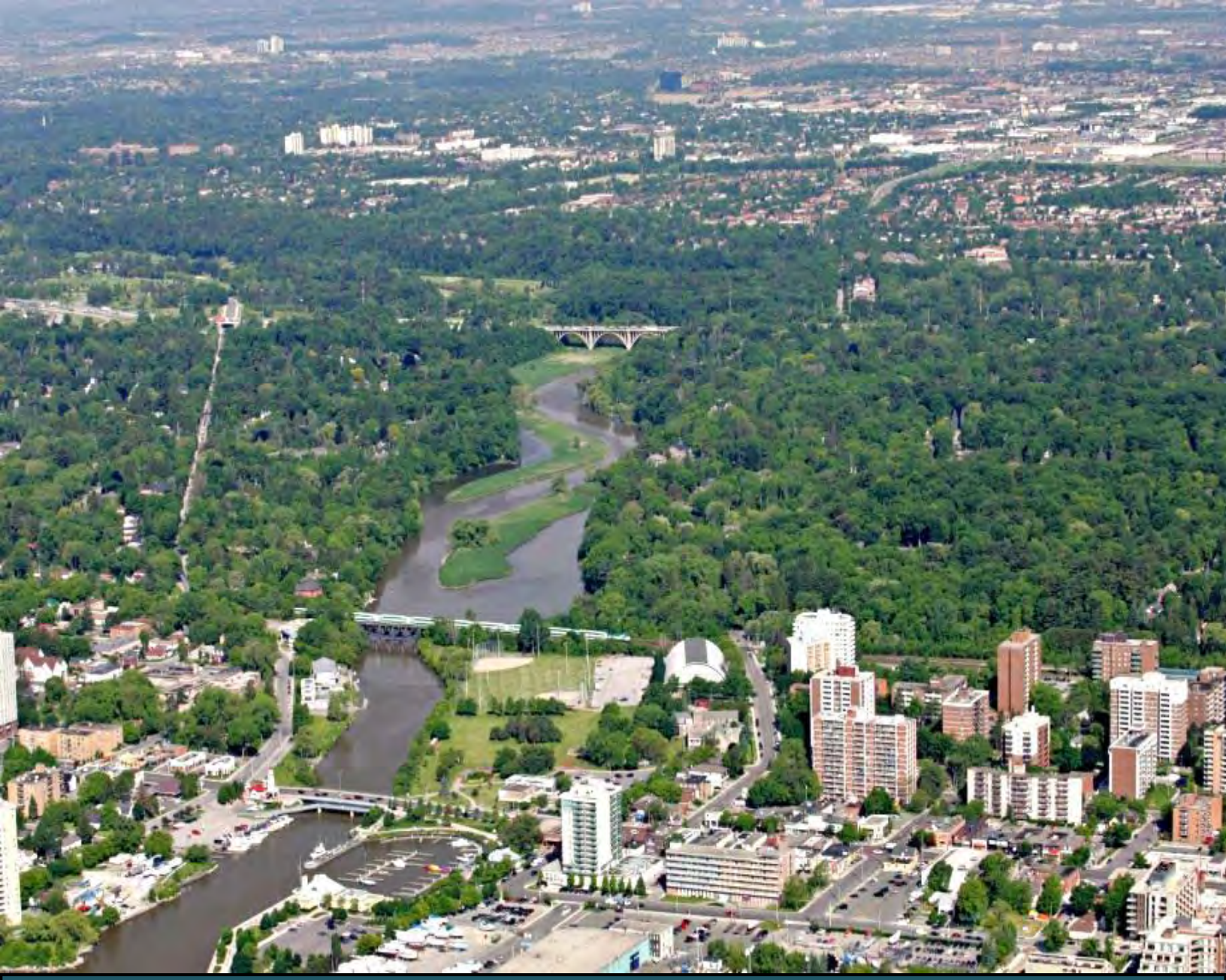

PEEL REGION URBAN FOREST STRATEGY

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ACKNOWLEDGEMENTS

The Peel Region Urban Forest Strategy has been prepared in partnership by the Toronto and Region Conservation Authority (TRCA), the Region of Peel, Credit Valley Conservation (CVC), City of Mississauga, City of Brampton and Town of Caledon. Appreciation and thanks are extended to the following members of the Technical Working Group:

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Cover Photo Credit: Credit Valley Conservation

Reference: TRCA, 2011. Peel Region Urban Forest Strategy.

EXECUTIVE SUMMARY

Introduction

The Peel Region Urban Forest Strategy has been prepared in partnership by the Toronto and Region Conservation Authority (TRCA), the Region of Peel, Credit Valley Conservation (CVC), City of Mississauga, City of Brampton and Town of Caledon. These partners have provided funding, as well as expertise and direction through their involvement in a technical working group. The Peel Region Urban Forest Strategy has been developed in part from the outcomes of a stakeholder consultation workshop held in November 2010. The workshop was central to building regional consensus and gaining a broad commitment to the implementation of the Strategy.

The urban forest in Peel includes all trees, shrubs and understory plants, as well as the soils that sustain them, located on public and private property. The purpose of the Strategy is to provide the framework and strategic direction for the protection and enhancement of the urban forest, as natural infrastructure. The Strategy presents the vision, goals and actions required to guide and engage individuals and organizations in urban forest management, and to ultimately contribute to a healthier, more sustainable Peel Region.

Peel Region's Urban Forest Today

Vegetation Resource Assessment

The results of the urban forest studies conducted in the municipalities of Mississauga, Brampton and Caledon have been summarized here at a regional scale. These studies utilized the i-Tree software suite of tools offered by the United States Department of Agriculture (USDA) Forest Service. The results of these studies are presented in detail in the Technical Reports provided for each area municipality.

MEASURE	RESULT	COMMENT
Canopy Cover	• Brampton: 11 % • Caledon East: 29 % • Bolton: 17 % • Mississauga: 15 %	45% of Peel Region's urban canopy cover is located on residential property; residents are therefore the most influential stewards of urban forest.
Leaf Area Density (m2/ m2)	• Mississauga: 0.78 • Brampton: 0.54 • Caledon East: 2.7 • Bolton: 0.8	There is a positive relationship between leaf area density and the volume of benefits provided to residents (more leaves = more benefits).
Tree Size	Over 70 percent of all trees measured are small (less than 15 cm in stem diameter).	Environmental, social and economic benefits increase with tree size.
Species Composition	Maple and ash species dominate the urban forest; a number of exotic invasive plant species are also common.	Greater species diversity will decrease the risk of large scale forest loss in the event of disease and pest outbreaks.

MEASURE	RESULT	COMMENT
Energy Savings	Energy savings of over $2.5 million annually to residents through shading in summer and acting as wind breaks in winter.	A greater number of mature trees and proper tree placement around residential buildings will provide even greater energy savings.
Carbon	19,000 tonnes of carbon sequestered and 400,000 tonnes of carbon stored annually by urban trees in Peel Region.	The urban forest plays an important role in both local and global climate change mitigation and adaptation.
Pollution	890 tonnes of air pollution removed annually by urban trees in Peel Region; total removal value is approximately $9.5 million.	The urban forest provides human health benefits and health care savings by reducing local air pollution.

Resource Management Approach

The existing policy framework that governs the urban forest is largely created and applied at the Area Municipal scale. Supporting policies and programs, particularly through Natural Heritage Systems management, are provided by Conservation Authorities and the Region of Peel. Recognizing that large, mature trees are underrepresented in the urban forest, additional policy tools are needed to ensure that trees are protected and maintained so that each tree will grow to reach maturity and provide greater benefits to the community.

The federal government is involved narrowly in urban forest management through the regulation and management of invasive insect pests (e.g. Asian longhorned beetle). Although provincial land use and planning policy strongly influences the health and distribution of the urban forest in Peel Region, the provincial government is not yet actively involved in urban forest management and does not provide clear direction to municipalities for urban forest conservation. By taking a leadership role in the management of this resource, the upper levels of government have the opportunity to build healthier, stronger communities.

Community Framework Assessment

An effective approach to urban forest stewardship must include programs that target both students, as the future stewards of this resource, and adults, as the primary land owners and managers. Students across the region currently have multiple opportunities to become engaged in broad conservation initiatives through the existing curriculum-based programs in schools. However, a specific focus on urban forest conservation has not yet been developed.

Assistance to residents for tree selection, planting and maintenance on private property is a notable gap in the outreach and stewardship currently offered across the region. Thus, a backyard tree planting program, such as that offered by LEAF in City of Toronto and York Region, has the potential to increase tree cover and associated benefits across Peel.

Peel Region's Urban Forest Tomorrow

The strategic vision describes the future urban forest that managers and partners in Peel Region are striving to achieve. Six principles have been developed to guide all partners in achieving this vision.

Strategic Vision

Our vision is for a healthy and resilient urban forest that provides diverse and sustained benefits to all and is grown from a shared commitment by all members of the community to the stewardship and care of this vital infrastructure.

Guiding Principles

PRINCIPLE 1: A sustainable urban forest promotes quality of life, human health and longevity.

PRINCIPLE 2: Residents of Peel Region are the most important and influential stewards of the urban forest.

PRINCIPLE 3: All residents should have the opportunity and means to benefit equally from the ecosystem services provided by the urban forest.

PRINCIPLE 4: Improved communication and coordinated action will result in a more informed, streamlined, and effective approach to urban forest management.

PRINCIPLE 5: The urban forest, as natural infrastructure, requires long-term, stable funding.

PRINCIPLE 6: Municipal Governments should lead by example.

Photo Credit: Toronto and Region Conservation Authority

Strategic Goals and Actions

Eight strategic goals have been established in the Strategy to facilitate a coordinated and consistent regional approach to sustainable urban forest management. The strategic goals and associated actions are presented in the following table as an abbreviated summary. The complete strategic framework, including lead roles, partners, and time frames, is presented in Part 2 of the Strategy.

STRATEGIC GOAL	ACTION
Goal 1: Facilitate partnerships and coordinate action across Peel Region	a. Develop and lead an interagency Urban Forest Working Group that will build focus and consistency across departments and agencies.
	b. Develop annual work plans for the purpose of achieving the goals outlined in the Strategy.
	c. Conduct a comprehensive review of the Strategy at regular five year intervals.
Goal 2: Develop urban forest targets	a. Develop regional and area municipal urban forest targets.
Goal 3: Develop and implement urban forest management plans	a. Develop and implement comprehensive Urban Forest Management Plans that fully addresses the operational actions and resources required to achieve a healthy and resilient urban forest.
	b. Review and update Management Plans at regular five year intervals.
Goal 4: Create a comprehensive urban forest policy framework	a. Integrate the strategic goals identified in the Strategy and targets, once defined, into Regional and Area Municipal Official Plans to recognize the contribution of the urban forest to local quality of life.
	b. Integrate the goals identified in the Strategy, as well as targets and directions from Urban Forest Management plans into public initiatives.
	c. Develop new municipal standards and guidelines for sustainable streetscape and subdivision design.
Goal 5: Gain formal support from upper levels of government for sustainable management of the urban forest as natural infrastructure	a. Encourage the Association of Municipalities of Ontario (AMO) and the Federation of Canadian Municipalities (FCM) to approach provincial and federal agencies to provide stronger support and direction for urban forest policies, programs and initiatives.
	b. Engage the Provincial and Federal Governments to provide funding for urban forest research and development.
	c. Engage the Provincial Government to provide policy direction within the Planning Act as well as guidance to support a healthy urban forest for the full range of ecosystem services it provides to the community.
Goal 6: Implement effective monitoring and research programs	a. Monitor the structure, distribution and function of the urban forest using the methods and parameters applied in the baseline assessments conducted in 2008 for each area municipality in Peel Region.
	b. Report on status and trends publically in order build and retain public support for urban forest conservation.
	c. Identify critical research questions and information gaps that must be addressed in order to manage the urban forest effectively and mitigate the threats and impacts to this resource.
	d. Identify potential research partners and explore new means of building connections among researchers, practitioners and community members.
	e. Identify new techniques and technologies through on-going communication with local, national and international research facilities and professional organizations with an urban forest mandate.
Goal 7: Secure long-term funding for urban forest management	a. Develop a business case for the urban forest as natural infrastructure to secure funding and support from all levels of government.
	b. Research funding opportunities and partnerships.
	c. Develop an incentive program for tree planting and establishment on private property.

