys - Heron Gate - Greenboro West	42%	48%	5%	4%	91%
Stittsville	44%	47%	6%	2%	91%
Stittsville - Basswood	42%	48%	10%	0%	90%
Tanglewood	29%	50%	19%	3%	79%
Trend-Arlington	41%	42%	15%	2%	83%
Vanier North	31%	54%	6%	9%	85%
Vanier South	25%	66%	4%	5%	91%
West Centertown	25%	55%	11%	10%	80%
Westboro	30%	49%	12%	8%	80%

Table A1.3 Distribution of street tree species suitability by neighbourhood. Values in which the combined Excellent and Good percentages are less than 75% are highlighted. See C&I criterion V3 in Appendix 2.

Neighbourhood	Excellent	Good	Fair	Poor	Excellent+Good
Whitehaven - Queensway Terrace North	34%	56%	7%	4%	90%
Woodroffe - Lincoln Heights	24%	60%	11%	5%	84%
Woodvale - Craig Henry - Manordale - Estates of Arlington Woods	42%	43%	12%	3%	85%
All street trees	37%	53%	7%	3%	90%

Table A1.4 Distribution of the five most common street tree species by neighbourhood. Any species representing more than 10% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.
Species codes: appspp= Apple Species, ashgre=Green Ash, ashspp=Ash species, ashwhi=White Ash, checho=Chokecherry, crahyb=Crab Apple, elmame= American elm, elmspp=elm species, hacber=Hackberry, liljap=Japanene Lilac, linlit=Little-leaf Linden, lochon=Honey Locust, mapamu=Amur Maple, mapnor=Norway Maple, mapred=Red Maple, mapsil= Silver Maple, mapsug=Sugar Maple, oakred=Red Oak, servic=Serviceberry, sprblu=Blue Spruce, sprwhi=White Spruce, unknow=Unknown species.

Neighbourhood	1	2	3	4	5	Other
Barrhaven	mapnor (14%)	sprblu (9%)	mapsug (8%)	mapred (8%)	linlit (6%)	54%
Bayshore	liljap (14%)	hacber (10%)	crahyb (10%)	mapsug (7%)	mapnor (7%)	53%
Beacon Hill South - Cardinal Heights	mapred (9%)	mapnor (8%)	linlit (7%)	liljap (6%)	sprwhi (6%)	64%
Beaverbrook	sprwhi (22%)	mapred (11%)	ashwhi (8%)	sprblu (7%)	crahyb (6%)	45%
Beechwood Cemetery	mapamu (25%)	mapsug (19%)	mapnor (13%)	hacber (10%)	unknow (8%)	25%
Bells Corners East	ashwhi (16%)	servic (13%)	mapsug (13%)	mapred (11%)	oakred (8%)	39%
Bells Corners West	ashwhi (62%)	mapsug (9%)	servic (6%)	mapred (6%)	liljap (6%)	12%
Billings Bridge - Alta Vista	mapnor (14%)	mapsug (11%)	ashgre (8%)	linlit (8%)	lochon (6%)	53%
Blackburn Hamlet	mapred (18%)	mapnor (11%)	sprblu (9%)	ashgre (6%)	mapsug (5%)	52%
Borden Farm - Stewart Farm - Parkwood Hills - Fisher Glen	mapnor (14%)	ashgre (9%)	sprblu (8%)	mapred (7%)	liljap (6%)	56%
Braemar Park - Bel Air Heights - Copeland Park	mapsug (18%)	mapnor (16%)	ashwhi (13%)	linlit (11%)	mapred (8%)	34%
Briar Green - Leslie Park	ashgre (11%)	mapnor (9%)	mapsug (7%)	mapred (7%)	ashwhi (7%)	59%

Table A1.4 Distribution of the five most common street tree species by neighbourhood. Any species representing more than 10% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.
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Neighbourhood	1	2	3	4	5	Other
Bridlewood - Emerald Meadows	mapnor (16%)	lochon (13%)	mapsug (12%)	ashwhi (12%)	linlit (8%)	40%
Britannia Village	hacber (16%)	mapsug (13%)	lochon (11%)	servic (9%)	ginkgo (9%)	42%
Byward Market	lochon (18%)	mapnor (15%)	liljap (9%)	elmspp (6%)	ashwhi (6%)	47%
Carleton Heights - Rideauview	mapnor (16%)	mapred (12%)	mapsug (11%)	ashgre (5%)	sprwhi (5%)	51%
Carlington	mapnor (18%)	mapred (11%)	mapsug (10%)	linlit (9%)	ashgre (7%)	46%
Carlingwood West - Glabar Park - McKellar Heights	mapnor (18%)	mapred (12%)	mapsug (10%)	ashgre (7%)	linlit (7%)	46%
Carson Grove - Carson Meadows	ashspp (21%)	linlit (9%)	mapsug (8%)	mapnor (7%)	mapred (7%)	47%
Centrepointe	sprblu (11%)	mapnor (9%)	lochon (8%)	ashgre (8%)	ashwhi (6%)	58%
Centretown	mapnor (16%)	lochon (12%)	linlit (8%)	liljap (7%)	mapsug (6%)	51%
CFB Rockcliffe-NRC	mapnor (19%)	unknow (15%)	mapsug (12%)	ashwhi (7%)	linlit (6%)	41%
Chapman Mills - Rideau Crest - Davidson Heights	lochon (10%)	sprblu (8%)	linlit (7%)	ashwhi (6%)	hacber (6%)	63%
Cityview - Skyline - Fisher Heights	sprblu (11%)	mapnor (11%)	mapred (10%)	sprwhi (8%)	mapsil (6%)	55%

Table A1.4 Distribution of the five most common street tree species by neighbourhood. Any species representing more than 10% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.
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Neighbourhood	1	2	3	4	5	Other
Civic Hospital-Central Park	mapnor (21%)	mapsug (11%)	sprblu (6%)	lochon (6%)	linlit (6%)	49%
Crestview - Meadowlands	mapnor (11%)	sprwhi (10%)	mapsug (8%)	sprblu (8%)	mapred (7%)	56%
Crystal Bay ? Lakeview Park	ashwhi (19%)	crahyb (16%)	liljap (14%)	mapsug (11%)	mapred (8%)	32%
Cummings	mapnor (13%)	mapsug (12%)	ashwhi (12%)	linlit (9%)	lochon (7%)	48%
East Industrial	mapnor (22%)	ashgre (18%)	lochon (7%)	mapsug (5%)	sprblu (5%)	43%
Elmvale - Eastway - Riverview - Riverview Park West	mapsug (18%)	mapnor (12%)	linlit (11%)	ashspp (10%)	mapred (7%)	42%
Emerald Woods - Sawmill Creek	mapred (14%)	checho (12%)	mapsug (11%)	linlit (9%)	mapnor (7%)	47%
Glebe - Dows Lake	mapnor (20%)	mapsug (9%)	mapred (9%)	liljap (8%)	lochon (5%)	49%
Glen Cairn - Kanata South Business Park	crahyb (17%)	mapnor (11%)	liljap (8%)	mapamu (7%)	sprblu (6%)	51%
Greenbelt	mapnor (19%)	sprblu (9%)	mapred (8%)	pinwhi (7%)	ashgre (5%)	52%
Greenboro East	mapnor (17%)	sprblu (15%)	crahyb (10%)	ashgre (10%)	liljap (8%)	41%
Hawthorne Meadows - Sheffield Glen	mapsug (20%)	ashgre (17%)	mapnor (12%)	lochon (7%)	linlit (5%)	39%

Table A1.4 Distribution of the five most common street tree species by neighbourhood. Any species representing more than 10% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.
Species codes: appspp= Apple Species, ashgre=Green Ash, ashspp=Ash species, ashwhi=White Ash, checho=Chokecherry, crahyb=Crab Apple, elmame= American elm, elmspp=elm species, hacber=Hackberry, liljap=Japanene Lilac, linlit=Little-leaf Linden, lochon=Honey Locust, mapamu=Amur Maple, mapnor=Norway Maple, mapred=Red Maple, mapsil= Silver Maple, mapsug=Sugar Maple, oakred=Red Oak, servic=Serviceberry, sprblu=Blue Spruce, sprwhi=White Spruce, unknow=Unknown species.

Neighbourhood	1	2	3	4	5	Other
Hintonburg - Mechanicsville	mapnor (23%)	lochon (11%)	checho (9%)	linlit (7%)	crahyb (6%)	44%
Hunt Club - Ottawa Airport	mapnor (12%)	lochon (12%)	liljap (10%)	sprblu (8%)	linlit (8%)	50%
Hunt Club East - Western Community	mapnor (23%)	lochon (13%)	mapsug (9%)	ashwhi (7%)	ashgre (6%)	41%
Hunt Club Park	mapnor (34%)	lochon (9%)	ashwhi (7%)	ashgre (7%)	sprblu (6%)	37%
Hunt Club South Industrial	sprblu (15%)	linlit (11%)	mapnor (10%)	appspp (10%)	mapsug (7%)	46%
Hunt Club Upper -Blossom Park - Timbermill	mapsug (13%)	linlit (11%)	mapred (10%)	mapnor (10%)	oakred (6%)	49%
Hunt Club Woods - Quintarra - Revelstoke	mapnor (16%)	mapsug (11%)	ashgre (10%)	linlit (9%)	ashwhi (8%)	46%
Iris	linlit (17%)	ashwhi (12%)	mapsug (11%)	ashgre (9%)	mapnor (9%)	42%
Island Park	mapnor (17%)	mapsug (11%)	lochon (8%)	mapred (7%)	crahyb (6%)	51%
Kanata Lakes - Marchwood Lakeside - Morgan's Grant - Kanata North	linlit (11%)	lochon (11%)	mapnor (11%)	ashwhi (9%)	mapsug (8%)	50%
B i P k Katimavik - Hazeldean	sprblu (13%)	mapnor (11%)	lochon (9%)	ashwhi (8%)	ashgre (7%)	52%
Laurentian	mapnor (18%)	mapsug (12%)	mapred (9%)	linlit (8%)	lochon (6%)	47%

Table A1.4 Distribution of the five most common street tree species by neighbourhood. Any species representing more than 10% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.
Species codes: appspp= Apple Species, ashgre=Green Ash, ashspp=Ash species, ashwhi=White Ash, checho=Chokecherry, crahyb=Crab Apple, elmame= American elm, elmspp=elm species, hacber=Hackberry, liljap=Japanene Lilac, linlit=Little-leaf Linden, lochon=Honey Locust, mapamu=Amur Maple, mapnor=Norway Maple, mapred=Red Maple, mapsil= Silver Maple, mapsug=Sugar Maple, oakred=Red Oak, servic=Serviceberry, sprblu=Blue Spruce, sprwhi=White Spruce, unknow=Unknown species.