STRATEGIC GOAL	ACTION
Goal 8: Provide comprehensive training, education, and support for residents and members of the public and private sector	a. Conduct a detailed assessment of opportunities to enhance urban forest stewardship through public outreach programs.
	b. Facilitate training, education and professional development for all public sector staff.
	c. Identify and pursue opportunities to build and expand partnerships with business owners and industry members for the purpose of increasing tree cover and improving tree health in the commercial and industrial areas of Peel.
	d. Identify and pursue opportunities to work with Landscape Ontario to increase awareness among members of the horticultural and landscaping industry of threats, trends and new research in urban forestry.
	e. Engage hospitals, universities and colleges in Peel in urban forest management.
	f. Work collaboratively with School Boards to increase tree cover on school grounds.

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PART 1: Peel Region's Urban Forest Today

INTRODUCTION

Peel Region is located on the shore of Lake Ontario where forests and wetlands historically regulated water quality and quantity, air quality and local climate. Today communities in the Peel rely on the urban forest for the provision of these **ecosystem services**. The urban forest is essential "**natural infrastructure**" that can mitigate both global climate change and the local **urban heat island effect**, improve local air quality, reduce the speed and volume of stormwater runoff, decrease residential energy costs, increase property values, provide habitat for local wildlife, increase the life span of **grey infrastructure**, and contribute to a safer, more relaxing and aesthetically pleasing urban environment. Extending from street trees to forest ravines, the urban forest contributes directly to environmental, social and economic health in Peel.

Benefits provided by the urban forest:

- Air pollution removal
- Ultra-violet radiation protection
- Lower summer temperatures
- Energy savings for residents
- Carbon sequestration and storage
- Safe, walkable communities
- Stronger social connections
- Stormwater management
- Higher property values
- Habitat for local and migratory wildlife
- Stress reduction and mental health benefits
- Recreation opportunities
- Noise reduction
- Beautiful communities

The Peel Region Urban Forest Strategy is a companion document to the Urban Forest Study Technical Reports provided for Mississauga, Brampton and Caledon. Both the Strategy and the Urban Forest Studies are initiatives of the Region of Peel; project management has been led by Toronto and Region Conservation Authority (TRCA). A Technical Working Group consisting of staff from Credit Valley Conservation (CVC), TRCA, the Region of Peel, and the Area Municipalities of Mississauga, Brampton and Caledon has provided funding, guidance and expertise throughout all stages of study design, analysis and review.

The purpose of the Strategy is to provide the strategic direction for the long-term protection and enhancement of the urban forest, as natural infrastructure, in Peel Region. The Strategy presents the vision, goals, and actions required to guide and engage individuals and organizations in sustainable urban forest management.

The objectives of the Peel Region Urban Forest Strategy are to:

- Support the development of policies and programs needed to protect urban trees and soils;
- Enhance community engagement and foster effective stewardship of the urban forest;
- Foster effective communication, collaboration, and research across departments and organizations; and
- Improve the long-term flow of ecosystem services to the community in order to promote human health and longevity.

What is the *urban forest*?

Peel Region's urban forest is a dynamic system that includes all trees, shrubs and understory plants, as well as the soils that sustain them, located on public and private property. It is a diverse mix of ***intensively*** managed trees located in the urban landscapes of the Region as well as ***extensively*** managed natural areas stretching along valley corridors and upland forests.

For management purposes the urban forest can be grouped into two broad categories:

- Intensively managed urban forest – where the unit of management is the individual trees and standard arboricultural practices are applied (i.e. street trees)
- Extensively managed urban forest – where the unit of management is the forest stand or vegetation community and landscape ecology or silvicultural practices are applied (i.e. woodlands and natural areas)

CHALLENGES AND THREATS

Urban forests are strongly influenced by the urbanized landscape in which they grow. In contrast with the forests and natural areas found in the more remote regions of Canada, urban forests require active human intervention to persist and thrive; **natural regeneration** alone cannot meet the goal of maintaining net benefits over time. In the absence of proactive management, the urban forest in Peel Region will deteriorate and decline. Consequently, many of the benefits provided by the urban forest will also be restricted. Through effective stewardship of the urban forest, municipalities and partners can protect and enhance these benefits and simultaneously address multiple sustainability objectives, including those pertaining to air quality, water quality, and **climate change mitigation and adaptation**. Meeting these objectives through urban forest management will be fiscally responsible and will result in healthier, more livable communities. Please see Appendix A for a more comprehensive review of the benefits provided by the urban forest.

The increase in housing density and associated infrastructure required to support projected population growth in the region creates challenges for urban forest managers. Competing demands for limited growing space forces managers to rely on creative solutions for tree habitat in order to grow and sustain trees in small spaces. Restricted root zones, degraded soils, and limited overhead growing space prevents urban trees from reaching their full genetic size potential and frequently leads to early mortality or removal. Therefore, strategic direction is needed to effectively include urban forest considerations at all scales of urban planning to ensure that the residents of Peel will have equitable and sustained access to the benefits provided by the urban forest.

Invasive insect pests such as the emerald ash borer and the Asian longhorned beetle pose a serious threat to the health of urban forests as no natural controls have developed to regulate these non-native species. Consequently, infestations commonly result in a substantial loss of leaf area and associated ecological services, an increase in municipal maintenance costs, a loss of species diversity, and a shift to a younger age class distribution.

The presence of invasive plant species may increase vegetative cover in the short term by colonizing the understory of forested areas, parks, yards, and open spaces. However, in the long term invasive plants will restrict the regeneration of native species that grow to a large size at maturity, such as red oak and sugar maple, thereby reducing total **leaf area density** and **canopy cover**.

Global climate change and the urban heat island effect will continue to increase the complexity of sustainable urban forest management. The urban forest, already under severe stress in the urban environment, will likely become more vulnerable to emerging stressors under future climate scenarios. Such stressors may include drought, higher temperatures, invasive pests, and salt damage caused by more frequent salt applications in winter months.

OPPORTUNITIES

Collaborative Strategy Development

The Peel Region Urban Forest Strategy has been developed from the outcome of a stakeholder consultation workshop held in November 2010. Please see Appendix B for a summary of the workshop. The consultation process was critical to ensuring that a diversity of perspectives was incorporated into the Strategy, and assisted in forming a constituency around the implementation of the Strategy that spanned across departments and organizations. Attendees included municipal planners, arborists, foresters and public health professionals, as well as representatives from school boards, community interest groups, and the development industry. At the workshop, stakeholders were given the task of identifying the key elements necessary to create a vision for a sustainable urban forest in Peel Region and with prioritizing the actions needed in the short-term to build the foundation for management of the urban forest over the next 30 years and beyond.

The Strategy has also been informed by the collaborative urban forest work that has been conducted across the Greater Toronto Area (GTA). In April 2007, TRCA coordinated the meeting of key stakeholders from across southern Ontario to explore the possibility of using compatible methodologies for urban forest studies in the GTA and beyond. Consequently, TRCA, CVC, the Regional Municipalities of Peel and York, Cities of Toronto, Mississauga, Brampton, Vaughan and Pickering, and the Towns of Markham, Richmond Hill, Ajax and Caledon, all became part of an informal working group that agreed to move forward with urban forest studies using standardized methods of data collection and analysis.

To date, TRCA has coordinated studies for the municipalities of Mississauga, Brampton, Caledon, Vaughan, Markham, Richmond Hill, Pickering and Ajax (Figure 1). The City of Toronto led its own concurrent urban forest study using the same methodology and tools. The range of expertise and knowledge utilized in this working group ensured that multiple viewpoints were represented in discussions of sustainable urban forest management. It also magnified opportunities for cooperation on urban forest management at larger scales (e.g. GTA, provincial and national).

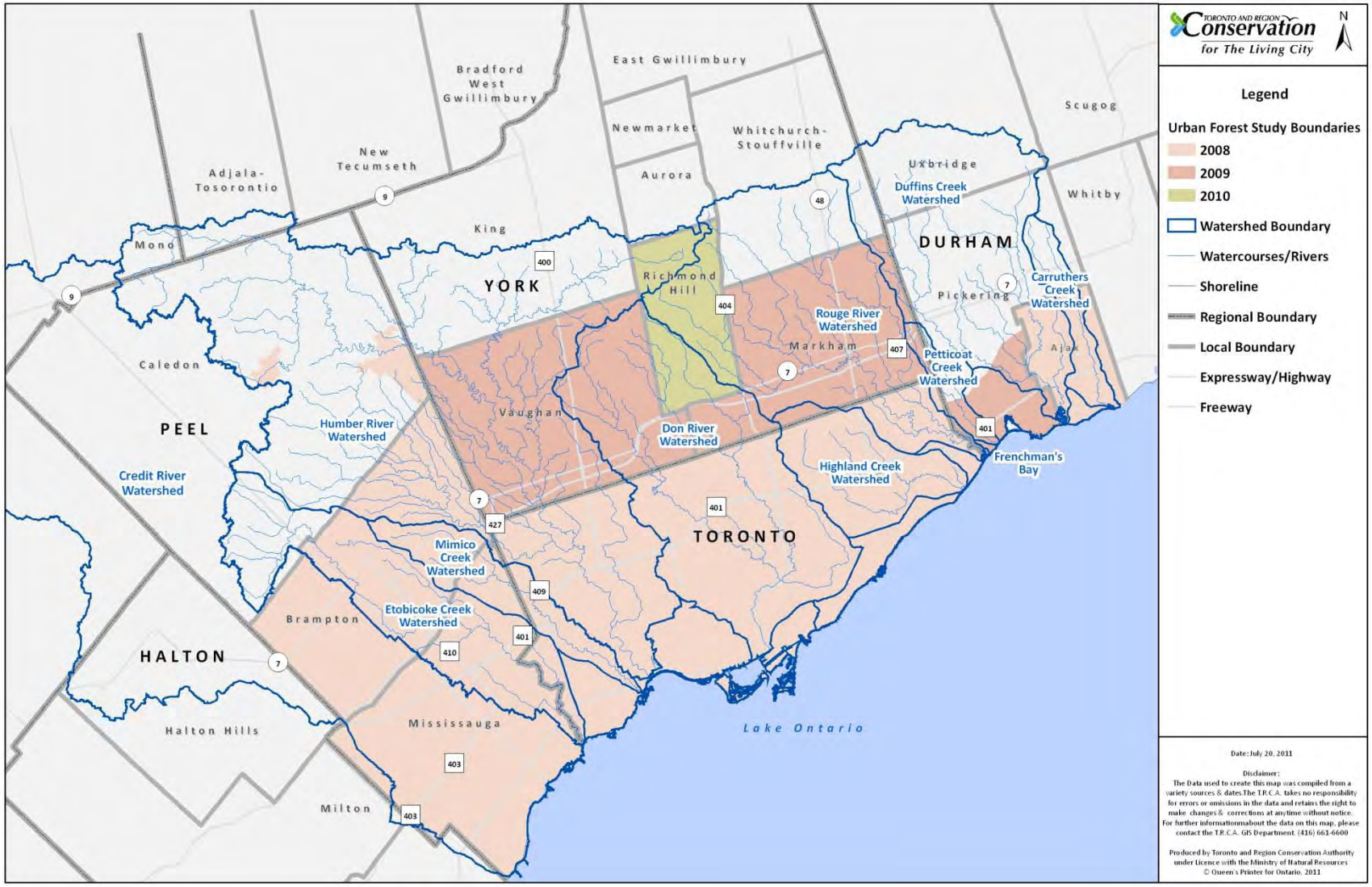


Figure 1: Municipalities in the Greater Toronto Area engaged in collaborative urban forest studies

Opportunities for Action

At a stakeholders workshop held in November 2010, participants highlighted several opportunities through which action can be taken to advance the urban forest agenda. Those opportunities, summarized here, informed the development of goals and actions in Part 2: Peel Region's Urban Forest Tomorrow.

In parts of the region, the grey infrastructure is aging and is in need of repair. Urban forest enhancements can be incorporated directly into capital works projects and other infrastructure maintenance as a means to address multiple objectives and minimize retrofits costs.

There is increasing support demonstrated for urban forest conservation in Regional and Municipal Official Plans. Residents of Peel Region have also expressed a desire to steward the urban forest; however, direction is needed. In addition, many new Canadians must now be introduced to the urban forest. Stronger connections are being made between the urban forest and community health. As a result, new opportunities to partner with public health organizations are emerging.

Urban forest conservation and management is gaining recognition as a cost effective strategy for climate change mitigation and adaptation. For example, the urban forest cool communities and provides relief during extreme heat events, while also decreasing flood intensity and controlling soil erosion associated with increased annual precipitation. The urban forest can also play a role in global climate change mitigation by sequestering and storing carbon. In addition, trees and shrubs adjacent to residential buildings reduce carbon emission from power plants by reducing the demand for heating and cooling. Taken together, the many complimentary benefits of the urban forest indicate that it is a very wise, low-risk investment; it is an investment that will appreciate in value over time as trees grow.

The urban forest studies conducted in Peel Region have characterized the current status of the urban forest; from this information a vision for the future can now be determined. Tools are now available that facilitate the quantification of ecosystem services, including cost / benefit analyses of the multiple services provided to communities. This evolving research begins to answer many questions being asked by politicians and the public, helps managers focus resources and target outreach, and enables urban development practices to be environmentally proactive.

EXISTING CONDITIONS

This section provides an assessment of the current state of the urban forest in Peel Region. The discussion of existing conditions is organized according to the three primary themes used in the model of urban forest sustainability developed by Clark *et al.* (1997):

> **THEME 1**: Vegetation Resource - the trees, shrubs, and relevant **biotic and abiotic elements** that form the urban forest.
> **THEME 2**: Resource Management Approach - the policy, planning and resources that affect, or are affected by, the urban forest.
> **THEME 3**: Community Framework - the manner in which residents are engaged in planning and caring for trees.

This model of urban forest sustainability also provides a list of criteria and associated indicators for the evaluation of the aforementioned elements of urban forest management. Kenney *et al.* (2011) expanded on this model to produce a more detailed set of criteria and measurable indicators. Please see Appendix C for a summary of the criteria, indicators and management objectives offered for each of the three themes listed above.

THEME 1: Vegetation Resource Assessment

The results of the urban forest studies conducted for the municipalities of Mississauga, Brampton and Caledon have been summarized here at a regional scale. These studies utilized the i-Tree software suite of tools offered by the United States Department of Agriculture (USDA) Forest Service to quantify the distribution, structure and function of the urban forest in Peel. The results of these studies are presented and discussed in a more comprehensive manner in the Urban Forest Study Technical Reports provided for each area municipality in Peel Region. The results provide important baseline information for future monitoring and will be used in the development of management plans.

Note: In Caledon the study area included only the urbanized communities of Caledon East and Bolton. The rural areas of the municipality were not characterized in analysis. The municipal boundaries of Mississauga and Brampton were used to define each respective study area. Study results have been derived from a sample of the entire land area within the study boundaries, and subsequently include estimates for both planted and natural forest cover on public and private property.

Urban Forest Distribution

The distribution and structure of the urban forest is strongly influenced by land use. Across all study areas, the largest proportion of existing tree cover (described as **Existing TC**) is located in the residential land use category, indicating that homeowners and tenants in Peel Region are the most important stewards of the urban forest (Figure 2). The greatest opportunity to establish additional tree cover is found in the residential land use (described as **Possible TC**).

Existing tree cover is highest in Caledon East (29 percent), followed by Bolton (17 percent) and Mississauga (15 percent). Tree cover is comparatively low in Brampton (11 percent). The Brampton study area supports the highest proportion of commercial and industrial land in the Region, in addition to a large total area of agricultural land; this land use pattern therefore influences the amount and distribution of tree cover in the municipality. Across all study areas tree cover is low in the commercial and industrial land uses (Figure 3). These land uses are typically dominated by **impervious cover**, which creates stormwater management challenges and exacerbates the urban heat island effect in the Region. Increasing tree cover in these land uses will reduce runoff during storm events and will reduce surface temperatures and subsequent heat transfer (please see Box 1 for a discussion of the urban heat island effect).

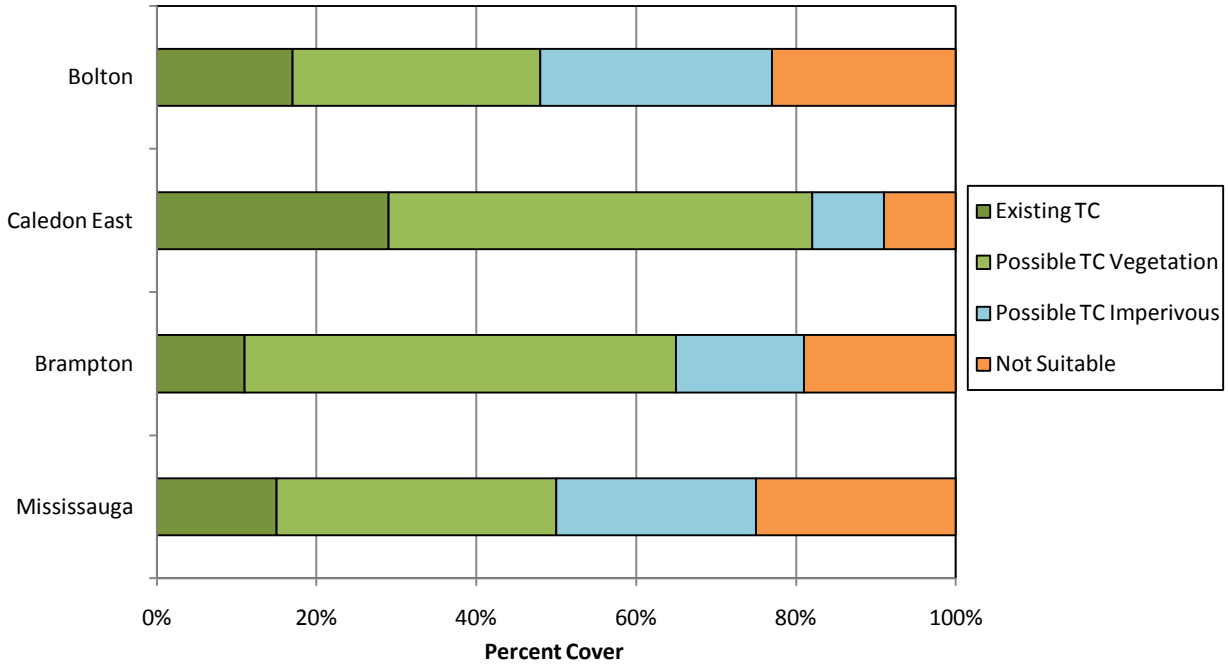


Figure 2: Existing and possible tree cover estimates for Mississauga, Brampton, Caledon East, and Bolton.

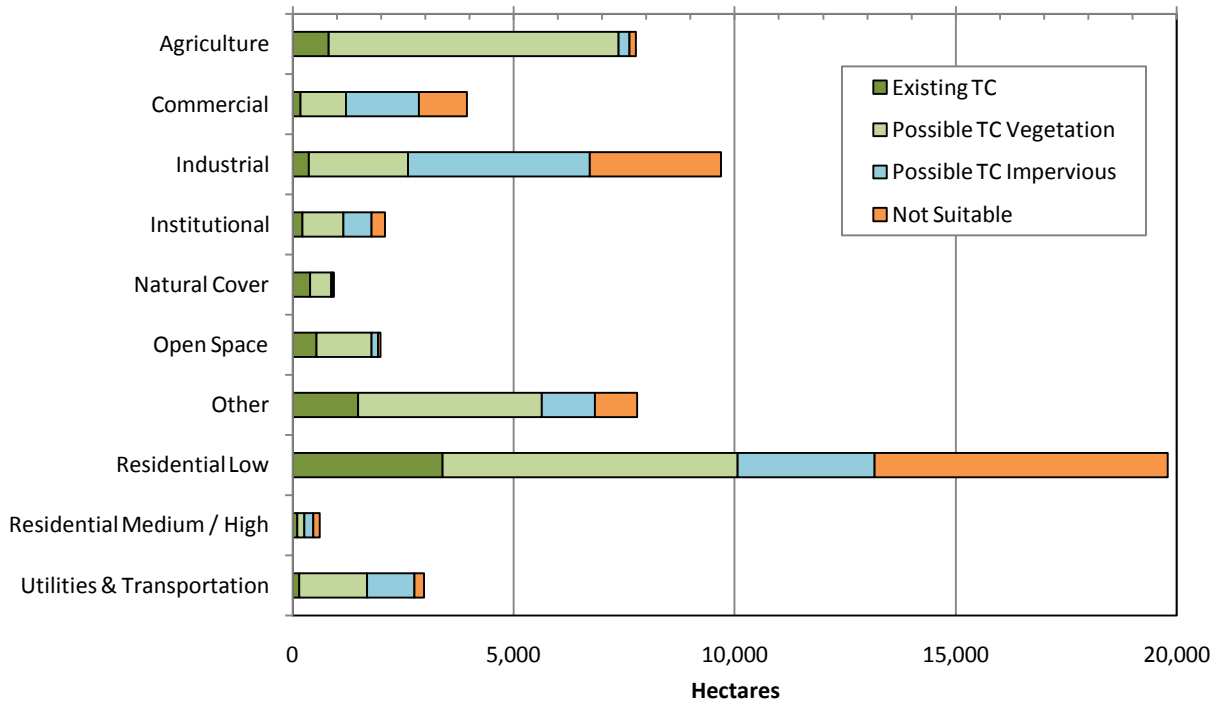


Figure 3: Aggregated tree canopy metrics for Mississauga, Brampton, Caledon East and Bolton, summarized by land use.

Tree cover has also been summarized by **service delivery areas,** as defined by the Region of Peel, to provide a neighbourhood scale analysis (Figure 4). Existing tree cover is highest in the older, well-

established neighbourhoods of southern Mississauga (indicated in dark green), while tree cover is lowest in the industrial areas located in the northeast portions of Mississauga and Brampton. Figure 5 illustrates existing and possible tree cover summarized by subwatershed boundaries.

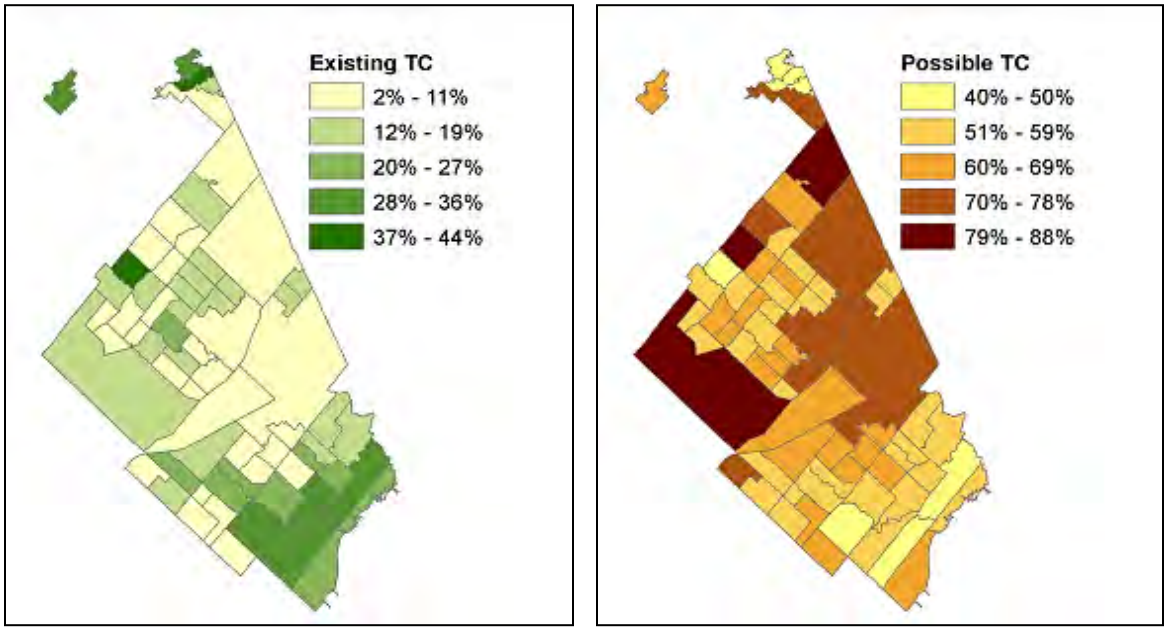


Figure 4: Existing (left) and possible (right) tree cover metrics summarized by service delivery areas in the Mississauga, Brampton, Caledon East and Bolton study areas.