Neighbourhood	1	2	3	4	5	Other
Lebreton Development	lochon (23%)	hacber (16%)	elmame (16%)	oakred (14%)	mapman (13%)	19%
Ledbury - Heron Gate - Ridgemont - Elmwood	ashgre (13%)	linlit (10%)	mapsug (9%)	mapnor (8%)	lochon (8%)	52%
Lindenlea - New Edinburgh	mapnor (17%)	mapsug (13%)	liljap (7%)	lochon (6%)	crahyb (6%)	51%
Lowertown	ashwhi (13%)	lochon (11%)	mapnor (10%)	linlit (8%)	mapred (8%)	49%
Merivale Gardens - Grenfell Glen - Pineglen - Country Place	sprblu (13%)	sprwhi (12%)	mapred (10%)	mapsug (8%)	crahyb (5%)	52%
Navan - Vars	oakred (67%)	mapsug (17%)	liljap (17%)			0%
New Barrhaven - Stonebridge	mapsug (11%)	mapred (8%)	linlit (8%)	lochon (7%)	oakred (7%)	57%
Orleans Avalon - Notting Gate - Fallingbrook - Gardenway South	liljap (10%)	servic (8%)	lochon (8%)	mapnor (7%)	crahyb (7%)	60%
Orleans Central	oakred (13%)	mapred (12%)	mapsug (10%)	lochon (10%)	linlit (8%)	47%
Orleans Chapel Hill	mapnor (13%)	mapsug (9%)	mapred (8%)	sprblu (7%)	ashwhi (7%)	56%
Orleans Chapel Hill South	mapnor (13%)	liljap (11%)	servic (9%)	mapamu (8%)	lochon (7%)	52%
Orleans Chatelaine Village	ashspp (21%)	mapnor (9%)	mapred (8%)	sprwhi (8%)	mapsug (8%)	46%

Table A1.4 Distribution of the five most common street tree species by neighbourhood. Any species representing more than 10% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.
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Neighbourhood	1	2	3	4	5	Other
Orleans Industrial	crahyb (95%)					0%
Orleans North West	lochon (14%)	mapred (13%)	mapnor (9%)	sprblu (7%)	crahyb (6%)	51%
Orleans Queenswood Heights	mapnor (13%)	mapred (9%)	sprwhi (9%)	sprblu (7%)	linlit (7%)	55%
Orleans Village - Chateauneuf	sprblu (11%)	mapnor (8%)	mapsug (7%)	lochon (7%)	elmspp (7%)	60%
Ottawa East	mapnor (21%)	mapred (9%)	liljap (8%)	crahyb (6%)	lochon (6%)	50%
Ottawa South	mapnor (13%)	mapsug (11%)	mapsil (10%)	linlit (8%)	mapred (7%)	51%
Overbrook - McArthur	mapnor (17%)	mapsug (12%)	ashwhi (11%)	lochon (7%)	ashspp (7%)	45%
Pineview	sprwhi (9%)	sprblu (8%)	hacber (7%)	mapred (7%)	lochon (7%)	62%
Playfair Park - Lynda Park - Guildwood Estates	linlit (17%)	mapsug (16%)	ashgre (10%)	mapnor (9%)	mapred (7%)	41%
Qualicum - Redwood Park	mapred (11%)	mapsug (9%)	mapnor (8%)	sprblu (8%)	ashgre (8%)	55%
Riverside Park	ashwhi (14%)	linlit (12%)	mapnor (10%)	ashgre (10%)	lochon (7%)	47%
Riverside South - Leitrim	lochon (13%)	hacber (11%)	mapred (9%)	mapsug (9%)	crahyb (8%)	49%

Table A1.4 Distribution of the five most common street tree species by neighbourhood. Any species representing more than 10% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.
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Neighbourhood	1	2	3	4	5	Other
Rockcliffe - Manor Park	mapsug (21%)	mapred (9%)	mapnor (9%)	sprwhi (5%)	crahyb (4%)	51%
Rothwell Heights - Beacon Hill North	mapred (13%)	sprwhi (9%)	mapsug (9%)	mapnor (7%)	sprblu (7%)	55%
Sandy Hill - Ottawa East	mapnor (19%)	mapred (10%)	mapsug (9%)	lochon (7%)	linlit (6%)	48%
South Keys - Heron Gate - Greenboro West	ashspp (17%)	mapnor (14%)	mapsug (12%)	sprwhi (7%)	lochon (5%)	45%
Stittsville	mapsug (12%)	lochon (9%)	hacber (8%)	sprblu (8%)	mapnor (8%)	56%
Stittsville - Basswood	oakred (30%)	mapsil (15%)	linlit (15%)	lochon (9%)	elmame (9%)	21%
Tanglewood	crahyb (15%)	linlit (13%)	mapred (8%)	mapnor (7%)	lochon (7%)	49%
Trend-Arlington	sprblu (13%)	mapnor (11%)	mapred (10%)	mapsug (8%)	sprwhi (6%)	53%
Vanier North	mapnor (17%)	linlit (11%)	mapsug (9%)	ashspp (8%)	mapred (4%)	50%
Vanier South	mapnor (21%)	linlit (17%)	mapsil (6%)	lochon (6%)	ashspp (6%)	44%
West Centertown	mapnor (16%)	liljap (10%)	lochon (10%)	crahyb (7%)	mapman (6%)	50%
Westboro	mapnor (20%)	crahyb (7%)	mapsug (7%)	lochon (7%)	mapred (6%)	53%

Table A1.4 Distribution of the five most common street tree species by neighbourhood. Any species representing more than 10% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.
Species codes: appspp= Apple Species, ashgre=Green Ash, ashspp=Ash species, ashwhi=White Ash, checho=Chokecherry, crahyb=Crab Apple, elmame= American elm, elmspp=elm species, hacber=Hackberry, liljap=Japanene Lilac, linlit=Little-leaf Linden, lochon=Honey Locust, mapamu=Amur Maple, mapnor=Norway Maple, mapred=Red Maple, mapsil= Silver Maple, mapsug=Sugar Maple, oakred=Red Oak, servic=Serviceberry, sprblu=Blue Spruce, sprwhi=White Spruce, unknow=Unknown species.

Neighbourhood	1	2	3	4	5	Other
Whitehaven - Queensway Terrace North	mapnor (15%)	linlit (11%)	ashgre (10%)	mapsug (9%)	ashwhi (8%)	47%
Woodroffe - Lincoln Heights	mapnor (21%)	lochon (13%)	ashgre (7%)	mapred (7%)	elmame (7%)	45%
Woodvale - Craig Henry - Manordale - Estates of Arlington Woods	sprwhi (10%)	mapnor (10%)	sprblu (9%)	crahyb (6%)	lochon (6%)	58%
All street trees	mapnor (12%)	mapsug (9%)	lochon (7%)	mapred (7%)	linlit (7%)	58%

Table A1.4 Distribution of the five most common street tree genera by neighbourhood. Any genus representing more than 20% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Barrhaven	Maple (32%)	Spruce (17%)	Ash (8%)	Linden-Basswood (6%)	Pine (5%)	32%
Bayshore	Maple (24%)	Lilac (14%)	Elm (12%)	Ash (12%)	Hackberry (10%)	29%
Beacon Hill South - Cardinal Heights	Maple (32%)	Spruce (12%)	Linden-Basswood (7%)	Lilac (6%)	Ash (6%)	36%
Beaverbrook	Spruce (30%)	Maple (24%)	Pine (13%)	Ash (9%)	Apple/Crabapple (6%)	17%
Beechwood Cemetery	Maple (58%)	Hackberry (10%)	unknown (8%)	Ash (8%)	Spruce (6%)	12%
Bells Corners East	Maple (24%)	Ash (16%)	Serviceberry (13%)	Elm (11%)	Oak (8%)	29%
Bells Corners West	Ash (62%)	Maple (15%)	Serviceberry (6%)	Lilac (6%)	unknown (3%)	9%
Billings Bridge - Alta Vista	Maple (35%)	Ash (14%)	Linden-Basswood (8%)	Honey Locust (6%)	Lilac (6%)	32%
Blackburn Hamlet	Maple (40%)	Spruce (14%)	Pine (7%)	Ash (7%)	Apple/Crabapple (4%)	28%
Borden Farm - Stewart Farm - Parkwood Hills - Fisher Glen	Maple (31%)	Spruce (15%)	Ash (14%)	Lilac (6%)	Apple/Crabapple (6%)	29%
Braemar Park - Bel Air Heights - Copeland Park	Maple (44%)	Ash (18%)	Linden-Basswood (12%)	Oak (4%)	Lilac (3%)	20%
Briar Green - Leslie Park	Maple (28%)	Ash (18%)	Spruce (14%)	Pine (6%)	Linden-Basswood (5%)	29%
Bridlewood - Emerald Meadows	Maple (37%)	Ash (15%)	Honey Locust (13%)	Linden-Basswood (8%)	Oak (6%)	21%
Britannia Village	Hackberry (16%)	Maple (14%)	Linden-Basswood (11%)	Honey Locust (11%)	Serviceberry (9%)	39%
Byward Market	Maple (28%)	Honey Locust (18%)	Elm (12%)	Ash (10%)	Lilac (9%)	23%
Carleton Heights - Rideauview	Maple (45%)	Ash (10%)	Spruce (8%)	Oak (5%)	Hackberry (5%)	28%
Carlington	Maple (45%)	Ash (14%)	Linden-Basswood (9%)	Honey Locust (4%)	Lilac (3%)	24%

Table A1.4 Distribution of the five most common street tree genera by neighbourhood. Any genus representing more than 20% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Carlingwood West - Glabar Park - McKellar Heights	Maple (46%)	Ash (10%)	Linden-Basswood (7%)	Spruce (7%)	Honey Locust (5%)	25%
Carson Grove - Carson Meadows	Ash (27%)	Maple (24%)	Linden-Basswood (9%)	Honey Locust (7%)	Spruce (6%)	26%
Centrepointe	Maple (22%)	Spruce (16%)	Ash (14%)	Honey Locust (8%)	Lilac (5%)	36%
Centretown	Maple (35%)	Honey Locust (12%)	Linden-Basswood (11%)	Elm (7%)	Lilac (7%)	28%
CFB Rockcliffe-NRC	Maple (37%)	unknown (15%)	Ash (12%)	Linden-Basswood (6%)	Honey Locust (5%)	25%
Chapman Mills - Rideau Crest - Davidson Heights	Maple (19%)	Ash (12%)	Spruce (12%)	Honey Locust (10%)	Linden-Basswood (10%)	37%
Cityview - Skyline - Fisher Heights	Maple (33%)	Spruce (20%)	Ash (8%)	Pine (6%)	Linden-Basswood (5%)	27%
Civic Hospital-Central Park	Maple (43%)	Spruce (8%)	Ash (8%)	Linden-Basswood (6%)	Honey Locust (6%)	29%
Crestview - Meadowlands	Maple (37%)	Spruce (18%)	Oak (5%)	Pine (4%)	Apple/Crabapple (4%)	32%
Crystal Bay ? Lakeview Park	Maple (19%)	Ash (19%)	Apple/Crabapple (16%)	Lilac (14%)	Serviceberry (7%)	26%
Cummings	Maple (36%)	Ash (19%)	Linden-Basswood (9%)	Honey Locust (7%)	Elm (4%)	25%
East Industrial	Maple (34%)	Ash (24%)	Pine (9%)	Spruce (7%)	Honey Locust (7%)	19%
Elmvale - Eastway - Riverview - Riverview Park West	Maple (39%)	Ash (15%)	Linden-Basswood (12%)	Oak (7%)	Honey Locust (5%)	23%
Emerald Woods - Sawmill Creek	Maple (34%)	Cherry/Plum (12%)	Linden-Basswood (9%)	Spruce (7%)	Hazel (7%)	31%
Glebe - Dows Lake	Maple (45%)	Lilac (8%)	Ash (7%)	Elm (6%)	Linden-Basswood (5%)	30%
Glen Cairn - Kanata South Business Park	Maple (30%)	Apple/Crabapple (17%)	Spruce (13%)	Lilac (8%)	Ash (5%)	27%