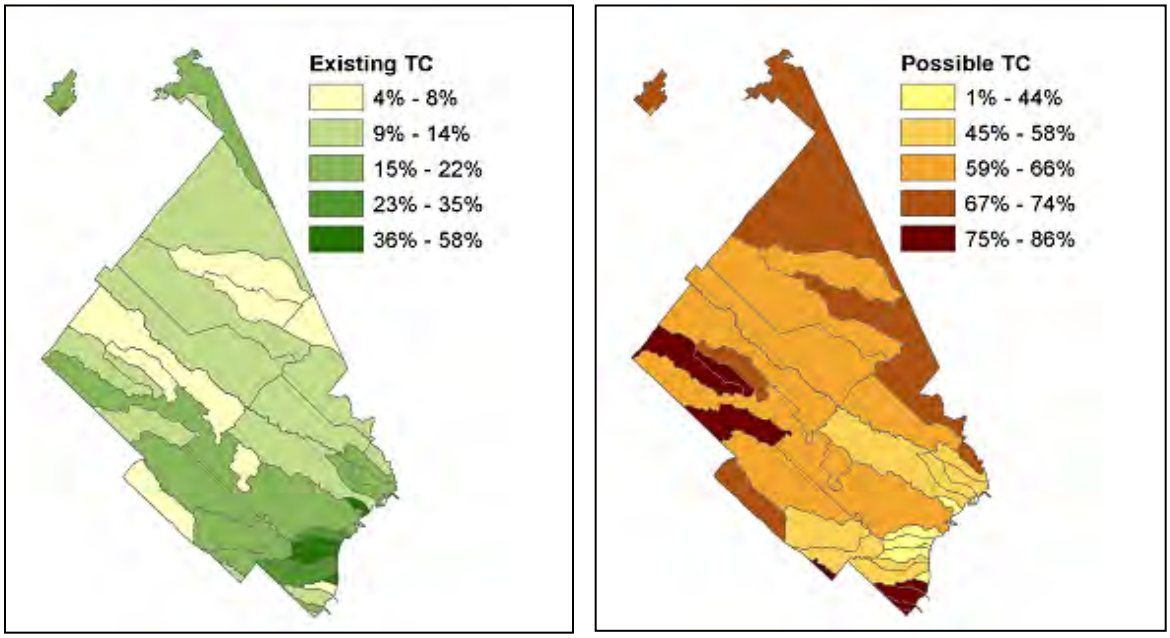


Figure 5: Existing (left and possible (right) tree cover metrics summarized by subwatershed in the Mississauga, Brampton, Caledon East and Bolton study areas.

Figure 6 provides a comparison of existing tree cover in the Peel study areas to other cities in North America. Broader comparisons are limited due to non-standardized approaches to generating tree cover metrics (e.g. aerial photo interpretation vs. satellite imagery).

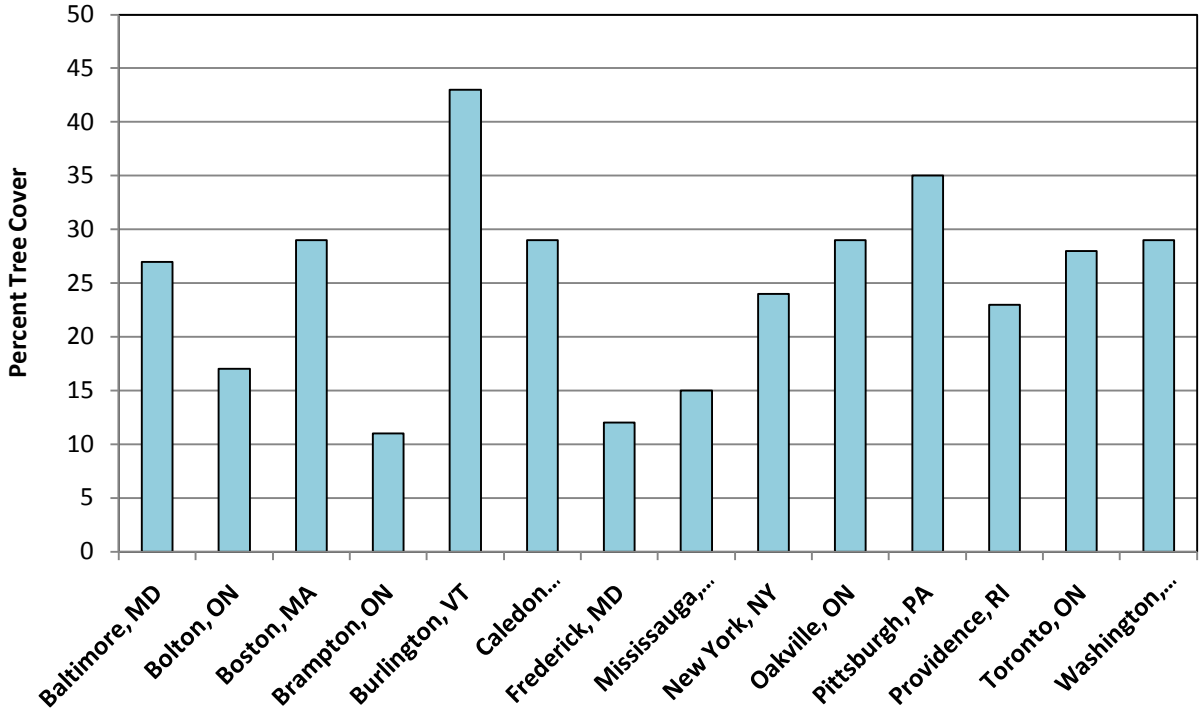


Figure 6: Tree cover estimates generated from satellite imagery for North American cities.

Urban Forest Structure

Urban forest structure was quantified using the i-Tree Eco model. The model relied on local field data collected from sample plots across each of the study areas. Measure of urban forest structure includes leaf area density, tree density, species composition, and tree condition.

Leaf area density is highest in the community of Caledon East and lowest in the City of Brampton (Table 1). Leaf area density also varies widely between land uses and is generally highest in natural areas (e.g. parks, woodlands, and ravines) and lowest in the industrial and commercial areas of Peel Region.

Table 1: Total leaf area and leaf area density in the Mississauga, Brampton, Caledon East and Bolton study areas.

Municipality	Total Leaf Area (km^2)	Study Area (km^2)	Leaf Area Density
Mississauga	223.8	288.0	0.78
Brampton	145.2	269.5	0.54
Caledon East	13.1	4.8	2.74
Bolton	13.5	16.8	0.80

Common species in Peel Region included maple species (*Acer saccharum, A. saccharinum, A. platanoides, A. negundo*), ash species (*Fraxinus americana, F. pennsylvanica, F. nigra*), and spruce species (*Picea abies, P. pungens*). Figures 7 and 8 present the dominant tree species in Mississauga and Brampton, respectively, expressed as a percent of the total leaf area and percent of the total number of stems (individual trees). Please see the Town of Caledon Urban Forest Study Technical Report for the species composition in Caledon East and Bolton.

Species composition varies widely by land use. For example, Norway maple (*Acer platanoides*) and white and green ash (*Fraxinus americana, F. pennsylvanica*) are dominant in residential areas, conifers species such as Austrian pine (*Pinus nigra*) and white spruce (*Picea glauca*) are common in commercial and industrial areas, and hawthorn (*Crataegus* spp.) and European buckthorn (*Rhamnus cathartica*) comprise much of the existing tree cover in agriculture areas.

Species diversity is lower than recommended diversity targets. The Technical Reports for each municipality recommend that in the intensively managed portion of the urban forest no single **species** represent more than 5 percent of the tree population, no **genus** represent more than 10 percent of the tree population, and no **family** represent more than 20 percent of the tree population. In Mississauga and Brampton, maple species represent 31 percent and 24 percent, respectively, of the leaf area in each municipality. Dominance by a single tree species or genus will increase the possibility of large-scale tree mortality in the event of pest or disease outbreaks.

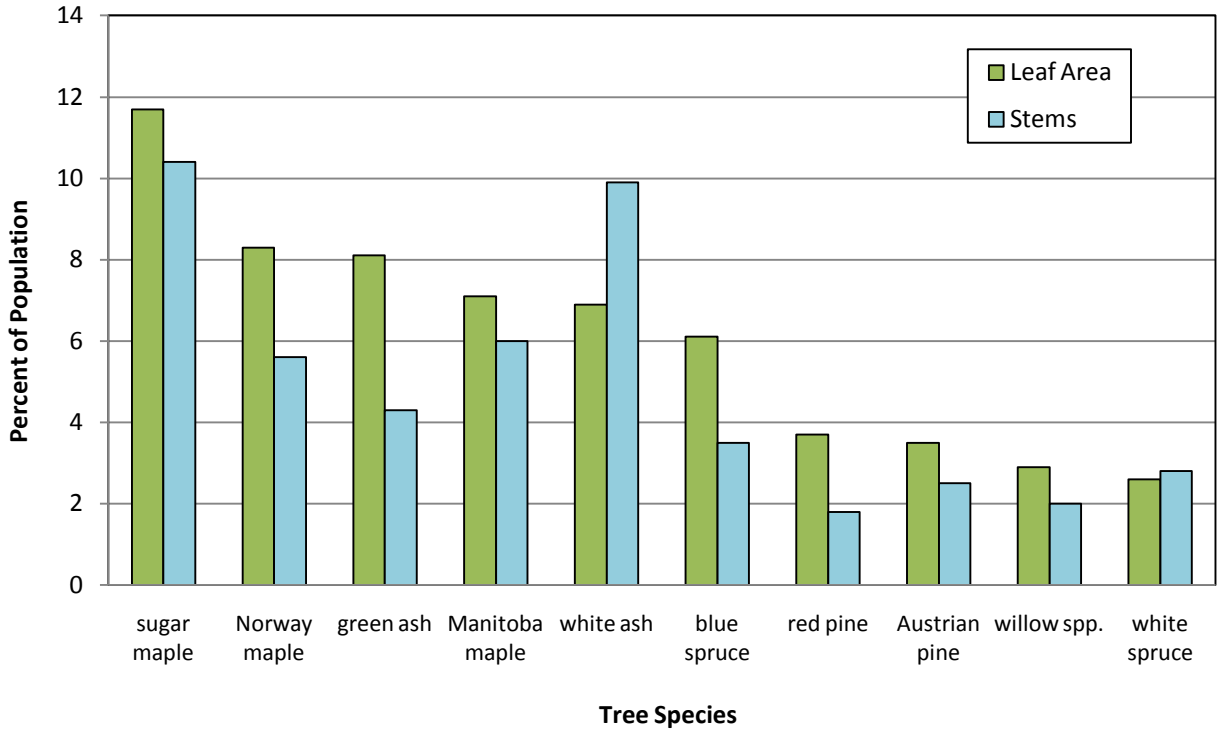


Figure 7: Tree species in Mississauga by percent of total leaf area and percent of total stems.

Box 1: The Urban Heat Island

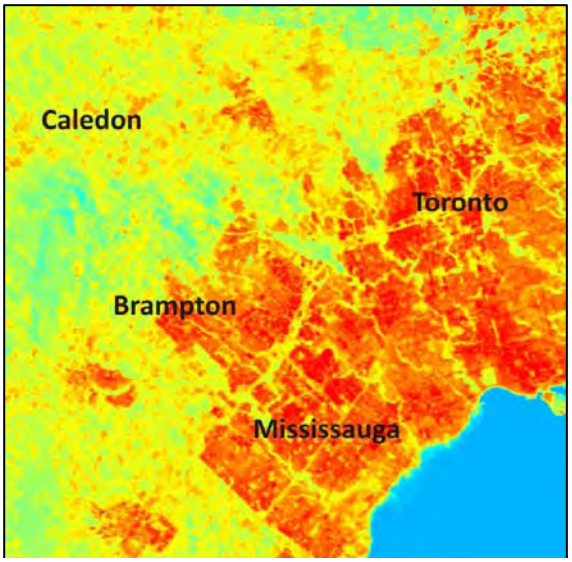
The urban heat island (UHI) effect occurs in urban and suburban areas where surface temperatures are significantly warmer than nearby rural areas. Surface temperatures in urban areas increase as natural land cover is replaced with pavement, buildings and other infrastructure.

Residents living in urban heat islands are more vulnerable to health risks associated with extreme heat events. The UHI effect also increases energy consumption for air conditioning, which leads to greater emissions of **criteria air contaminants** and greenhouse gases by power plants. According to a recent study conducted by Natural Resources Canada in the Greater Toronto Area (GTA), the suburban areas of Mississauga, Brampton and Vaughan recorded the highest surface temperatures and highest nighttime urban heat island intensities (NRCan, 2009). The lowest surface temperatures were recorded in the vegetated corridors of the Don and Humber river valleys.