Table A1.4 Distribution of the five most common street tree genera by neighbourhood. Any genus representing more than 20% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Greenbelt	Maple (34%)	Pine (14%)	Spruce (13%)	Ash (10%)	Elm (4%)	26%
Greenboro East	Maple (25%)	Spruce (18%)	Ash (13%)	Apple/Crabapple (10%)	Lilac (8%)	26%
Hawthorne Meadows - Sheffield Glen	Maple (40%)	Ash (21%)	Honey Locust (7%)	Linden-Basswood (5%)	Spruce (5%)	22%
Hintonburg - Mechanicsville	Maple (36%)	Honey Locust (11%)	Cherry/Plum (10%)	Linden-Basswood (7%)	Apple/Crabapple (6%)	30%
Hunt Club - Ottawa Airport	Maple (28%)	Honey Locust (12%)	Lilac (10%)	Spruce (10%)	Linden-Basswood (8%)	32%
Hunt Club East - Western Community	Maple (38%)	Ash (15%)	Honey Locust (13%)	Linden-Basswood (5%)	Hackberry (5%)	25%
Hunt Club Park	Maple (45%)	Ash (14%)	Honey Locust (9%)	Spruce (9%)	Lilac (4%)	18%
Hunt Club South Industrial	Maple (25%)	Spruce (18%)	Linden-Basswood (11%)	Apple (10%)	Ash (7%)	28%
Hunt Club Upper -Blossom Park - Timbermill	Maple (37%)	Linden-Basswood (11%)	Spruce (9%)	Ash (7%)	Oak (6%)	30%
Hunt Club Woods - Quintarra - Revelstoke	Maple (34%)	Ash (19%)	Linden-Basswood (9%)	Spruce (6%)	Honey Locust (5%)	27%
Iris	Maple (28%)	Ash (22%)	Linden-Basswood (18%)	Honey Locust (6%)	Oak (4%)	23%
Island Park	Maple (40%)	Honey Locust (8%)	Spruce (7%)	Linden-Basswood (6%)	Apple/Crabapple (6%)	34%
Kanata Lakes - Marchwood Lakeside - Morgan's Grant - Kanata North Business Park	Maple (27%)	Ash (16%)	Linden-Basswood (11%)	Honey Locust (11%)	Spruce (8%)	26%
Katimavik - Hazeldean	Maple (25%)	Spruce (19%)	Ash (15%)	Honey Locust (9%)	Linden-Basswood (7%)	25%
Laurentian	Maple (45%)	Linden-Basswood (8%)	Ash (7%)	Spruce (6%)	Honey Locust (6%)	29%

Table A1.4 Distribution of the five most common street tree genera by neighbourhood. Any genus representing more than 20% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Lebreton Development	Honey Locust (23%)	Elm (21%)	Maple (16%)	Hackberry (16%)	Oak (15%)	9%
Ledbury - Heron Gate - Ridgemont - Elmwood	Maple (25%)	Ash (18%)	Linden-Basswood (12%)	Honey Locust (8%)	Lilac (6%)	31%
Lindenlea - New Edinburgh	Maple (44%)	Lilac (7%)	Linden-Basswood (6%)	Honey Locust (6%)	Apple/Crabapple (6%)	31%
Lowertown	Maple (28%)	Ash (16%)	Honey Locust (11%)	Linden-Basswood (8%)	Elm (7%)	29%
Merivale Gardens - Grenfell Glen - Pineglen - Country Place	Maple (27%)	Spruce (27%)	Pine (8%)	Apple/Crabapple (5%)	Birch (4%)	28%
Navan - Vars	Oak (66%)	Maple (17%)	Lilac (17%)			0%
New Barrhaven - Stonebridge	Maple (31%)	Ash (12%)	Oak (9%)	Linden-Basswood (9%)	Honey Locust (7%)	33%
Orleans Avalon - Notting Gate - Fallingbrook - Gardenway South	Maple (25%)	Lilac (10%)	Ash (9%)	Serviceberry (8%)	Honey Locust (8%)	39%
Orleans Central	Maple (23%)	Oak (15%)	Honey Locust (10%)	Ash (10%)	Linden-Basswood (8%)	33%
Orleans Chapel Hill	Maple (36%)	Spruce (11%)	Ash (9%)	Oak (8%)	Honey Locust (5%)	30%
Orleans Chapel Hill South	Maple (29%)	Lilac (11%)	Serviceberry (9%)	Ash (9%)	Honey Locust (7%)	34%
Orleans Chatelaine Village	Maple (29%)	Ash (23%)	Spruce (14%)	Lilac (5%)	Poplar (5%)	24%
Orleans Industrial	Apple/Crabapple (100%)					0%
Orleans North West	Maple (29%)	Honey Locust (14%)	Spruce (10%)	Ash (7%)	Apple/Crabapple (6%)	34%
Orleans Queenswood Heights	Maple (33%)	Spruce (17%)	Linden-Basswood (7%)	Apple/Crabapple (6%)	Pine (5%)	32%
Orleans Village - Chateauneuf	Maple (29%)	Spruce (14%)	Ash (9%)	Elm (7%)	Honey Locust (7%)	35%
Ottawa East	Maple (42%)	Lilac (8%)	Oak (8%)	Apple/Crabapple	Honey Locust	30%

Table A1.4 Distribution of the five most common street tree genera by neighbourhood. Any genus representing more than 20% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
				(6%)	(6%)	
Ottawa South	Maple (46%)	Linden-Basswood (11%)	Ash (6%)	Apple/Crabapple (5%)	Lilac (5%)	28%
Overbrook - McArthur	Maple (40%)	Ash (19%)	Honey Locust (7%)	Linden-Basswood (6%)	Apple/Crabapple (4%)	23%
Pineview	Maple (22%)	Spruce (17%)	Pine (9%)	Oak (7%)	Hackberry (7%)	37%
Playfair Park - Lynda Park - Guildwood Estates	Maple (34%)	Linden-Basswood (17%)	Ash (14%)	Spruce (5%)	Oak (4%)	26%
Qualicum - Redwood Park	Maple (33%)	Ash (15%)	Spruce (14%)	Oak (5%)	Apple/Crabapple (5%)	27%
Riverside Park	Maple (25%)	Ash (25%)	Linden-Basswood (12%)	Honey Locust (7%)	Lilac (6%)	25%
Riverside South - Leitrim	Maple (27%)	Honey Locust (13%)	Hackberry (11%)	Oak (8%)	Apple/Crabapple (8%)	33%
Rockcliffe - Manor Park	Maple (43%)	Spruce (10%)	Ash (6%)	Pine (5%)	Linden-Basswood (4%)	31%
Rothwell Heights - Beacon Hill North	Maple (37%)	Spruce (18%)	Pine (8%)	Ash (6%)	unknown (4%)	28%
Sandy Hill - Ottawa East	Maple (44%)	Ash (10%)	Honey Locust (7%)	Linden-Basswood (7%)	Lilac (5%)	27%
South Keys - Heron Gate - Greenboro West	Maple (37%)	Ash (18%)	Spruce (12%)	Honey Locust (5%)	Linden-Basswood (5%)	24%
Stittsville	Maple (32%)	Spruce (13%)	Honey Locust (9%)	Oak (9%)	Hackberry (8%)	29%
Stittsville - Basswood	Oak (36%)	Maple (24%)	Linden-Basswood (15%)	Elm (15%)	Honey Locust (9%)	0%
Tanglewood	Maple (26%)	Apple/Crabapple (15%)	Linden-Basswood (13%)	Spruce (8%)	Ash (8%)	29%
Trend-Arlington	Maple (33%)	Spruce (19%)	Pine (12%)	Ash (8%)	Apple/Crabapple (5%)	22%

Table A1.4 Distribution of the five most common street tree genera by neighbourhood. Any genus representing more than 20% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Vanier North	Maple (39%)	Linden-Basswood (11%)	Ash (9%)	Spruce (6%)	Elm (5%)	30%
Vanier South	Maple (40%)	Linden-Basswood (17%)	Ash (8%)	Honey Locust (6%)	Lilac (6%)	22%
West Centertown	Maple (35%)	Lilac (10%)	Honey Locust (10%)	Apple/Crabapple (7%)	Elm (6%)	33%
Westboro	Maple (40%)	Apple/Crabapple (7%)	Spruce (7%)	Honey Locust (7%)	Ash (7%)	32%
Whitehaven - Queensway Terrace North	Maple (35%)	Ash (18%)	Linden-Basswood (11%)	Spruce (6%)	Honey Locust (5%)	26%
Woodroffe - Lincoln Heights	Maple (34%)	Honey Locust (13%)	Ash (11%)	Spruce (9%)	Elm (7%)	25%
Woodvale - Craig Henry - Manordale - Estates of Arlington Woods	Maple (27%)	Spruce (21%)	Apple/Crabapple (6%)	Honey Locust (6%)	Lilac (6%)	34%
All street trees	Maple (34%)	Ash (11%)	Spruce (8%)	Linden-Basswood (7%)	Honey Locust (7%)	33%

Table A1.5 Distribution of the five most common street tree families by neighbourhood. Any family representing more than 30% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Barrhaven	Aceraceae (32%)	Pinaceae (23%)	Oleaceae (10%)	Rosaceae (8%)	Tiliaceae (6%)	20%
Bayshore	Oleaceae (25%)	Aceraceae (24%)	Ulmaceae (22%)	Rosaceae (15%)	Pinaceae (3%)	10%
Beacon Hill South - Cardinal Heights	Aceraceae (32%)	Pinaceae (17%)	Oleaceae (13%)	Rosaceae (9%)	Tiliaceae (7%)	23%
Beaverbrook	Pinaceae (45%)	Aceraceae (24%)	Oleaceae (10%)	Rosaceae (8%)	Betulaceae (4%)	8%
Beechwood Cemetery	Aceraceae (58%)	Ulmaceae (10%)	Oleaceae (10%)	unknown (8%)	Pinaceae (6%)	10%
Bells Corners East	Oleaceae (24%)	Aceraceae (24%)	Rosaceae (18%)	Ulmaceae (16%)	Ginkgoaceae (8%)	11%
Bells Corners West	Oleaceae (68%)	Aceraceae (15%)	Rosaceae (6%)	unknown (3%)	Fagaceae (3%)	6%
Billings Bridge - Alta Vista	Aceraceae (35%)	Oleaceae (19%)	Tiliaceae (8%)	Rosaceae (8%)	Pinaceae (8%)	22%
Blackburn Hamlet	Aceraceae (40%)	Pinaceae (24%)	Rosaceae (9%)	Oleaceae (9%)	Betulaceae (3%)	15%
Borden Farm - Stewart Farm - Parkwood Hills - Fisher Glen	Aceraceae (31%)	Oleaceae (20%)	Pinaceae (20%)	Rosaceae (10%)	Fabaceae (4%)	16%
Braemar Park - Bel Air Heights - Copeland Park	Aceraceae (44%)	Oleaceae (21%)	Tiliaceae (12%)	Rosaceae (6%)	Fagaceae (4%)	14%
Briar Green - Leslie Park	Aceraceae (28%)	Pinaceae (21%)	Oleaceae (20%)	Rosaceae (8%)	Tiliaceae (5%)	17%
Bridlewood - Emerald Meadows	Aceraceae (37%)	Oleaceae (17%)	Fabaceae (13%)	Tiliaceae (8%)	Pinaceae (8%)	17%
Britannia Village	Ulmaceae (24%)	Rosaceae (15%)	Aceraceae (14%)	Tiliaceae (11%)	Fabaceae (11%)	24%