The Region of Peel has partnered with the Clean Air Partnership, Natural Resources Canada, City of Toronto, City of Hamilton, and Town of Ajax, to develop an on-line mapping tool to help staff achieve the following objectives: asses the vulnerability to heat of both populations and places in the Greater Toronto and Hamilton Area; examine the relationship between 'hotspots' and other variables; and support heat-related communications activities.

Research has shown that by increasing the amount of urban vegetation the effects of UHI can be mitigated (Rosenzweig *et al.*, 2006; Solecki *et al.*, 2005). Specifically, the shade generated by tree canopies will reduce the amount of solar radiation transmitted to underlying surfaces, which in turn, reduces the heat transfer from these surfaces to the surrounding air. In addition, evapotranspiration by urban vegetation can result in peak summer temperature reductions of 1-5°C in urban areas (EPA, 2007). According to Simpson (1998), every 1 percent increase in canopy cover results in a maximum mid-day air temperature reduction of 0.04 to 0.2°C.

Planting and establishing trees to increase leaf area in the hot-spots identified by thermal mapping will reduce surface temperatures and associated human health impacts in addition to reducing the formation of ground level ozone. Ozone has been identified as the primary component of photochemical smog and is known to irritate and damage the respiratory system, reduce lung function and increase susceptibility to respiratory infections (EPA, 2003).



Thermal imagery indicating the urban heat island effect across Peel Region and the City of Toronto. Image courtesy of Natural Resources Canada.

Thermal imagery illustrating the contrast in temperatures observed between neighbourhoods with varying tree cover. Image courtesy of Natural Resources Canada.

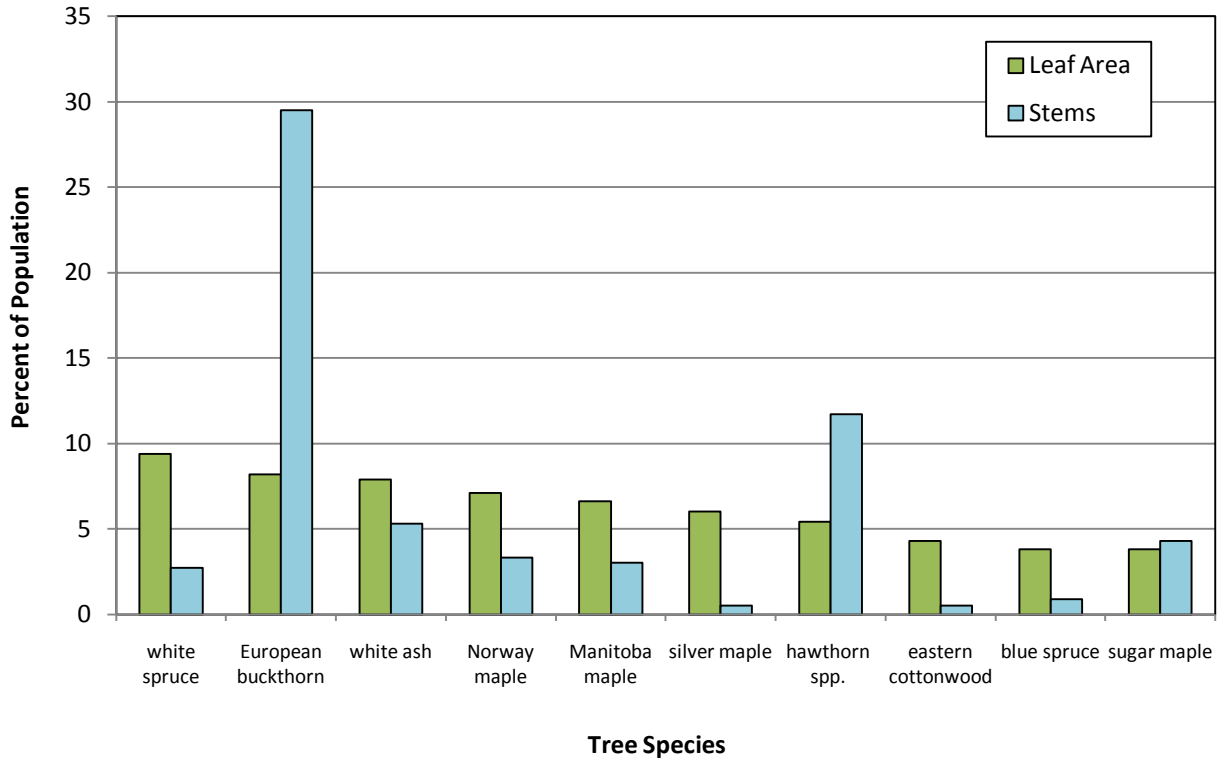


Figure 8: Tree species in Brampton by percent of total leaf area and percent of total stems.

Several **exotic invasive plant species** are abundant throughout the Region, most notably European buckthorn (*Rhamnus cathartica*), exotic bush honeysuckle (*Lonicera spp.*), and Norway maple (*Acer platanoides*). These species reproduce aggressively, displace native vegetation, impede the natural regeneration of forest tree species, modify habitat and hybridize with other native species.

> "The vegetation resource is the engine that drives urban forests. Its composition, extent, distribution and health define the limit of benefits provided and costs accrued. Therefore, sustainable urban forests must possess a mix of species, sizes and ages that allows for continuity of benefits while trees are planted and removed."(Clark *et. al.* 1997)

The proportion of large trees is low across all study areas in the Region. Over 70 percent of all trees are less than 15.3 cm dbh (Figure 9). As urban trees increase in size, their environmental, social and economic benefits increase as well. For example, the average tree in Brampton that measures 65 cm in diameter stores 10 times more carbon and 75 times more pollution than a tree that is 11 cm in diameter. Large trees also provide greater energy savings, water quality improvements, runoff reduction, visual impact, increase in property values and carbon sequestration.

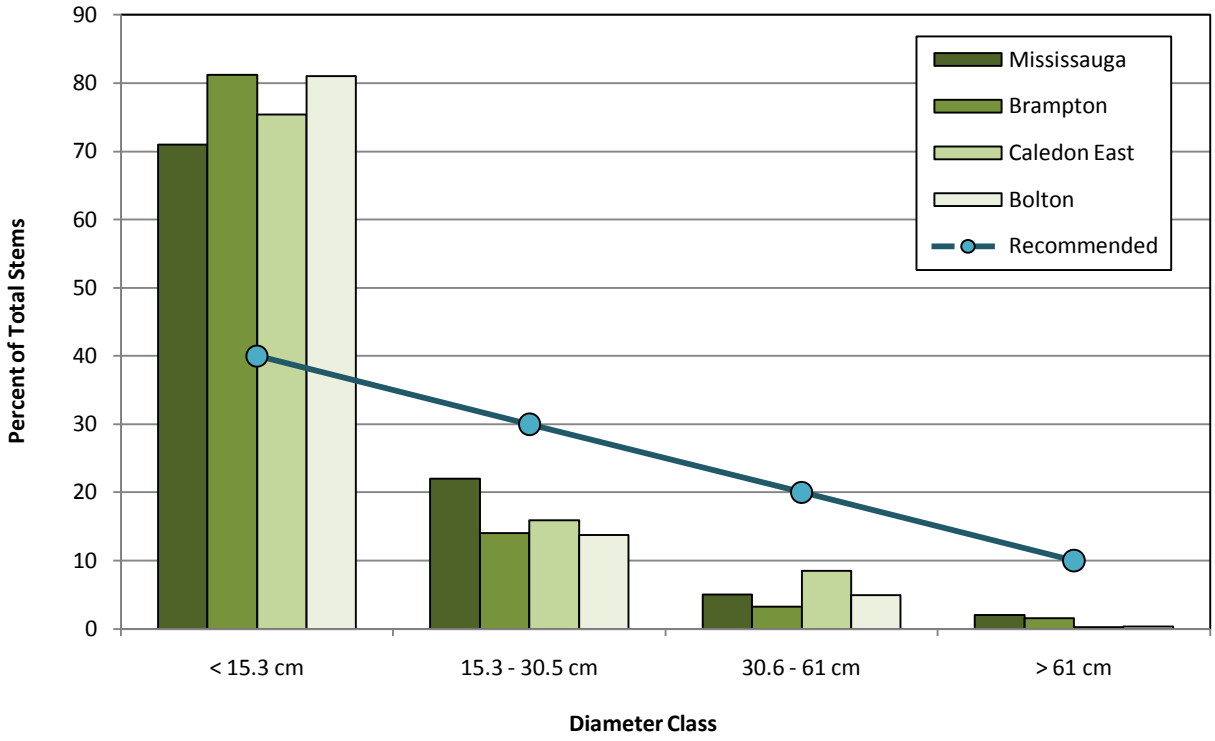


Figure 9: Existing and recommended diameter class distribution for trees in Mississauga, Brampton, Caledon East and Bolton.

Urban Forest Benefits

The urban forest provides multiple benefits to the residents of Peel Region. The urban forest can mitigate climate change by sequestering, or removing, atmospheric carbon. Trees and shrubs then store this carbon as woody biomass. Trees and shrubs in the municipal study areas sequester approximately 19,000 tonnes of carbon annually, which is valued at approximately $550,000 annually (Table 2). Total carbon storage by trees and shrubs is approximately 400,000 tonnes; the value for this service is estimated at $11.5 million. Tree size directly influences carbon storage and sequestration capacity. Thus, an increase in the proportion of large healthy trees in the urban forest will result in an increase in the volume of carbon stored.

Table 2: Carbon stored and sequestered by the urban forest in Mississauga, Brampton, Caledon East and Bolton.

Municipality	Total Carbon Stored (tonnes)	Carbon Storage per Hectare (tonnes/ha)	Net Carbon Sequestered Annually (tonnes/ yr)	Carbon Sequestration (tonnes/ha/yr)
Mississauga	203,000	7.0	7,400	0.3
Brampton	175,000	6.5	5,900	0.3
Caledon East	14,000	28.6	400	0.8
Bolton	13,000	7.6	700	0.4

Trees reduce emissions by power plants by reducing the demand for heating and cooling in buildings. Specifically, trees shade and cool residences during summer months and provide protection from cold winds in the winter. As a result of the moderating effect of trees on building temperature, the production of 4,300 tonnes of carbon emission by power plants is avoided annually. This also translates to direct financial savings for residents. The cumulative value of energy savings for residents across all study areas is over $2.5 million annually (Table 3).

Table 3: Annual savings in residential energy expenditures in Mississauga, Brampton, Caledon East and Bolton during heating and cooling seasons (based on 2008-2009 energy costs).

Energy Units	Mississauga	Brampton	Caledon East	Bolton
Natural Gas	$ 687,000	$ 641,000	$ 106,400	$ 135,500
Electricity	$ 488,000	$ 325,000	$ 23,000	$ 33,200
Carbon Avoided	$61,800	$50,600	$ 6,800	$ 8,900
Total	**$ 1,236,800/yr**	**$1,016,600/yr**	**$ 136,200/yr**	**$ 177,600/yr**

Trees and shrubs in the urban forest can improve local air quality by absorbing gaseous pollutants or by binding particulate to leaf and bark surfaces. Annually, 890 tonnes of air pollution are removed by the urban forest in Mississauga, Brampton, Caledon East and Bolton (Figure 10); the total removal value is approximately $9.5 million.[1] Values are based median **externality** costs associated with pollutants and have been updated for 2007 (Murray, *et al*., 1994). Pollution removal by the urban forest is greatest for ozone (O_3) (Table 4). Ozone has been identified as the primary component of photochemical smog and is known to irritate and damage the respiratory system, reduce lung function, and increase susceptibility to respiratory infections (EPA, 2003).

Annual sulphur dioxide removal by trees in Mississauga = annual sulphur dioxide emissions by 19,100 automobiles.

In 2005, the Ontario Medical Association released *The Illness Cost of Air Pollution in Ontario*, which stated that exposure to air pollution was associated with approximately 5,800 premature deaths, 17,000 hospital admissions, and 60,000 emergency room visits annually in Ontario in 2005 (OMA, 2005). The report also found that if nothing was done to improve Ontario's air quality the number of premature deaths could reach an estimated 10,000 annually by the year 2026 as the population ages. Thus, the Region's urban forest plays an important role in community wellness and illness prevention by mitigating the human health risks of air pollution, particularly for the more vulnerable members of the population.