Table A1.5 Distribution of the five most common street tree families by neighbourhood. Any family representing more than 30% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Byward Market	Aceraceae (28%)	Oleaceae (19%)	Fabaceae (18%)	Ulmaceae (13%)	Rosaceae (8%)	15%
Carleton Heights - Rideauview	Aceraceae (45%)	Oleaceae (13%)	Pinaceae (11%)	Ulmaceae (8%)	Rosaceae (8%)	15%
Carlington	Aceraceae (45%)	Oleaceae (17%)	Tiliaceae (9%)	Rosaceae (7%)	Pinaceae (5%)	17%
Carlingwood West - Glabar Park - McKellar Heights	Aceraceae (46%)	Oleaceae (13%)	Pinaceae (9%)	Tiliaceae (7%)	Rosaceae (7%)	18%
Carson Grove - Carson Meadows	Oleaceae (31%)	Aceraceae (24%)	Tiliaceae (9%)	Pinaceae (9%)	Fabaceae (7%)	19%
Centrepointe	Aceraceae (22%)	Pinaceae (20%)	Oleaceae (19%)	Rosaceae (8%)	Fabaceae (8%)	23%
Centretown	Aceraceae (35%)	Oleaceae (13%)	Fabaceae (13%)	Tiliaceae (11%)	Rosaceae (9%)	19%
CFB Rockcliffe-NRC	Aceraceae (37%)	Oleaceae (16%)	unknown (15%)	Tiliaceae (6%)	Pinaceae (6%)	20%
Chapman Mills - Rideau Crest - Davidson Heights	Aceraceae (19%)	Oleaceae (17%)	Pinaceae (16%)	Fabaceae (11%)	Tiliaceae (10%)	28%
Cityview - Skyline - Fisher Heights	Aceraceae (33%)	Pinaceae (28%)	Oleaceae (11%)	Rosaceae (8%)	Tiliaceae (5%)	16%
Civic Hospital-Central Park	Aceraceae (43%)	Oleaceae (14%)	Rosaceae (10%)	Pinaceae (9%)	Tiliaceae (6%)	18%
Crestview - Meadowlands	Aceraceae (37%)	Pinaceae (24%)	Rosaceae (8%)	Oleaceae (6%)	Fagaceae (6%)	19%
Crystal Bay ? Lakeview Park	Oleaceae (32%)	Rosaceae (31%)	Aceraceae (19%)	Ulmaceae (8%)	Fabaceae (4%)	5%
Cummings	Aceraceae (36%)	Oleaceae (22%)	Tiliaceae (9%)	Ulmaceae (8%)	Fabaceae (7%)	18%

Table A1.5 Distribution of the five most common street tree families by neighbourhood. Any family representing more than 30% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
East Industrial	Aceraceae (34%)	Oleaceae (25%)	Pinaceae (16%)	Fabaceae (7%)	Ulmaceae (5%)	13%
Elmvale - Eastway - Riverview - Riverview Park West	Aceraceae (39%)	Oleaceae (17%)	Tiliaceae (12%)	Fagaceae (7%)	Rosaceae (6%)	19%
Emerald Woods - Sawmill Creek	Aceraceae (34%)	Rosaceae (16%)	Tiliaceae (9%)	Oleaceae (8%)	Pinaceae (7%)	25%
Glebe - Dows Lake	Aceraceae (45%)	Oleaceae (15%)	Rosaceae (12%)	Ulmaceae (7%)	Tiliaceae (5%)	16%
Glen Cairn - Kanata South Business Park	Aceraceae (30%)	Rosaceae (23%)	Pinaceae (18%)	Oleaceae (13%)	Betulaceae (5%)	11%
Greenbelt	Aceraceae (34%)	Pinaceae (28%)	Oleaceae (13%)	Rosaceae (9%)	Ulmaceae (5%)	12%
Greenboro East	Aceraceae (25%)	Oleaceae (21%)	Pinaceae (20%)	Rosaceae (16%)	Tiliaceae (5%)	14%
Hawthorne Meadows - Sheffield Glen	Aceraceae (40%)	Oleaceae (24%)	Fabaceae (7%)	Ulmaceae (6%)	Rosaceae (6%)	17%
Hintonburg - Mechanicsville	Aceraceae (36%)	Rosaceae (20%)	Fabaceae (11%)	Oleaceae (9%)	Tiliaceae (7%)	17%
Hunt Club - Ottawa Airport	Aceraceae (28%)	Oleaceae (15%)	Rosaceae (12%)	Pinaceae (12%)	Fabaceae (12%)	21%
Hunt Club East - Western Community	Aceraceae (38%)	Oleaceae (17%)	Fabaceae (13%)	Rosaceae (6%)	Ulmaceae (6%)	19%
Hunt Club Park	Aceraceae (45%)	Oleaceae (19%)	Pinaceae (11%)	Fabaceae (9%)	Rosaceae (4%)	12%
Hunt Club South Industrial	Aceraceae (25%)	Pinaceae (21%)	Rosaceae (13%)	Tiliaceae (11%)	Oleaceae (8%)	21%
Hunt Club Upper -Blossom Park - Timbermill	Aceraceae (37%)	Pinaceae (13%)	Oleaceae (12%)	Tiliaceae (11%)	Ulmaceae (6%)	20%

Table A1.5 Distribution of the five most common street tree families by neighbourhood. Any family representing more than 30% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Hunt Club Woods - Quintarra - Revelstoke	Aceraceae (34%)	Oleaceae (22%)	Pinaceae (11%)	Tiliaceae (9%)	Rosaceae (8%)	16%
Iris	Aceraceae (28%)	Oleaceae (25%)	Tiliaceae (18%)	Fabaceae (6%)	Ulmaceae (5%)	18%
Island Park	Aceraceae (40%)	Rosaceae (11%)	Pinaceae (10%)	Oleaceae (10%)	Fabaceae (8%)	20%
Kanata Lakes - Marchwood Lakeside - Morgan's Grant - Kanata North Business Park	Aceraceae (27%)	Oleaceae (19%)	Pinaceae (12%)	Tiliaceae (11%)	Fabaceae (11%)	20%
Katimavik - Hazeldean	Aceraceae (25%)	Pinaceae (24%)	Oleaceae (17%)	Fabaceae (9%)	Rosaceae (7%)	18%
Laurentian	Aceraceae (45%)	Oleaceae (11%)	Pinaceae (8%)	Tiliaceae (8%)	Rosaceae (7%)	21%
Lebreton Development	Ulmaceae (37%)	Fabaceae (23%)	Aceraceae (16%)	Fagaceae (15%)	Oleaceae (7%)	2%
Ledbury - Heron Gate - Ridgemont - Elmwood	Aceraceae (25%)	Oleaceae (24%)	Tiliaceae (12%)	Ulmaceae (10%)	Fabaceae (8%)	21%
Lindenlea - New Edinburgh	Aceraceae (44%)	Rosaceae (12%)	Oleaceae (12%)	Pinaceae (7%)	Fabaceae (7%)	18%
Lowertown	Aceraceae (28%)	Oleaceae (21%)	Ulmaceae (12%)	Fabaceae (11%)	Tiliaceae (8%)	20%
Merivale Gardens - Grenfell Glen - Pineglen - Country Place	Pinaceae (36%)	Aceraceae (27%)	Rosaceae (9%)	Oleaceae (6%)	Betulaceae (4%)	18%
Navan - Vars	Fagaceae (67%)	Oleaceae (17%)	Aceraceae (17%)			0%
New Barrhaven - Stonebridge	Aceraceae (31%)	Oleaceae (16%)	Rosaceae (9%)	Fagaceae (9%)	Tiliaceae (9%)	27%
Orleans Avalon - Notting Gate - Fallingbrook - Gardenway South	Aceraceae (25%)	Oleaceae (20%)	Rosaceae (18%)	Pinaceae (9%)	Fabaceae (8%)	20%

Table A1.5 Distribution of the five most common street tree families by neighbourhood. Any family representing more than 30% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Orleans Central	Aceraceae (23%)	Fagaceae (15%)	Oleaceae (13%)	Ulmaceae (10%)	Rosaceae (10%)	28%
Orleans Chapel Hill	Aceraceae (36%)	Pinaceae (17%)	Oleaceae (12%)	Fagaceae (8%)	Rosaceae (7%)	20%
Orleans Chapel Hill South	Aceraceae (29%)	Oleaceae (20%)	Rosaceae (15%)	Fabaceae (8%)	Ulmaceae (7%)	21%
Orleans Chatelaine Village	Aceraceae (29%)	Oleaceae (28%)	Pinaceae (18%)	Rosaceae (6%)	Salicaceae (5%)	15%
Orleans Industrial	Rosaceae (100%)					0%
Orleans North West	Aceraceae (29%)	Fabaceae (14%)	Pinaceae (13%)	Oleaceae (10%)	Rosaceae (10%)	24%
Orleans Queenswood Heights	Aceraceae (33%)	Pinaceae (23%)	Rosaceae (9%)	Oleaceae (8%)	Tiliaceae (7%)	19%
Orleans Village - Chateauneuf	Aceraceae (29%)	Pinaceae (17%)	Oleaceae (14%)	Ulmaceae (13%)	Fabaceae (9%)	18%
Ottawa East	Aceraceae (42%)	Rosaceae (14%)	Oleaceae (13%)	Fagaceae (8%)	Pinaceae (6%)	17%
Ottawa South	Aceraceae (46%)	Rosaceae (14%)	Tiliaceae (11%)	Oleaceae (11%)	Fabaceae (5%)	15%
Overbrook - McArthur	Aceraceae (40%)	Oleaceae (22%)	Rosaceae (8%)	Fabaceae (7%)	Tiliaceae (6%)	17%
Pineview	Pinaceae (27%)	Aceraceae (22%)	Ulmaceae (11%)	Oleaceae (10%)	Fagaceae (7%)	22%
Playfair Park - Lynda Park - Guildwood Estates	Aceraceae (34%)	Tiliaceae (17%)	Oleaceae (17%)	Pinaceae (8%)	Rosaceae (6%)	18%
Qualicum - Redwood Park	Aceraceae (33%)	Pinaceae (20%)	Oleaceae (18%)	Rosaceae (7%)	Fagaceae (5%)	16%

Table A1.5 Distribution of the five most common street tree families by neighbourhood. Any family representing more than 30% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Riverside Park	Oleaceae (31%)	Aceraceae (25%)	Tiliaceae (12%)	Rosaceae (8%)	Fabaceae (7%)	17%
Riverside South - Leitrim	Aceraceae (27%)	Rosaceae (13%)	Fabaceae (13%)	Ulmaceae (12%)	Oleaceae (12%)	23%
Rockcliffe - Manor Park	Aceraceae (43%)	Pinaceae (17%)	Rosaceae (7%)	Oleaceae (7%)	Ulmaceae (6%)	19%
Rothwell Heights - Beacon Hill North	Aceraceae (37%)	Pinaceae (28%)	Oleaceae (8%)	Rosaceae (7%)	unknown (4%)	16%
Sandy Hill - Ottawa East	Aceraceae (44%)	Oleaceae (15%)	Rosaceae (9%)	Fabaceae (8%)	Tiliaceae (7%)	18%
South Keys - Heron Gate - Greenboro West	Aceraceae (37%)	Oleaceae (23%)	Pinaceae (15%)	Rosaceae (6%)	Fabaceae (6%)	14%
Stittsville	Aceraceae (32%)	Pinaceae (16%)	Ulmaceae (11%)	Fabaceae (9%)	Fagaceae (9%)	23%
Stittsville - Basswood	Fagaceae (36%)	Aceraceae (24%)	Ulmaceae (15%)	Tiliaceae (15%)	Fabaceae (9%)	0%
Tanglewood	Aceraceae (26%)	Rosaceae (20%)	Tiliaceae (13%)	Oleaceae (11%)	Pinaceae (10%)	20%
Trend-Arlington	Pinaceae (33%)	Aceraceae (33%)	Oleaceae (9%)	Rosaceae (7%)	Betulaceae (5%)	13%
Vanier North	Aceraceae (39%)	Oleaceae (13%)	Rosaceae (11%)	Tiliaceae (11%)	Pinaceae (7%)	19%
Vanier South	Aceraceae (40%)	Tiliaceae (17%)	Oleaceae (14%)	Pinaceae (6%)	Fabaceae (6%)	16%
West Centertown	Aceraceae (35%)	Rosaceae (17%)	Oleaceae (13%)	Fabaceae (10%)	Ulmaceae (10%)	15%
Westboro	Aceraceae (40%)	Rosaceae (12%)	Pinaceae (10%)	Oleaceae (10%)	Fabaceae (7%)	20%

Table A1.5 Distribution of the five most common street tree families by neighbourhood. Any family representing more than 30% of the total number of trees is highlighted. See C&I criterion V4 in Appendix 2.

Neighbourhood	1	2	3	4	5	Other
Whitehaven - Queensway Terrace North	Aceraceae (35%)	Oleaceae (23%)	Tiliaceae (11%)	Pinaceae (9%)	Rosaceae (7%)	16%
Woodroffe - Lincoln Heights	Aceraceae (34%)	Oleaceae (14%)	Fabaceae (14%)	Rosaceae (10%)	Pinaceae (10%)	19%
Woodvale - Craig Henry - Manordale - Estates of Arlington Woods	Pinaceae (27%)	Aceraceae (27%)	Rosaceae (12%)	Oleaceae (11%)	Fabaceae (6%)	17%
All street trees	Aceraceae (34%)	Oleaceae (16%)	Pinaceae (11%)	Rosaceae (9%)	Tiliaceae (7%)	23%

Appendix 2 – Criteria and Indicators baseline assessment

The Criteria and Indicators framework for urban forest management was initially developed by Clark *et al.* (1997). The authors provided a list of Criteria and Indicators (C&I) for urban forest sustainability that consider the vegetation resource, the community framework, and resource management approaches. Each criterion includes indicators describing low, moderate, good and optimal levels of performance, as well as a key objective which describes the intended outcome to be achieved.

The original C&I framework was expanded and revised by Kenney *et al.* (2011) to make it more applicable to urban forest management planning by providing more quantifiable performance measures. The C&I framework was further revised by a United States Department of Agriculture (USDA)-led working group (Leff, 2016), and this latest revised framework is used in this UFMP.

Table A2.1: Baseline Criteria and Indicators analysis of Ottawa's urban forestry program at outset of development of Urban Forest Management Plan.

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
V1	Vegetation Resource	**Relative Canopy Cover (4)**	The existing canopy cover equals 0-25% of the potential.	The existing canopy cover equals 25-50% of the potential.	The existing canopy cover equals 50-75% of the potential.	The existing canopy cover equals 75-100% of the potential.	Achieve climate-appropriate degree of tree cover, community-wide	No data currently available. To be available on Completion of Recommendation #4.
V2	Vegetation Resource	**Age distribution (3)**	Even-age distribution, or highly skewed toward a single age class (maturity stage) across entire population.	Some uneven distribution, but most of the tree population falls into a single age class.	Total tree population across municipality approaches an ideal age distribution of 40% Class I, 30% Class II, 20% Class III, and 10% Class IV	Total population approaches that ideal distribution municipality-wide as well as at the neighbourhood level.	Provide for uneven-aged distribution city-wide as well as at the neighbourhood level.	Current analysis (Appendix 1) based on City street tree inventory.
V3	Vegetation Resource	**Species suitability (3)**	Less than 50% of trees are of species considered suitable for the area.	50% to 75% of trees are of species considered suitable for the area.	More than 75% of trees are of species considered suitable for the area.	Virtually all trees are of species considered suitable for the area.	Establish a tree population suitable for the urban environment and adapted to the regional environment.	Current analysis (Appendix 1) based on City street tree inventory.

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
V4	Vegetation Resource	**Species diversity (3)**	Fewer than 5 species dominate the entire tree population city-wide.	No single species represents more than 10% of total tree population; no genus more than 20%; and no family more than 30%.	No single species represents more than 5% of total tree population; no genus more than 10%; and no family more than 15%.	At least as diverse as "Moderate" rating (10/20/30) municipality-wide – and at least as diverse as "Good" (5/10/15) at the neighbourhood level.	Establish a genetically diverse tree population city-wide as well as at the neighbourhood level.	Current analysis (Appendix 1) based on City street tree inventory.
V5	Vegetation Resource	**Condition of Publicly-owned Trees (trees managed intensively) (3)**	No tree maintenance or risk assessment. Request based/reactive system. The condition of the urban forest is unknown	Sample-based inventory indicating tree condition and risk level is in place.	Complete tree inventory which includes detailed tree condition ratings.	Complete tree inventory which includes detailed tree condition and risk ratings.	Detailed understanding of the condition and risk potential of all publicly-owned trees	Full inventory exists for street trees within GIS. Condition rating is housed within SAP and is not yet complete for street tree inventory. Both should be housed within GIS and condition ratings must be completed.

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
V6	Vegetation Resource	**Publicly-owned wooded natural areas** (trees managed extensively, e.g. woodlands, ravine lands, etc.) **(7, 12)**	No information about publicly-owned wooded natural areas.	All publicly-owned wooded natural areas are identified based on desktop studies.	All publically-owned wooded natural areas are identified based on field verification and assessed in a "natural areas survey" or similar document.	The ecological structure and function of all publicly-owned wooded natural areas are well-documented through desktop and field assessments, and included in the city-wide GIS.	The ecological structure and function of all publicly-owned wooded natural areas is well-understood and can be used as a basis for their protection and management.	Wooded natural areas survey done in 2005 and 2006.
V7	Vegetation Resource	**Trees on private property (4)**	No information about privately owned trees.	Aerial, point-based assessment of trees on private property, capturing overall extent and location.	Ground-based SAMPLE assessment of trees on private property, as well as basic aerial view (as described in "Moderate" rating).	Ground-based SAMPLE assessment on private property, as well as detailed Urban Tree Canopy (UTC) analysis of entire urban forest, including private property, integrated into municipality-wide GIS system.	Understanding of extent, location, and general condition of privately owned trees across the urban forest.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
C1	Community Resource	**Municipal agency cooperation (2)**	Municipal departments/agencies take actions impacting urban forest with no cross-departmental coordination or consideration of the urban forest resource.	Municipal departments/agencies recognize potential conflicts and reach out to urban forest managers on an ad hoc basis – and vice versa.	Informal teams among departments and agencies communicate regularly and collaborate on a project-specific basis.	Municipal policy implemented by formal interdepartmental/interagency working teams on all municipal projects.	All municipal departments and agencies cooperate to advance goals related to urban forest issues and opportunities.	Urban forestry staff sit on formal and informal teams with other municipal agencies however advancement of urban forest goals is not yet consistent, therefore rating is moderate.
C2	Community Resource	**Involvement of large private and institutional land holders (26)**	Large private landholders are generally uninformed about urban forest issues and opportunities.	Municipality conducts outreach directly to landholders with educational materials and technical assistance, providing clear goals and incentives for managing their tree resource.	Landholders develop comprehensive tree management plans (including funding strategies) that advance municipality-wide urban forest goals.	As described in "Good" rating, plus active community engagement and access to the properties forest resource.	Large private landholders embrace and advance municipality-wide urban forest goals and objectives by implementing specific resource management plans.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
C3	Community Resource	**Utilities cooperation (2, 6)**	Utilities take actions impacting urban forest with no municipal coordination or consideration of the urban forest resource.	Utilities employ best management practices, recognize potential municipal conflicts, and reach out to urban forest managers on an ad hoc basis – and vice versa.	Utilities are included in informal municipal teams that communicate regularly and collaborate on a project-specific basis.	Utilities help advance urban forestry goals and objectives by participating in formal interdepartmental/interagency working teams on all municipal projects.	All utilities – above and below ground – employ best management practices and cooperate with municipality to advance goals and objectives related to urban forest issues and opportunities.	
C4	Community Resource	**Green industry cooperation (26)**	Little or no cooperation among segments of green industry or awareness of municipality-wide urban forest goals and objectives.	Some cooperation among green industry as well as general awareness and acceptance of municipality-wide goals and objectives.	Specific collaborative arrangements across segments of green industry in support of municipality-wide goals and objectives.	Shared vision and goals and extensive committed partnerships in place. Solid adherence to high professional standards.	Green industry works together to advance municipality-wide urban forest goals and objectives, and adheres to high professional standards.	The C&I defines the "Green Industry" as businesses involved in the production, distribution and services associated with trees and ornamental plants (such as nurseries, consulting arborists, and landscape architects).

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
C5	Community Resource	**Citizen involvement and neighbourhood action (2, 22, 23, 25)**	Little or no citizen involvement or neighbourhood action.	Some neighbourhood groups engaged in advancing urban forest goals, but with little or no overall coordination by municipality or its partnering NGOs.	Many active neighbourhood groups engaged across the community, with actions facilitated by municipality and/or its partnering NGOs.	Proactive outreach and coordination efforts by municipality and NGO partners resulting in widespread citizen involvement and collaboration among active neighbourhood groups engaged in urban forest stewardship.	At the neighbourhood level, citizens participate and groups collaborate with the municipality and/or it's partnering NGOs in urban forest stewardship activities to advance municipality-wide plans.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
C6	Community Resource	**General appreciation of trees as a community resource (7, 22, 23, 25)**	General ambivalence or negative attitudes about trees, which are perceived as neutral at best or as the source of problems. Actions harmful to trees may be taken deliberately.	Trees generally recognized as important and beneficial.	Trees widely acknowledged as providing environmental, social, and economic services resulting in some action or advocacy in support of the urban forest.	Urban forest recognized as vital to the community's environmental, social, and economic well-being. Widespread public and political support and advocacy for trees, resulting in strong policies and plans that advance the viability and sustainability of the entire urban forest.	Stakeholders from all sectors and constituencies within municipality – private and public, commercial and non-profit, entrepreneurs and elected officials, community groups and individual citizens – understand, appreciate, and advocate for the role and importance of the urban forest as a resource.	This is difficult to assess and staff will determine how best to make this assessment.

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
C7	Community Resource	**Regional collaboration (2)**	Municipalities have no interaction with each other or the broader region. No regional planning or coordination on urban forestry.	Some neighbouring municipalities and regional agencies share similar policies and plans related to trees and urban forest.	Some urban forest planning and cooperation across municipalities and regional agencies.	Widespread regional cooperation resulting in development and implementation of regional urban forest strategy.	Cooperation and interaction on urban forest plans among neighbouring municipalities within a region, and/or with regional agencies.	This includes the Conservation Authorities and the National Capital Commission, among others.
M1	Resource Management Approach	**Tree Inventory (3)**	No inventory	Complete or sample-based inventory of publicly-owned trees	Complete inventory of publicly-owned trees AND sample-based inventory of privately-owned trees.	Complete inventory of publicly-owned trees AND sample-based inventory of privately-owned trees included in city-wide GIS	Complete inventory of the tree resource to direct its management. This includes: age distribution, species mix, tree condition, risk assessment.	The City's tree inventory currently includes city owned street trees. The inventory of trees in city parks is pending completion.