[1] Pollution value estimates for Caledon East include values for NO_2, O_3, and PM_{10}. Values for CO and SO_2 have not been included due to data analysis errors.

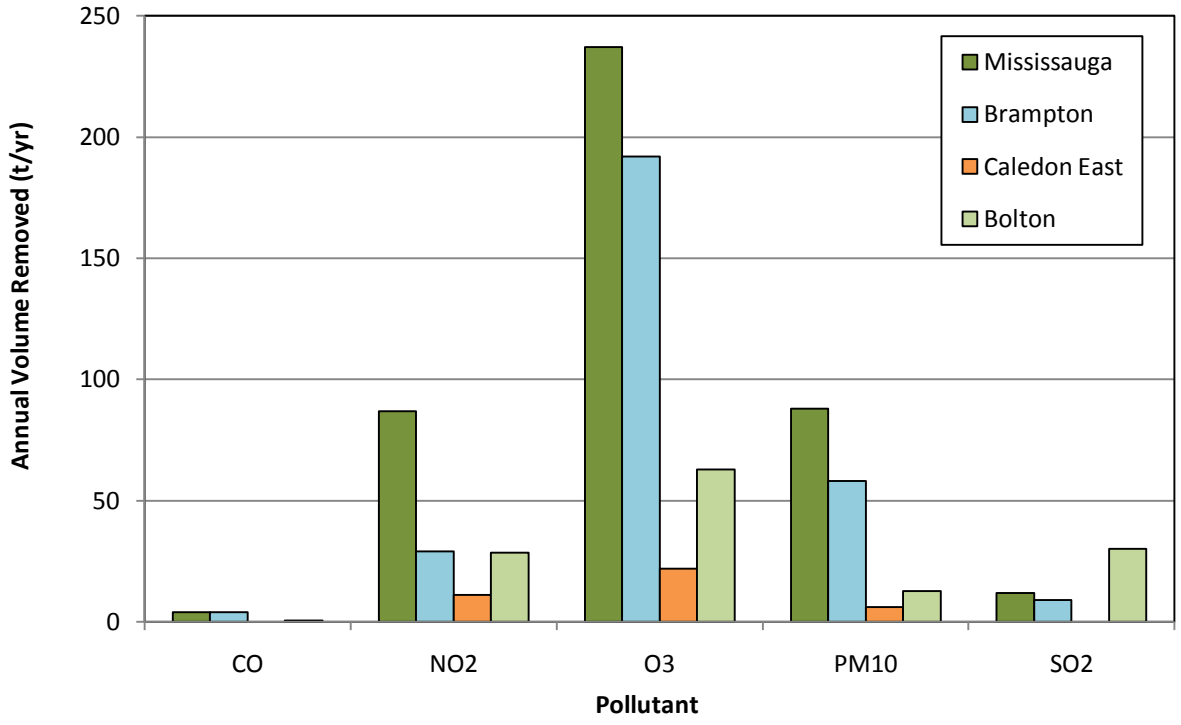


Figure 10: Annual pollution removal by trees and shrubs in Mississauga, Brampton and Bolton.

Table 4: Value of pollution removal by the urban forest in Mississauga, Brampton, Caledon East and Bolton.

Pollutant	Mississauga	Brampton	Caledon East	Bolton
Carbon Monoxide (CO)	$ 8,000	$ 6,000	n/a	$ 800
Nitrogen Dioxide (NO_2)	$ 1,087,000	$ 358,000	$ 110,600	$ 282,000
Ozone (O_3)	$ 2,933,000	$ 2,371,000	$ 217,900	$ 623,000
Particulate Matter 10 (PM10)	$ 729,000	$ 481,000	$ 39,600	$ 84,000
Sulphur Dioxide (SO_2)	$ 36,000	$ 26,000	n/a	$ 73,000
Total	**$ 4,793,000**	**$ 3,242,000**	**$ 368,100**	**$ 1,063,000**

Stormwater management is a significant challenge in urbanized areas that are dominated by impervious cover. High volumes of stormwater frequently exceed the capacity of existing municipal infrastructure, resulting in stream bank erosion, damage to property, and degradation of local water quality and aquatic habitat. Trees can help to manage stormwater flow by intercepting and storing rainfall in the canopy and increasing infiltration into the soil. A modeling exercise conducted in the Spring Creek Subwatershed found that a simulated increase in tree cover reduced stream flow, base flow, as well as flow regenerated from both pervious and impervious areas. Specifically, increasing tree cover by 1 percent averaged a 0.13 percent decrease in stream flow.

Box 2: Additional Benefits Provided by the Urban Forest

Urban trees have been shown to reduce neighborhood crime levels. For example, Kuo and Sullivan (2001) found that apartment buildings with high levels of greenery observed 52 percent fewer crimes than those without trees. This research suggests that trees reduce crime by helping to soothe violent temperaments, and by increasing surveillance on city streets, as people tend to use treed spaces more than treeless spaces.

Hospital patients were found to recover from major surgery more quickly and with fewer complications when provided with a view of trees (Ulrich, 1984). Trees and urban parks also improve mental health and over all well-being by conveying a sense of calm and facilitating relaxation and outdoor activity. Contact with nature has also been found to relieve symptoms of children with Attention Deficit-Hyperactivity Disorder (AD/HD) (Taylor, *et al.*, 2001).

An economic benefit of urban vegetation can be observed in the relationship between tree cover and property value. Both residential tree cover and proximity to green space have been associated with higher property values in residential neighborhoods (Dombrow *et al*., 2000; Anderson and Cordell, 1988). The Center for Urban Forest Research (2005) estimates that properties with trees are valued five to fifteen percent higher than comparable properties without trees. Furthermore, research shows that shoppers in well-landscaped business districts were willing to pay more for both parking and goods and services (Wolf, 1999).

Urban tree cover can also increase the longevity of grey infrastructure thereby reducing the frequency of costly repairs. McPherson and Muchnick (2005) have demonstrated that tree shade is correlated with reduced pavement fatigue, cracking, rutting and other distress.

As rural forests are replaced with urban development, many wildlife species are removed from the landscape completely. In Peel Region and southern Ontario as a whole, few large and well-connected woodlands remain to serve as breeding or wintering habitat for native fauna species or to provide migratory species with places to rest and refuel. Consequently, the urban forest now plays an important role in the conservation of local biodiversity by providing habitat for these many of these species.

Monarch butterflies make use of the urban forest during their annual migration. Photo credit: S. Sampson

Summary of Vegetation Resource

The distribution and structure of the urban forest across the Region is strongly influenced by land use. Approximately 45 percent of existing tree cover is located in the residential areas of Peel Region; the greatest opportunity to increase tree cover is also found in the residential land use category. Across the Region, average tree size is generally small (less than 15 cm in diameter). In each municipality species diversity is lower than the recommended diversity targets. A number of invasive tree and shrub species are common across Peel Region. Low levels of diversity and an abundance of invasive species are serious threats to the resilience and sustainability of the urban forest.

Urban trees in Peel Region provide over $12.2 million annually in benefits for pollution removal, carbon sequestration, residential energy savings and avoided carbon emissions; in addition, the value for total carbon storage by urban trees is $11.5 million. Trees also provide stormwater management benefits by intercepting rainfall and decreasing stream flow. The benefits discussed here represent only a small sample of the wide variety of services provided by the urban forest. New research and tools that quantify these additional benefits are emerging rapidly, with a strong focus being placed on measuring the public health benefits of urban vegetation (see Box 3). However, it must also be recognized that many of the benefits provided are simply beyond measure.

THEME 2: Resource Management Approach

Table 5 provides a summary of the policies and resources that are currently used in the governance and management of the urban forest. Academic training and research has also been included in the assessment of this framework. A summary of the needs and opportunities with respect to policies, resources and research is also provided. Please see Appendix D for a detailed summary of each policy tool as it applies to the urban forest in Peel Region.

The existing policy framework that governs the urban forest is largely created and applied at the Area Municipal scale. Supporting policies and programs, particularly through natural systems management, are provided by Conservation Authorities and the Region of Peel. Recognizing that large, mature trees are underrepresented in the urban forest, additional policy tools are needed to ensure that trees are protected and maintained so that each tree will grow to reach maturity and provide greater benefits to the community.

The federal government is involved narrowly in urban forest management through the regulation and management of invasive insect pests (e.g. Asian longhorned beetle). Although provincial land use and planning policy strongly influences the health and distribution of the urban forest in Peel Region, the provincial government is not yet actively involved in urban forest management and does not provide clear direction to municipalities for urban forest conservation. By taking a leadership role in the management of this resource, the upper levels of government have the opportunity to build healthier, stronger communities.

> "[M]anagement of the urban forest must exist in connection to the larger landscape (such as adjacent forests). For example, maintenance of intact riparian corridors requires the cooperation of the managing agency of the stream." (Clark *et al*. 1997)

Table 5: Summary of Existing Policy Tools, Needs and Opportunities in Resource Management Framework

Organization	Existing Tools	Needs and Opportunities
Federal	• **Canadian Food Inspection Agency (CFIA)**: Government agency that regulates invasive insect species and coordinates management response in infested areas. • **Canadian Urban Forest Network**: National network of urban forest professionals; developed and implemented the Canadian Urban Forest Strategy.	• Federal government support for urban forest research and development that would facilitate a consistent and compatible approach to urban forest research and monitoring across all provinces.
Provincial	• ***Grow Green: Ontario's Climate Change Action Plan*:** Sets a target of 50 million new trees planted across southern Ontario by 2020; provides funding for public agencies, institutional landowners and community organizations to undertake volunteer-driven tree planting projects. • ***Planning Act*:** As applied to the urban forest, allows the provincial government to promote sustainable economic development in a *healthy natural environment*. • ***Provincial Policy Statement*:** Provides direction to protect natural features and natural heritage systems. • ***Growth Plan for Greater Golden Horseshoe*:** Directs future growth to urban growth centres, encouraging a more compact urban form that will have implications for urban forest management. • ***Oak Ridges Moraine Conservation Plan:*** Provides direction for the protection of the Moraine's ecological features and functions, which directly influences land use planning and urban forest management in Caledon. • ***Greenbelt Plan:*** Protects natural heritage (extensively managed urban forest) and water resource systems around which major urbanization in south-central Ontario will be organized.	• Provincial direction and leadership to ensure that municipal governments have the policy tools to elevate the urban forest to a higher priority in planning and design. Initial steps toward this end have been taken. For example, the "mitigating effects of urban vegetation" for energy conservation and air quality improvement are promoted in the Provincial Policy Statement. Clearer direction can ensure that development standards provide suitable growing conditions (i.e. soil quality and space) needed to support long-term tree health. • Stronger and clearer protection for the urban forest outside of key natural heritage features. • Assistance to municipalities for urban forest risk management (i.e. invasive pest species). • Dedicated support for urban forest research and development.

Organization	Existing Tools	Needs and Opportunities
Regional	• ***Regional Official Plan*:** Provides direction to work with agencies and Area Municipalities to develop urban forest strategies and to encourage and support programs and initiatives that enhance the urban forest. • ***Peel Climate Change Strategy*:** Recognizes the role of the urban forest and natural system in climate change mitigation and adaptation. • ***Peel – Caledon Significant Woodlands and Significant Habitat Study***: Identifies significant woodlands in Caledon and ensures that these components of the urban forest are given consideration in future growth management decisions in the Region.	• A consistent strategic approach to urban forest management across Peel Region. Collaborative urban forest studies conducted across Peel Region and the Greater Toronto Area have built the foundation from which this approach is now taking shape, as demonstrated through the development of this Strategy. • Effective communication and collaboration across departments and organizations.
Area Municipal	• **Mississauga**: o *Official Plan* o *Strategic Plan: Our Future Mississauga* o *Tree Permit By-law* o *Street Tree By-law* o *Encroachment By-law* • **Brampton:** o *Official Plan* o *Tree Preservation By-law* o *Woodlot Conservation By-law* • **Caledon:** o *Woodland Conservation By-law*	• Funding for maintenance, staff training, by-law enforcement, research and monitoring. • Urban forest management plans for all municipalities; these plans have been initiated but are not yet completed. • Incentives and regulations to protect existing trees and encourage tree planting on private property. • Development standards and guidelines that protect trees and soils. • Effective communication across departments and organizations built from common vision and goals. • Comprehensive inventory and monitoring data for trees on public property; better access to tools for inventory, monitoring and analysis.