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
M2	Resource Management Approach	**Canopy cover assessment and goals (4, 20)**	No assessment or goals set; or goals not based on potential canopy cover.	Low-resolution and/or point-based sampling of canopy cover using aerial photographs or satellite imagery and no goal-setting based on potential canopy cover.	Complete, detailed, and spatially explicit, high-resolution Urban Tree Canopy (UTC) assessment based on enhanced data (such as LiDAR) – accompanied by comprehensive set of goals by land use and other parameters.	As described for "Good" rating – and all utilized effectively to drive urban forest policy and practice municipality-wide and at neighbourhood or smaller management level.	Urban forest policy and practice driven by accurate, high-resolution, and recent assessments of existing and potential canopy cover, with comprehensive goals municipality-wide and at neighbourhood or smaller management level.	
M3	Resource Management Approach	**Environmental justice and equity (4, 20, 25)**	Tree planting and outreach is not determined equitably by canopy cover or need for benefits.	Planting and outreach includes attention to low canopy neighbourhoods or areas.	Planting and outreach targets neighbourhoods with low canopy and a high need for tree benefits.	Equitable planting and outreach at the neighbourhood level is guided by strong citizen engagement in those low-canopy/high-need areas.	Ensure that the benefits of urban forests are made available to all, especially to those in greatest need of tree benefits.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
M4	Resource Management Approach	**Municipality-wide urban forest management plan (all)**	No plan	Existing plan limited in scope and implementation	Recent comprehensive plan developed and implemented for publicly owned forest resources, including trees managed intensively (or individually) and those managed extensively, as a population (e.g., trees in natural areas).	Strategic multi-tiered plan for public and private intensively- and extensively-managed forest resources accepted and implemented with adaptive management mechanisms.	Develop and implement a comprehensive urban forest management plan for private and public property.	Once the UFMP is approved, this rating will go from Low to Good.
M5	Resource Management Approach	**Municipality-wide urban forestry funding (all)**	Funding only for emergency, reactive management.	Funding sufficient for some proactive management based on urban forest management program.	Funding from public sources sufficient to implement a proactive urban forest management program.	Sustained funding from public and private sources to fully implement comprehensive urban forest management program.	Develop and maintain adequate funding to implement municipality-wide urban forest management program.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
M6	Resource Management Approach	**Municipal urban forestry program capacity (all)**	Team limited by lack of trained staff and/or access to adequate equipment	Team able to implement some of the goals and objectives of the urban forest management program.	Team able to implement many of the goals and objectives of the urban forest management program.	Team able to implement all of the goals and objectives of the urban forest management program.	Maintain sufficient well-trained personnel and equipment – whether in-house or through contracted or volunteer services – to implement municipality-wide urban forest management program.	
M7	Resource Management Approach	**Tree establishment planning and implementation (2, 7, 9, 13, 20)**	Little or no tree planting; tree establishment is ad hoc.	Some tree planting and establishment occurs, but with limited overall municipality-wide planning and post-planting care.	Tree planting plan is guided by municipality-wide goals, with some post-planting establishment care.	Comprehensive tree establishment plan is guided by needs derived from canopy and other assessments, includes both planting and young tree care, and is sufficient to make progress toward canopy cover objectives.	Comprehensive and effective tree planting and establishment program is driven by canopy cover goals and other considerations according to plan.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
M8	Resource Management Approach	**Growing site suitability (9)**	Trees selected and planted without consideration of site conditions.	Appropriate tree species are considered in site selection.	Municipality-wide guidelines in place for the improvement of planting site conditions and selection of suitable species.	All trees planted in sites with adequate soil quality and quantity, and with sufficient growing space and overall site conditions to achieve their genetic potential and thus provide maximum ecosystem services.	All publicly owned trees are selected for each site and planted in conditions that are modified as needed to ensure survival and maximize current and future tree benefits.	This is a "patchwork" across the City.
M9	Resource Management Approach	**Maintenance of publicly-owned, intensively managed trees (15, 16)**	No maintenance of publicly owned trees, or on a reactive basis only.	Publicly owned trees receive only ad-hoc inspection and maintenance (as time and budgets allow).	All publicly-owned trees are systematically maintained on a cycle longer than seven years.	All mature publicly-owned trees are maintained on a seven-year cycle. All immature trees are structurally pruned.	All publicly-owned trees are maintained to maximize current and future benefits. Tree health and condition ensure maximum longevity and minimizes risk potential.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
M10	Resource Management Approach	**Tree Risk Management (18)**	No tree risk assessment or risk management program. Response is on a reactive basis only.	Level I (limited visual assessment) inspection and follow-up conducted periodically.	Level II (basic assessment) conducted periodically, resulting in scheduled follow-ups.	Level III (advanced assessment) undertaken when recommended during a level II inspection. Appropriate mitigation promptly implemented.	Comprehensive tree risk management program fully implemented, according to ANSI A300 (Part 9) "Tree Risk Assessment" standards, and supporting industry best management practices.	
M11	Resource Management Approach	**Tree retention and protection policy development and enforcement (6, 7, 8, 14, 24)**	No tree retention and protection policy.	Policies and industry best management practices in place to retain and protect public and private trees, but inconsistently enforced.	Policies and industry best management practices in place to retain and protect public and private trees, generally enforced.	Integrated municipality-wide policies and industry best management practices to retain and protect public and private trees, consistently enforced and supported by significant deterrents.	The benefits derived from trees on public and private land are ensured by the enforcement of municipality-wide policies, including tree care best management practices.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
M12	Resource Management Approach	**Wooded natural area retention and protection policy development and enforcement (7, 8, 12)**	No wooded natural area retention and protection policy.	Policies in place to retain and protect public wooded natural areas and employ industry best management practices, but inconsistently enforced.	Policies and industry best management practices in place to retain and protect public wooded natural areas, generally enforced.	Integrated municipality-wide policies and industry best management practices to retain and protect public and private wooded natural areas, consistently enforced.	The benefits derived from wooded natural areas are ensured by the enforcement of municipality-wide policies, including woodland conservation best management practices.	This is a new Criterion created for the City of Ottawa.
M13	Resource Management Approach	**Publicly-owned wooded natural areas planning and implementation (12, 22, 23, 25)**	No stewardship plans or implementation in effect.	Reactionary stewardship in effect to facilitate public use of wooded natural areas (e.g. hazard abatement, trail maintenance, etc.)	Stewardship plan in effect for each publicly-owned wooded natural area to facilitate public use (e.g. hazard abatement, trail maintenance, etc.)	Stewardship plan in effect for each publicly-owned wooded natural area focused on sustaining the ecological structure and function of the feature.	The ecological structure and function of all publicly-owned wooded natural areas are protected and, where appropriate, enhanced.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
M14	Resource Management Approach	**Native vegetation (9)**	No coordinated focus on native vegetation.	Voluntary use of native species on publicly and privately owned lands; invasive species are recognized.	Use of native species is encouraged on a project-appropriate basis in all areas; invasive species are recognized and discouraged on public and private lands.	Native species are widely used on a project-appropriate basis in all areas; invasive species are proactively managed for eradication to the full extent possible.	Preservation and enhancement of local natural biodiversity.	
M15	Resource Management Approach	**Urban wood, green waste /residue, food utilization (17)**	No utilization plan; wood, other green waste /residue, and food goes to landfill with little or no recycling, reuse, or distribution.	Some green waste/residue is reused or recycled for energy, products, and other purposes beyond chips or mulch. Some food is collected for distribution.	The majority of green waste/residue is reused or recycled for energy, products, and other purposes beyond chips or mulch. Programs in place to identify urban food tree sources and to collect food products.	Comprehensive plan and processes in place to utilize all green waste/residue and food, to the fullest extent possible.	Create a closed system diverting all urban wood, green waste/residue, and food (fruit and nuts) through reuse, recycling, and distribution.	

Number	Group	Criteria (Reco. #)	Low	Moderate	Good	Optimal	Key Objectives	Comments
M16	Resource Management Approach	**Value of the Urban Forest (4, 5)**	Value of the urban forest has not been determined.	Value of sample areas of the publicly owned portion of the urban forest is known.	Value of the publicly owned portion of the urban forest is known and adopted by the City within the Asset Management program.	Value of urban forest, public and private, is known and adopted by the City within the Asset Management program.	The value of the full urban forest resource (including economic, environmental, and social aspects), both publicly and privately owned, is known, is fundamental to decision making within the City, and is reflected in the City's Asset Management program.	This is a new Criterion created for the City of Ottawa.

Appendix 3 – The Public Health Value of Urban Trees and Green Spaces

Provided by Ottawa Public Health

The Public Health Value of Urban Trees and Green Spaces

Introduction

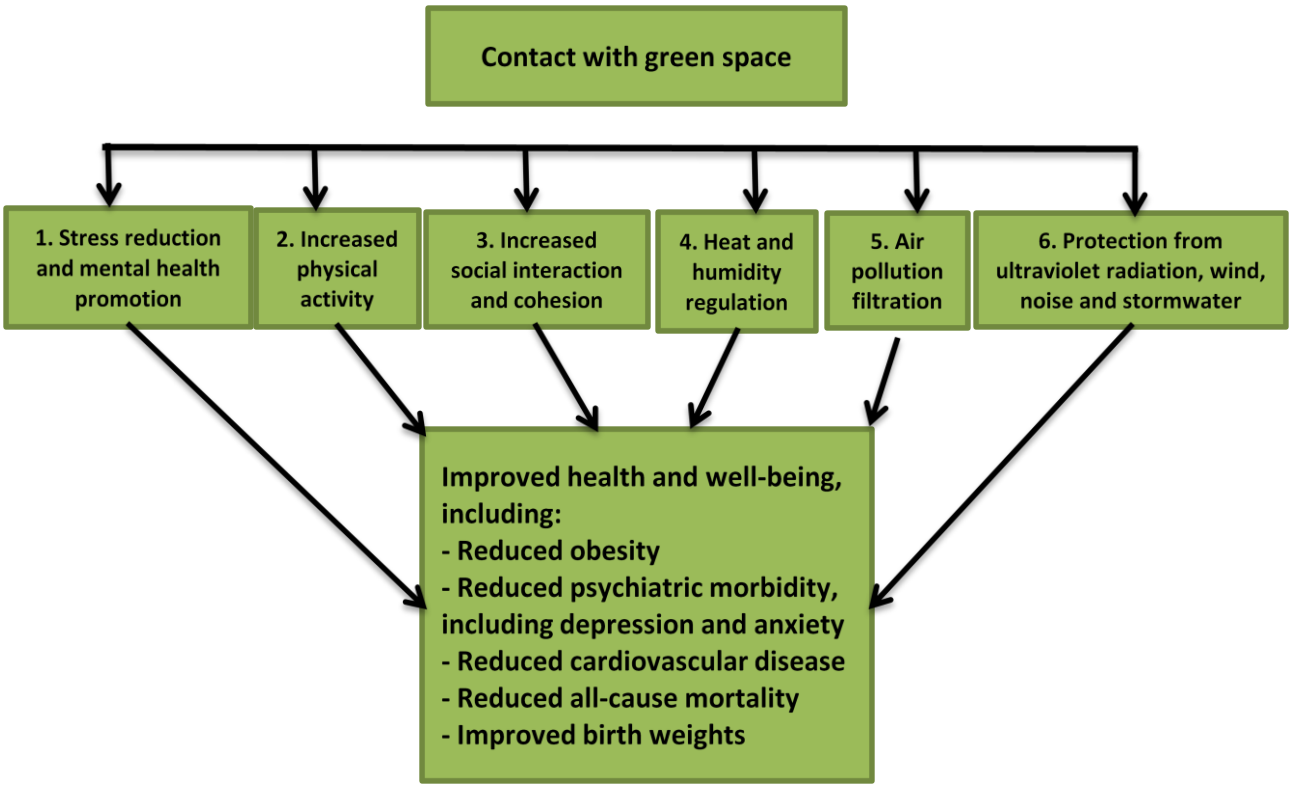
The urban environment impacts people's health and well-being.[1] Access to green spaces plays an important role in providing significant health benefits in reducing chronic disease risk factors such as obesity, physical inactivity, heart disease, and diabetes. Urban trees and forests are an important component of quality green spaces and help create the physical environments that can foster health.