Organization	Existing Tools	Needs and Opportunities
Conservation Authority	• **Toronto and Region Conservation Authority:** o *Living City Strategic Plan* o *Terrestrial Natural Heritage System Strategy* o *Humber River Watershed Plan: Pathways to a Healthy Humber* o *Greening Our Watersheds: A Strategy for the Etobicoke and Mimico Creeks Watersheds;* and *Etobicoke and Mimico Creeks Watersheds Technical Update* o Subwatershed Plans o Restoration, tree planting, and forestry services (Managed Forest Tax Incentive Program Planning Services) • **Credit Valley Conservation:** o *Credit Valley Conservation Strategic Plan* o *Terrestrial Ecosystem Enhancement Model* o *Credit River Water Management Strategy Update* o Subwatershed Plans o Restoration, tree planting, and forestry services	• Effective communication across departments and organizations. • Conservation Authorities rely on the implementation of other public agency policies for lands beyond their valley and stream corridor regulated area in order to achieve their mandate (e.g. flood and erosion control, stormwater management and resilient ecosystems). By strengthening their own municipal and provincial policies and practices to reduce impervious surfaces and create plantable space for urban forests throughout watersheds, these public agencies can help Conservation Authorities to successfully achieve their mandate.
Academic	• **University of Toronto**: Faculty of Forestry (Dr. W.A. Kenney); Faculty of Geography and Planning (Dr. T. Conway) • **Ryerson University**: Urban Forest Research and Ecological Disturbance Group (Dr. A. Millward) • **York University**: Institute for Research and Innovation in Sustainability (Dr. D.R. Bazely) • **Dalhousie University**: School for Resource and Environmental Management (Dr. P. Duinker)	• Formal training and education in urban forest conservation and management, particularly with a focus on strategic issues and landscape level management approaches. • University level programs dedicated to urban forestry. • Research dedicated to urban forestry.

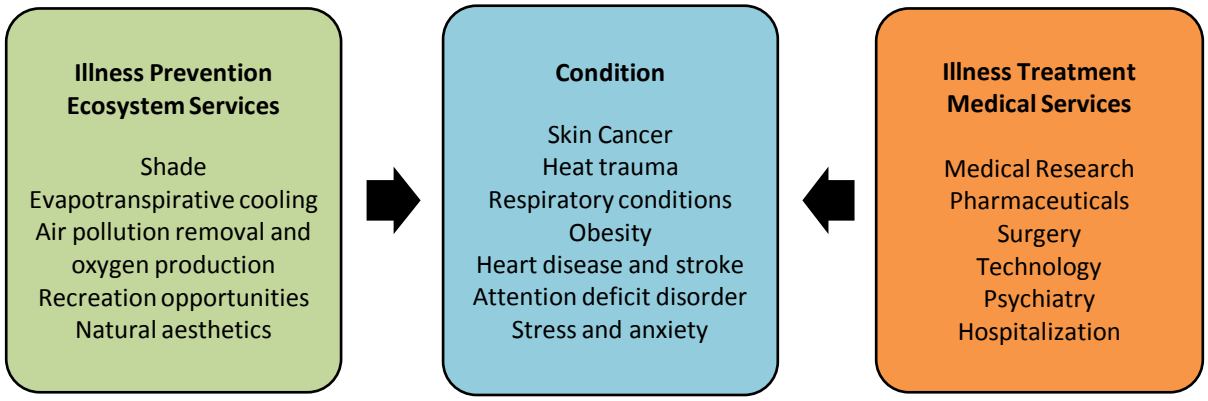
Box 3: Urban Forests and Preventative Health Care

Health Care Costs

The Federal Government and the Province of Ontario spend approximately 30 percent and 40 percent, respectively, of the annual budgets on health care (Canadian Institute for Health Information, 2010; Province of Ontario, 2010). Health care costs are expected to increase as the "Baby Boomer" population ages. Thus, an alternative approach to health care is in order. Specifically, shifting focus from illness treatment to illness prevention will not only provide a more cost effective approach to health care, but it will enable health care providers to combat the true causes of illness rather than simply treat the symptoms. In order to promote preventative medicine, the medical industry and all levels of government must invest in environmental solutions based on the direct link between the environment and human health.

Complementary Health Care

Urban forests can play an integral role in community health and wellness by providing a suite of physical, emotional, cognitive, and social benefits to citizens. When necessary, conventional medical services (illness treatment) can then complement the benefits of ecosystem services (illness prevention), not vice versa.



Examples and Opportunities

The Region of Peel's research into, and intent to remediate, the urban heat island effect in part through urban forest management is an example of a progressive approach to illness prevention (see Box 1). The Ontario Ministry of Health Promotion and Sport, created in 2005, has the opportunity to promote trees in the landscape as a preventative health care solution. The Ministry's vision is:

> *"To enable Ontarians to lead healthy, active lives and make the province a healthy, prosperous place to live, work, play, learn and visit. Health Promotion and Sport sees that its fundamental goals are to promote and encourage Ontarians to make healthier choices at all ages and stages of life, to create healthy and supportive environments, lead the development of healthy public policy, and assist with embedding behaviours that promote health."*

Social Equity

The Canada Health Act is based on the five principles that health care must be "comprehensive, accessible, universal, portable and publicly administered" (Government of Canada, 2005). It follows that the urban forest, as a component of preventative health care, must be accessible to all and distributed equitably.

THEME 3: Community Framework Assessment

An effective approach to urban forest stewardship must include programs that target both students, as the future stewards of this resource, and adults, as the primary land owners and managers. Students across the Region currently have multiple opportunities to become engaged in broad conservation initiatives through the existing curriculum-based programs in schools. However, a specific focus on urban forest conservation has not yet been developed.

Assistance to residents for tree selection, planting and maintenance on private property is a notable gap in the outreach and stewardship currently offered across the Region. Thus, a backyard tree planting program, such as that offered by LEAF in City of Toronto and York Region, has the potential to increase tree cover and associated benefits across Peel. Please see Appendix E for a more detailed description of the various organizations listed in Table 6.

Table 6: Summary of Existing Community Framework, Needs and Opportunities

Organization	Existing Tools	Needs and Opportunities
Regional	• ***Teach Green in Peel***	• Regional communication and resource sharing between organizations and community groups.
Municipal	• **Brampton Clean City**	• Programs to assist residents in tree selection, planting, and long-term care. • Outreach and assistance for large institutional land holders. • Clear understanding of barriers to participation in urban forest stewardship programs. • Stronger focus on creating healthy ecosystems.
Conservation Authority	• **Toronto and Region Conservation Authority:** o Etobicoke-Mimico Watersheds Coalition o *Healthy Yards Program* o *Private Land Tree Planting Program* o *Sustainable Neighbourhood Retrofit Action Plan* • **Credit Valley Conservation:** o *Green Cities* o *Your Green Yard* o *Greening Corporate Grounds* o CVC Conservation Youth Corps	• Stronger focus on urban forest conservation and stewardship outside of natural areas.
Community	• **EcoSource** • **Peel Environmental Alliance** • **The Riverwood Conservancy** • **Association of Canadian Education Resources**	• Stronger focus specifically on *urban forest* conservation and the long-term retention of trees; need to move beyond tree planting and focus on effective protection and care.
Green Industry Partnerships	• **Green Infrastructure Ontario** • **Partners in Project Green** • **Horticultural Outreach Collaborative**	• Effective communication among nurseries, tree care companies, and municipalities.

PART 2: Peel Region's Urban Forest Tomorrow

Strategic planning and management of the urban forest is essential to sustaining or enhancing the provision of environmental, economic and social benefits to the community. A coordinated regional approach will increase the collective capacity for success across all organizations in Peel by avoiding duplication of effort, creating opportunities to leverage funding, facilitating collaboration across the Greater Toronto Area, and bringing together resources, knowledge and expertise.

The vision, guiding principles and goals presented here provide the foundation for the strategic management of the urban forest in Peel Region and offer a framework within which to coordinate government, agencies and community organizations for maximum benefit. The Strategy is intended guide strategic urban forest management over a 20 year horizon. However, the commitment to urban forest conservation and management must continue indefinitely; therefore this Strategy should lead directly into ensuing Strategies that build on past success and address emerging challenges.

Photo Credit: Toronto and Region Conservation Authority

STRATEGIC VISION

The Strategic Vision describes the future urban forest that the Region and its partners are striving to achieve. All principles, goals and actions found in the Strategy flow directly from this vision:

Our vision is for a healthy and resilient urban forest that provides diverse and sustained benefits to all and is grown from a shared commitment by all members of the community to the stewardship and care of this vital infrastructure.

GUIDING PRINCIPLES

The principles listed here bring focus to the most important aspects of sustainable urban forest management and can help to guide all partners in achieving the strategic vision for the urban forest. These principles capture challenges and opportunities as expressed through the stakeholder consultation process.

The Strategy is intended to be a living document that is revisited, refined, and updated at regular five year intervals in order to track progress towards achieving the strategic vision. At each five year review

period the guiding principles should collectively serve as the lens through which new actions are developed and prioritized.

PRINCIPLE 1: A sustainable urban forest promotes quality of life, human health and longevity.

A resilient and expansive urban forest offers preventative health benefits by filtering harmful air pollutants, providing protection from ultraviolet radiation, improving local water quality, mitigating heat related illness caused by the urban heat island, and creating more cohesive communities. As the urban forest grows, so too does the volume of services that flow to the community.

PRINCIPLE 2: Residents of Peel Region are the most important and influential stewards of the urban forest.

As stated in the Canadian Urban Forest Strategy (2010) community residents own 100 percent of the urban forest; they are the most influential stewards, as well as the greatest resource for advocacy and education. A sustainable urban forest cannot be achieved without the support of fully engaged community members.

PRINCIPLE 3: All residents should have the opportunity and means to benefit equally from the ecosystem services provided by the urban forest.

The urban forest and the resources needed to sustain it must be distributed equitably across Peel Region in a manner that ensures that all community members will benefit from the ecosystem services provided.

PRINCIPLE 4: Improved communication and coordinated action across departments, agencies and governments, will result in a more informed, streamlined, and effective approach to urban forest management.

The resources, policies and programs needed to create and maintain a sustainable urban forest cannot be developed or implemented solely by urban forest managers. Rather, a coordinated approach that spans across departments, governments, and community organizations is necessary to ensure that trees are given the soil, space, maintenance, and protection to survive in the long-term and provide the maximum benefit to the community.

PRINCIPLE 5: The urban forest, as natural infrastructure, requires long-term, stable funding.

The urban forest is a dynamic resource that will respond to change, stress, and good care across a range of time frames. Thus, a long-term and adaptive approach to urban forest management will be necessary if future generations are to enjoy the benefits provided by this resource. In order to achieve long-term

goals and objectives a stable source of funding will be critical. Ultimately, the urban forest should be formally recognized and funded as vital *natural* infrastructure.

PRINCIPLE 6: Municipal Governments should lead by example.

The Region of Peel together with the Area Municipalities can take a leadership role by modeling good stewardship and demonstrating best management practices in all operations. Maintenance and protection of public trees by municipal governments can be used as means to educate and inspire residents to care for trees on private property. Effective leadership must also be demonstrated through support for innovation and the development of new tools, research and management approaches.

STRATEGIC GOALS

Eight strategic goals are outlined in this section; each goal has a number of corresponding actions. A complete summary of the strategic goals and recommended actions is provided in Appendix F. Each strategic goal has been assigned a lead agency that will be responsible for engaging and coordinating all partners and initiating the corresponding actions. Each goal addresses one or more of the three themes introduced in Part 1 of the Strategy: Vegetation Resource; Resource Management Approach; and Community Framework. Progress toward achieving the eight strategic goals can therefore be evaluated, in part, using the relevant criteria and indicators outlined by Kenney *et al.* (2011).

The proposed timeframe for the implementation of each action is indicated as short term, medium term or on-going. Short term actions should be initiated immediately and completed (where appropriate) within two years of adopting and implementing this Strategy. Medium term actions should be prioritized for completion within 2 to 7 years of implementing the Strategy. On-going actions will require a long-term commitment and should not be limited to a 20 year planning horizon, but rather these actions should be carried through to ensuing strategies.