Living near green space is related to better self reported well-being, and this is more pronounced in low income neighbourhoods.[2] The community benefits from contact with green spaces that affect general well-being include physical, mental, social, environmental and economic. Urban green space is an under-utilize public health resource that offers a potential for address the growing burden to mental health and disease in Ottawa.[3]

Urban forests, trees, and green spaces also have important effects on regulating air quality and thermal comfort in urban settings, as well as on exposure to ultraviolet radiation, wind and noise. This will become more important as climate change increases average temperatures and results in extreme weather events.

Research into the health benefits of green spaces that include trees and urban forests have demonstrated a range of health benefits, through a number of pathways. These are described in the figure below, and expanded upon in this document.

Figure 1: Associations and pathways through which green space benefits health (adapted from James et. al, 2015).[4]



1. Stress Reduction and Mental Health Promotion

Mental health is essential for overall health and well-being and impacts people's ability to enjoy life.[5] Mental health is an issue in our community, with associated pressures. In Ontario, mental illness is more than 1.5 times the burden of all cancers, and seven times the burden of all infectious diseases.[6] Ten percent of Ottawa residents age 19 and over report having been diagnosed with a mood disorder; 9% report an anxiety disorder; 1 in 4 students in grades 7-12 report visiting a mental health professional at least once in the past year, and there were nearly 1,200 emergency room visits due to self harm among Ottawa residents[7].

There is growing evidence that exposure to green space reduces stress, anger, fatigue, sadness, anxiety and increase energy independent of other benefits such as physical activity.[8] Researchers found that surgical patients who had access to nature healed more quickly than those who did not.[9] Living near urban green space can lead more time spent outside and better self-reported mental and physical health. For example, children who are active in nature perform better on tests, and dementia patients exposed to nature were calmer.[10]

2. Increased Physical Activity

Regular physical activity is an important factor in mitigating and preventing chronic diseases and promoting health. Physical activity can be recreational or purposeful, such as walking or cycling to work, school or running errands. In Ottawa only one in four (22%) students (grades 7 to 12) reported meeting physical activity recommendations of 60 minutes per day and close to half of adults (47%) report they are overweight or obese. Additionally, only 19% of students in grades 7-12 in Ottawa use active transportation to get to school whereas 10% of residents us it to get to work.[8] Being active is known to reduced the risks of chronic diseases, including cardiovascular disease, stroke, hypertension, colon cancer, breast cancer, and Type 2 diabetes. It promotes positive self-esteem and helps to prevent overweight and obesity.[11]

Living near urban green space is beneficial to physical activity.[11] Physical activity in natural environments, compared with exercising indoors, has been associated with greater positive feelings.[12] Higher greenness in neighbourhoods was associated with lower odds of children and youth increasing their Body Mass Index scores. A significant association was found between children's weight status and the presence of parks larger than one acre within 800 metres of their homes.[13] There is an emerging practice whereby health practitioners are prescribing "time outdoors" to encourage physical and mental health due to the proven benefits.[14]

Trees contribute to making urban green spaces attractive environments for physical activity. When they are planted along roads they can reduce perceived width and thereby calm traffic which can indirectly promote active transportation as it is perceived as safer.[15]

3. Increased Social Interaction and Cohesion

Social relationships and connections with friends, family, neighbours, and volunteer organizations have a direct association with health. People with fewer social ties have a mortality rate double those with more social ties. Lacks of social connections have been linked to an increase risk for health conditions such as cardiovascular disease, atherosclerosis, high blood pressure, cancer, impaired immune function, reduced mobility, depression and slower recovery times.[16]

Community design that is able to incorporate accessible green space and trees can have a positive impact on creating spaces that encourage social interactions and connections, by making spaces more attractive, cooler, and more beautiful. They foster a sense of place and belonging. [11,17]

Additionally, they can also have the potential to address social disparities. A more even distribution of trees across communities can equalize the benefits from green space and trees. Low income areas may benefit greater from urban green spaces than more affluent neighbourhoods as it provides spaces and opportunities to connect that they otherwise wouldn't have.[18] In more vulnerable neighbourhoods, perceived safety of community green spaces is an important factor to its use.[19] For older adults vulnerable to social isolation, green space has been shown to provide an environment for mental restoration and social connections.[20]

4. Heat and Humidity Regulation

Urban heat island is a term used to describe built-up areas that are hotter than nearby rural areas due to the way human-made surfaces absorb and store heat. The average air temperature of a city in large urban centres, such as Ottawa, can be 1 to 3°C warmer than its surrounding rural areas, and include hot spots that are even warmer. In the evening, as surfaces release their heat into the environment, the air temperature difference can be as high as 12°C.[21] Climate change is expected to exacerbate the urban heat island effect as average temperatures increase. Environment Canada projects that by mid-century, the average number of days per year where the temperature exceeds 30°C in Ottawa will double from the current 22 days per year to over 40 days. In addition, warm night time temperatures will increase fourfold by the end of the century.

Prolonged exposure to high temperatures and humidity for people who are not acclimatized can create heath risks where mitigating resources (air conditioning, cool breezes) are not available. The most vulnerable to extreme heat are young children, people with chronic illnesses, the marginally housed or homeless, isolated seniors, occupational groups that work outdoors, and physically active people.[22] The short term and long term health impacts can include heat cramps, heat exhaustion, and heat stroke, and in extreme cases death. Each year in Ottawa there are approximately 77 emergency room visits that are directly related to the exposure of extreme heat.

The impact of the urban heat islands on human health will increase as the built environment grows and intensifies. Increasing urban forests and trees reduces the impact of urban heat islands because a healthy urban tree canopy protects the urban landscape from rising temperatures. Trees also cool the air by releasing water vapour during their breathing process. Ultimately, trees increase the ability for people to withstand the health effects of extreme heat.

Studies show that urban trees have a superior ability to provide thermal comfort and relief from heat when compared to artificial shade structures or open green spaces. The cooling impact of urban forests and trees is influenced by the ambient temperature, plant type and density, wind and shape.[23] A tree can be a natural air conditioner. The evaporation from a single tree can produce the cooling effect of 10 room size air conditioners operating 20 hours a day.[24]

5. Air Pollution Filtration

With larger Cities and industrialization, humans have created and released chemicals in the air that have decreased the air quality. There are many different types of air pollutants. Some sources of pollution are from household products[25], motor vehicles, industries and forest fires.[26] The most critical pollutants that impact health include particulate matter, ground level ozone, nitrogen dioxides.

This air pollution contaminates both indoor and outdoor environments and can affect health. Some people are at greater risk. These include older adults, children, pregnant woman, people with chronic diseases, and people of lower socio-economic status. Those at risk may develop more severe health effects more quickly when exposed to air pollution. Breathing air pollution can lead to a wide range of health impacts),[27,28] which includes the following:

- tiredness, headache or dizziness,
- more mucous in the nose or throat,
- dry or irritated eyes, nose, throat and skin,
- wheezing, coughing, shortness of breath,
- exacerbation of asthma symptoms, allergies, and chronic obstructive pulmonary disease and other respiratory conditions,
- premature death,
- heart attack, stroke and other cardiovascular diseases,
- Increased risk for certain types of cancers, and
- low birth weight and infant mortality.

In Ottawa, it is estimated that air pollution is responsible for 503 acute premature deaths per year.[29] The Ontario Medical Association estimates that across Ontario, it is responsible for 9,500 deaths per year along with 4,597 hospital admissions, over 39,500 emergency room visits and 262,315 doctors' office visits.

Outdoor air quality is expected to decline with climate change due to higher levels of ground-level ozone and airborne dust (including smoke from wildfires), as well as increased production of pollens and spores by plants, and the burning of fossil fuels.[30]

Trees have varying capacity to capture and/or filter air pollution, depending on the density and species. The leaves from trees clean the air by capturing and filtering the pollution. There is evidence that some tree species contribute small amounts of harmful volatile organic compounds that can contribute air pollutants. Increasing the tree cover in urban areas leads to greater absorption of pollution and helps improve the air quality in urban areas.[31] They are effective at removing ozone, fine particulate matter, nitrogen dioxide, sulphur dioxide and carbon monoxide. Urban trees have also been shown to remove micro pollutants including cadmium, chromium, nickel and lead from the air.[32] Twelve trees will absorb 1.9 tonnes of carbon which is the same amount produced by an SUV travelling 20,000 km.[33] A 10km x 10km area with a 25% tree cover can remove 90.4 tonnes of particulate matter which was estimated to prevent two deaths and two hospitalizations per year.[34]

Computer modeling shows that for each 1% improvement in air quality from tree filtration, there is an associated avoidance of more than 850 deaths and 670,000 incidences of acute respiratory symptoms in the United States.[35]

6. Protection from Ultraviolet Radiation, Wind, Noise and Storm Water Runoff

Prolonged exposure to the sun (UV radiation) induces changes to the skin which can lead to skin cancers.[36] It has been linked to sunburns, premature skin aging, skin cancer, eye problems, and weakening of the immune system.[37] Melanoma skin cancer is one of the fastest rising cancers directly caused by UV radiation and the most serious form of skin cancer. The direct cost of skin cancer in Canada is about $532 million per year.[38] Reducing overall exposure to sunlight is the most important way to prevent skin cancer and other health effects of UV radiation. Communities that are designed

with shade trees provide residents with shelter from the sun and decreases health risks associated with sun exposure.[39]

Additionally, trees are also important to buffering the effects of wind. Increased wind speeds at street level are created in cities when wind becomes accelerated as air hits a building and doesn't have anywhere else to go. This can increase human comfort in the summer months by decreasing the temperature but in the winter months can reduce the temperature by producing a windchill. Planting trees strategically can act as a wind buffer and reduce the air speed at street level.

Trees are also useful tools in mitigating land-use compatibility issues in protecting against noise. Urban environments can foster high levels of background noise that is known to have health impacts (e.g. from traffic). Planting trees close to the noise source reduces noise levels. Trees scatter the sound and the ground absorbs it. Noise reductions between 5 to 8 decibels have been achieved with tree and vegetation planting along roadsides.[40] Wide belts (30 meters) of tall dense trees combined with soft ground surfaces can reduce noise by 50% or more.[41]

Trees and urban forests play an important role in mitigating urban surface water management and runoff. Cities have more paved surfaces and less vegetation and soil to absorb the water. This can lead to more water runoff, and can create flooding conditions that could lead to health concerns and hazards (e.g. poor indoor air quality and structural damage). Urban forests and trees intercept and retain or slow the flow of precipitation reaching the ground. They are an important part of a comprehensive storm water management strategy because they can reduce the rate and volume of storm water runoff, decrease flood damage, reduce storm water treatment costs, and enhance water quality.[42]

Conclusion

Urban forests and access to them are a key component to reducing health risks and maximizing community well-being. Planning communities that incorporate urban trees and forests that are accessible, well maintained and safe provides significant public health benefits. Access to urban trees and forests is not equal among the different socio-economic groups and therefore there is also limited access to their associated health benefits. Exposure to nature helps address the growing burden of mental health and chronic diseases in Ottawa, and help create safe and comfortable conditions for vibrant, socially connected communities.[43] This includes planning for communities with a robust tree canopy network in order to maximize potential health benefits.

Ottawa Public Health Programs and Policies related to Healthy Built Environments and Access to Nature

Ottawa Public Health (OPH) seeks to improve and advocate for health and well-being through advancing health protection and promotion. As part of the Ottawa Public Health Strategic Plan, OPH is committed to contributing to building healthy, complete communities. To help with this OPH developed a framework for addressing health through the built environment. This framework identifies the land use and transportation elements that contribute to creating health-promoting, complete communities. The potential for urban design to have significant impact on health through improving local air and water quality, lessening the impact of extreme weather events and climate change, promoting social cohesion, and lower health inequities is recognized. OPH seeks to build awareness of the health benefits of access to green spaces and trees so that they are valued, promoted, and enhanced.

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Appendix 4 – Stewardship partnership programs

Table A5: Urban forest stewardship partnership programs that can be pursued in Ottawa.

Organization	Program Name	Opportunity in Ottawa	Required Lead and/or Partnerships	Nature of Support
Canadian Tree Fund	Jack Kimmel Grants	Could be pursued in partnership with someone at one of the Universities.	Most suited for an academic lead	Grants for tree planting
Community Foundation of Ottawa	Community Grants Program	Makes grants from the earnings of funds from charitable donations to support a broad variety of initiatives, from health, education and social services, to arts, culture and the environment;	Groups or organizations registered with CRA as a charitable organization	Provides funding for various initiatives including environmental and education. One-year and multi-year grants
Ducks Unlimited		Support for conservation projects mainly associated with wetlands.		Provide cash and/or in-kind resources/ expertise to landowners and groups.
Environment Canada	EcoAction Community Funding Program	City could support or partner with a local non-profit organization to apply for a reforestation / restoration project in any one of a number of identified potential restoration areas on City lands.	Non-profit community group	Program supports projects (including tree establishment and naturalization) that address clean air, clean water, and reducing greenhouse gas emissions that contribute to climate change and nature.

Organization	Program Name	Opportunity in Ottawa	Required Lead and/or Partnerships	Nature of Support
				Grant values are variable.
Evergreen	Toyota Evergreen Learning School Grounds Greening	City could post / provide this information to interested schools, and potentially provide technical support.	Schools	Grants and advisory support for tree establishment and naturalization on school grounds
Ontario Trillium Foundation	Community Program or Province-Wide Program	City could apply for a grant if they are part of a community collaborative that involves at least one eligible organization (i.e., a registered charitable or non-profit organization) and has a clear benefit to the community.	Non-profit or charitable organization	Community Grants Program (up to $15K) or Province-Wide Grants Program (over $15 K; up to about $100 K). A range of urban forest initiatives could be eligible, including assessment and establishment.
Province of Ontario	Great Lakes Guardian Community Fund	Groups could apply for grants to support watershed-based conservations and restoration projects in the Ottawa River watershed, including shoreline and	Not-for-profits First Nations and Métis communities	Provides funding up to $25,000.

Organization	Program Name	Opportunity in Ottawa	Required Lead and/or Partnerships	Nature of Support
		wetland restoration, tree planting etc.		
Tree Canada	TD Green Streets Program	City could obtain funds to for tree planting, inventory, maintenance and educational activities. Wide range of potential activities.	Municipality	Grants of up to $15,000 for successful municipalities (from Tree Canada through TD Friends of the Environment Fund) for tree establishment or research. Requires 50% matching funding from another source.
Tree Canada	Greening Canada's School Grounds	Provides to the selected schools: educational information, technical advice and financial support towards the transformation of their school grounds into environmentally enriched learning landscapes.	Schools	Up to $10,000 value for tree establishment for successful schools. Application form available online.

Organization	Program Name	Opportunity in Ottawa	Required Lead and/or Partnerships	Nature of Support
Tree Canada	Grow Clean Air	Tree Canada estimates the amount of carbon potentially sequestered by the number of trees planted. Useful to businesses who wish to enter their carbon credits on to the Voluntary Challenge Registry.	Industries	Businesses are required to plant and maintain the trees themselves, but are provided with a "Carbon Certificate" at no cost.
Tree Canada	CN EcoConnexions From the Ground Up	In partnership with Tree Canada and Communities in Bloom CN will support projects intended to enhance a community's environmental / social health and well-being. Projects related to urban forestry.	Municipality	Up to $25,000 for environmental projects including tree planting for traffic calming, school greening, transforming spaces, and park naturalization.
Tree Canada	Edible Trees	Provides support for projects that increase equitable access to healthy food, strengthen communities, assists residents in	Community groups	Up to $4,000 to purchase, plant and maintain (for 3-years) fruit trees on public property.

Organization	Program Name	Opportunity in Ottawa	Required Lead and/or Partnerships	Nature of Support
		understanding environmental issues		
TD Bank	TD Friends of the Environment Fund	Funding for various environmental projects including tree planting, environmental education and habitat restoration.	Municipality or schools	Grants for various environmental projects, including urban forest outreach and education, tree establishment and naturalization.

Appendix 5 – Recommendation summary

Table A5.1: Summary of Recommendations, *Putting Down Roots for the Future: City of Ottawa Urban Forest Management Plan (2018-2037).*

#	Recommendation	Management Period	Objectives [10]	Criteria [11]	Leads [12]	Time	Prereq. [13]	Resources [14]
Urban Forest Management Plan program structure and administration								
1 [15]	Undertake active adaptive management through a formal Urban Forest Management Plan review process	All five management periods (2018-2037)	All UFMP objectives	All Criteria	NSEP	2 mos., every 4 years	2	Existing
2	Establish an Internal (Interdepartmental) and External (Interagency) Urban Forestry Working Group	1st – (2018-2021)	All UFMP objectives	C1, C7	NSEP	-	-	Existing
3	Develop an urban forest inventory collection and maintenance plan	1st – (2018-2021)	3,4,7	V5, V7, C5, M1, M16	FMU	Ongoing	-	Additional (consulting $ and staffing)
4	Undertake comprehensive urban forest canopy study and develop tree planting prioritization tool	1st – (2018-2021)	1,2,3,4,5,7	V1, M3, M7, M8, M16	NSEP	1 yr.	-	Additional (secured)
5	Integrate urban forest resources in the City's Asset Management Program	All five management periods (2018-2037)		V1, M16	NSEP / FMU	Ongoing	4	Existing (based on #3) / *Additional* [16]
Planning for the urban forest								
6	Improve implementation of the Official Plan policies through internal outreach and engagement	All five management periods (2018-2037)	1,2,4	M11, M12	NSEP	Ongoing	-	Existing
7	Update significant woodland policies in the urban area	1st – (2018-2021)	1,2	M12	NSEP	2 yrs.	-	Existing
8	Review and update the City's tree by-laws	1st – (2018-2021)	1,2,4	V5, V7, M11, M12	NSEP / FMU	1-2 yrs.	-	Existing / *Additional*

[10] Refer to Section 3.4.1. of the Plan for Objectives.
[11] Refer to Appendix 2 for complete list of Criteria and Indicators.
[12] NSEP – Natural Systems and Environmental Protection; FMU – Forest Management Unit
[13] Prerequisite Recommendation. Even if no prerequisite Recommendation is specified, implementation of the Recommendation may benefit or be supported by other ongoing initiatives or recommended Recommendations. Refer to Section 5 of the Plan for more information. *TI* denotes that Recommendation should be implemented upon completion of, or will be supported by, the street and park tree inventory (an ongoing City initiative).
[14] Identifies whether existing resources will be allocated or if additional resources are required to implement the Recommendation. "Existing/Additional" denotes existing resources are to be allocated for review, investigation, development, etc., and additional resources are required for implementation.
[15] The Recommendations to be completed within the first management period are shaded in grey.
[16] "*Additional*" (in italics) indicates that additional resources may be required for implementation of a given recommendation.

#	Recommendation	Management Period	Objectives [10]	Criteria[11]	Leads[12]	Time	Prereq.[13]	Resources[14]
9	Develop new and update and consolidate existing guidelines, standards and specifications for tree planting and establishment	1st – (2018-2021)	1,2,5	M7, M8	FMU / NSEP	2 yrs.	-	*Additional*
10	Improve outreach, enforcement and monitoring of the City's urban forest policies and by-laws	2nd – (2022-2025)	1,2,3,4,7	V7, M11	NSEP / FMU	Ongoing	-	*Additional*
Maintaining and growing the urban forest								
11	Improve process for assumption of trees planted in new developments	1st – (2018-2021)	1,2,5	V5, M9, M10	FMU	Ongoing	-	Existing
12	Develop a Forested Areas Maintenance Strategy (FAMS)	1st – (2018-2021)	1,5,6,7	V6, M10, M12	FMU	1 yr.	-	Existing/ *Additional*
13	Review City tree planting programs	1st – (2018-2021)	1,2	M8	FMU	Ongoing	-	*Additional*
14	Develop city-wide tree compensation guidelines	1st – (2018-2021)	1,2,5,7	M7, M11, M12	NSEP	1 yr.	-	Existing
15	Review the 7-year tree lifecycle maintenance program in the urban area	2nd – (2022-2025)	6,7	V5, M9, M10	FMU	1 mo./ ongoing	*TI*	Existing/ *Additional*
16	Assess maintenance levels of service for newly planted street and park trees	2nd – (2022-2025)	5,6,7	V5, M7, M9, M10	FMU	Ongoing	*TI*	*Additional*
17	Develop an urban tree product utilization strategy	2nd – (2022-2025)	1,4	M15	FMU	6 mos.	-	Existing
18	Enhance tree risk management for City-managed trees	2nd – (2022-2025)	3,6,7	V5, M9, M10, M13	FMU	6 mos.	*TI*	Additional
19	Develop city-wide urban forest pest and disease management strategy	2nd – (2022-2025)	1,5,6,7	V3, V6, M9, M13, M14	FMU / NSEP	1.5 yrs.	-	Existing/ *Additional*
20	Develop neighborhood-level planting plans	2nd – (2022-2025)	1,2,5,7	V1, V2, V3, V4, M7, M8	FMU	Ongoing	4, *TI*	Existing/ Additional
21	Develop tree nursery stock growing contracts	2nd – (2022-2025)	1,2,5	V3, V4, M7	FMU	Ongoing	-	Existing
Urban forest outreach, education and stewardship								
22	Expand community engagement, public education and marketing of urban forestry	1st – (2018-2021)	1,2,3,4	C5, C6	FMU	Ongoing	-	Additional - staffing

#	Recommendation	Management Period	Objectives [10]	Criteria[11]	Leads[12]	Time	Prereq.[13]	Resources[14]
23	Develop and implement an urban forest outreach and engagement strategy	1st – (2018-2021)	1,2,3,4	C2, C4, C5, C6	FMU	1 yr./ ongoing	22	Existing (based on #22)
24	Identify and formalize incentives for encouraging tree conservation and tree establishment	1st – (2018-2021)	1,2,4,7	M7	NSEP	2 yrs.	-	Existing
25	Promote and facilitate the development and implementation of Neighbourhood Stewardship Plans	2nd – (2022-2025)	1,2,3,4	C5	FMU	Ongoing	-	Existing (based on #22)
26	Expand outreach to tree care and landscaping industries and large private and institutional landowners in the Ottawa area	2nd – (2022-2025)	2,3,4	C2, C4	FMU	1 yr.	-	Existing (based on #22)