GOAL 1: Facilitate partnerships and coordinate action across Peel Region

GOAL 2: Develop urban forest targets

GOAL 3: Develop and implement urban forest management plans

GOAL 4: Create a comprehensive urban forest policy framework

GOAL 5: Gain formal support from upper level government for sustainable management of the urban forest as natural infrastructure

GOAL 6: Implement effective monitoring and research programs

GOAL 7: Secure long-term funding for urban forest management

GOAL 8: Provide comprehensive training, education, and support for residents and members of the public and private sectors

GOAL 1: Facilitate partnerships and coordinate action across Peel Region

THEMES ADDRESSED: Resource Management Approach, Community Framework

LEAD: Region of Peel and Area Municipalities

PARTNERS: Conservation Authorities, Community Stewardship Groups, Academic Institutions, and Landscape Ontario

RATIONALE: Acting together, the Region of Peel and Area Municipalities can coordinate partnership development between agencies and across the GTA, which will yield new opportunities for data-sharing, research, and funding. The Region and Area Municipalities can pool knowledge, resources, and capacity, thereby facilitating more effective urban forest management (with respect to effort, time and cost) and building a stronger understanding of urban forest challenges, threats and opportunities in a broader context. By improving interagency and interdepartmental communication a shared understanding of the value of trees as infrastructure can be built and priorities can be harmonized.

To achieve this goal the Region and Area Municipalities should develop and lead an interagency Urban Forest Working Group. This Working Group will be tasked with creating a work plan for the goals and actions outlined in this Strategy and will be responsible for liaising with relevant departments and organizations to reduce redundancy and align goals and actions.

ACTION: Develop and lead an interagency Urban Forest Working Group that will build focus and consistency across departments and agencies. The Working Grouping will convene monthly during the initial stages of Strategy implementation, and then at regular intervals deemed appropriate by Working Group members thereafter. **(Short Term)**

ACTION: Develop and implement annual work plans for the purpose of achieving the goals outlined in this Strategy. **(Short Term)**

ACTION: Conduct a comprehensive review of the Strategy at regular five year intervals by completing the following tasks:

- Evaluate progress made towards achieving each strategic goal, Regional and Area Municipal targets, as well as the objectives outlined in *Criteria and Indicators for Strategic Urban Forest Management and Planning* (Kenney *et al.,* 2011);
- Address barriers to up-take and implementation of goals and actions;
- Identify threats and emerging trends; and
- Incorporate recommended solutions. **(On-going)**

GOAL 2: Develop urban forest targets

THEME ADDRESSED: Resource Management Approach

LEAD: Region of Peel and Area Municipalities

PARTNERS: Conservation Authorities

RATIONALE: Urban forest targets can provide focus across organizations and stakeholder groups, shape expectations, increase momentum and interest in urban forest conservation, and enable partners to more easily measure success and monitor trends.

The Region of Peel and Area Municipalities can work together to develop urban forest targets. A regional target should consider targets set by each Area Municipality, which can be created through the development of Urban Forest Management Plans. However, a regional target may also be generated to encourage action in the interim while Area Municipal targets are being set and Management Plans are being completed. All targets should consider both the existing and possible urban forest cover (as identified in the Urban Forest Studies) and can be built from targets set for land use categories.

In recent years cities across North America have identified target setting as an essential component of sustainable urban forest management (see for example: City of Toronto; City of Seattle). The most commonly used metric for urban forest targets is canopy cover. Canopy cover is a useful metric that can be measured relatively easily using aerial orthophotography or satellite imagery. Canopy cover represents the urban forest in a two-dimensional form (from an aerial perspective), and as such is most useful and informative when combined with additional targets. For example, leaf area density is recommended as an additional target that is complementary to canopy cover as it accounts for the depth and density of the tree canopy (Kenney, 2000).

The urban forest is a complex system that is managed and influenced by a diverse group of stakeholders. As such, setting suitably sensitive and informative targets will be challenging as certain complexities and structural elements cannot be captured by a single metric. For example, species diversity and age-class distribution must be addressed in order to achieve a truly sustainable urban forest; these measures should therefore be considered when developing targets. Above all, the natural character and ecological function required for the equitable and sustainable provision of ecosystem services should be the primary consideration in the target setting process (Figure 11). Further research and collaborative discussion will be needed in order to develop final targets that will be sensitive to change and will effectively inform management practices.

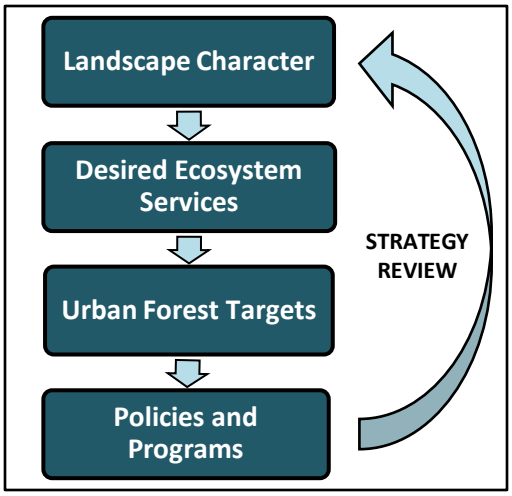


Figure 11: Peel urban forest target setting process.

ACTION: Develop regional and area municipal urban forest targets in collaboration with Conservation Authorities and other stakeholders. **(Short term)**

GOAL 3: Develop and implement urban forest management plans

THEME ADDRESSED: Resource Management Approach

LEAD: Area Municipalities

PARTNERS: Region of Peel, Conservation Authorities

RATIONALE: Urban Forest Management Plans are the principle planning and operational tool through which the urban forest in Peel Region will be protected and enhanced. Management Plans must comprehensively address a wide range of management themes including maintenance and pruning, strategic planting and establishment, stewardship and outreach, by-laws and enforcement, risk assessment and response, and long-term monitoring. It is acknowledged that urban forest management in Peel Region is the responsibility and mandate of the Area Municipalities. As such, Management Plans must be designed and implemented at the level of the Area Municipality. However, the targets and objectives outlined in the Management Plans should be used to develop and inform regional targets and objectives.

The *Criteria and Indicators for Strategic Urban Forest Planning and Management* (Kenney *et al.,* 2011) can serve as a standardized framework for developing and monitoring best management practices at the Area Municipal level. This framework should therefore be incorporated into the development and subsequent review of Management Plans. Achieving all objectives outlined in the framework simultaneously will not be feasible. Therefore, objectives should be prioritized as necessary. However, all twenty-five objectives should eventually be addressed through the management process. Each criterion is described by a key objective and is assessed by low, moderate, good and optimal indicators of urban forest management success (Appendix C). Dobbs *et al.* (2011) propose a framework for developing indicators of urban forest ecosystem services; this framework can also be used in the Management Plan review process to evaluate the manner in which the provision of services is influenced by changes in ecosystem structure, urban morphology, socio-cultural dynamics and political contexts over time.

ACTION: Develop and implement comprehensive Urban Forest Management Plans that fully address the operational actions and resources required to achieve a healthy and resilient urban forest. **(Short term)**

ACTION: Review and update Management Plans at regular five year intervals to ensure that management activities are adapting to changing conditions. This action should be directly informed by the monitoring program outlined in Goal 6. **(On-going)**

GOAL 4: Create a comprehensive urban forest policy framework

FOCUS AREA 1: Policy Integration and Development

THEME ADDRESSED: Community Framework, Resource Management Approach

LEAD: Urban Forest Working Group (Area Municipalities, Region of Peel, Conservation Authorities)

PARTNERS: All Municipal Departments

RATIONALE: Integrating urban forest considerations into Regional, Area Municipal, and Conservation Authority policies and programs will not only assist urban forest managers in successfully meeting targets and objectives outlined in management plans, but will provide complementary outcomes that improve quality of life for all residents of Peel. For example, Peel Public Health's 10-Year Strategic Plan highlights the "importance of prevention versus treatment" (Peel Public Health, 2009). The services provided by the urban forest offer such preventative care options and should therefore be formally incorporated into future strategic healthcare plans. Municipal Governments are able to look beyond provincial minimum standards when designating and protecting the existing and potential urban forest in Official Plans in order to ensure that quality of life considerations are captured at a local scale. In doing so, all levels of government will be more successful in achieving the long-term prosperity, environmental health, and social well-being desired through the Provincial Policy Statement.

The distinction between the intensively managed urban forest (as defined in Area Municipal Urban Forest Studies) and the extensively managed urban forest (i.e. natural system - as defined by the TEEM and TNHSS), is necessary in all policies and programs as these two components of the urban forest require very different management practices. However, an integrated approach must also be sought that recognizes the benefit of the *entire* urban forest to the sustainability of urban and urbanizing watersheds. Thus, the goals and targets outlined in this Strategy and future Urban Forest Management Plans should be integrated into all Watershed and Subwatershed Plans.

ACTION: Integrate the strategic goals identified in the Peel Region Urban Forest Strategy and targets, once defined, into Regional and Area Municipal Official Plans to recognize the contribution of both the extensively and intensively managed urban forest to quality of life. (**Medium Term**)

ACTION: Integrate the strategic goals identified in the Peel Region Urban Forest Strategy, as well as targets and directions from Urban Forest Management plans into public initiatives. These initiatives include, but are not limited to, the following policies and programs:

- Region of Peel Climate Change Strategy
- Peel Public Health's 10-Year Strategic Plan
- Region of Peel Energy Management Plan
- Area Municipal By-laws
- Area Municipal Environmental Master Plans
- Regional, Area Municipal and Conservation Authority Natural Heritage System Strategies
- Conservation Authority Watershed and Subwatershed Plans
- Conservation Authority and EcoSource Educational Programs
- Public and Catholic School Board Curriculum **(Medium term)**

FOCUS AREA 2: Sustainable Development Policies and Standards

THEMES ADDRESSED: Vegetation Resource, Resource Management Approach

LEAD: Area Municipalities

PARTNERS: Region of Peel, Conservation Authorities, Ontario Building Industry and Land Development Association (BILD)

RATIONALE: The health of a tree depends directly on the quality, volume, and moisture content of the soil in which it grows. Development practices that degrade soils will in turn restrict the establishment and growth of urban trees; as a result these trees cannot reach their full potential to provide services to the community. At the streetscape scale, many urban trees must compete for limited space with other forms of infrastructure; roots zones then become restricted and trees succumb to early mortality. To ensure that community members benefit from mature healthy trees and the services they provide, adequate tree habitat (growing space and soil conditions) must be prioritized during the preliminary design stages of all new development and retrofit plans. Trees and soils must be included as part of the complete vision for sustainable development.

ACTION: Develop new municipal standards and guidelines for sustainable streetscape and subdivision design that will meet the following objectives:

- Provide adequate soil quality and quantity for tree establishment and long-term growth;
- Eliminate conflict between natural and grey infrastructure; and
- Ensure suitable species diversity at street segment, block and neighbourhood scales. **(Medium term)**

Portion of Portland Oregon's Green Streets Program.
Photo credit: City of Portland, Environmental Services.

Crown Street, Vancouver, British Columbia.
Photo credit: Waterbucket

GOAL 5: Gain formal support from upper level government for sustainable management of the urban forest as natural infrastructure

THEMES ADDRESSED: Resource Management Approach, Community Framework

LEAD: Urban Forest Working Group (Area Municipalities, Region of Peel, Conservation Authorities)

PARTNERS: Green Infrastructure Ontario (GIO), Trees Ontario, Ontario Urban Forest Council, EcoSource, and Local Community Groups

RATIONALE: Formal direction and support from the Provincial and Federal governments for sustainable urban forest management will better equip the Region, Area Municipalities, and other local agencies with the resources needed to build healthy and livable communities. The Region can deliver to upper levels of government a clear and consistent message that will represent multiple stakeholders, including area municipalities, watershed managers, community organizations, and residents. Specifically, the Region can convey to the Provincial and Federal governments the status of the urban forest, the existing gaps in policy, as well as policy and resource needs. Strengthening relationships with provincial and federal urban forest organizations, including the Ontario Urban Forest Council and Canadian Urban Forest Network, will assist the Region in achieving this goal.

ACTION: Encourage the Association of Municipalities of Ontario (AMO) and the Federation of Canadian Municipalities (FCM) to approach provincial and federal agencies to provide stronger support and direction for urban forest policies, programs and initiatives. **(Short term)**

ACTION: Engage the Provincial Government to provide policy direction within the Planning Act as well as guidance to support a healthy urban forest for the full range of ecosystem services it provides to the community. **(Medium term)**

ACTION: Engage the Provincial and Federal Governments to provide funding for urban forest research and development. **(Medium term)**

GOAL 6: Implement effective monitoring and research programs

FOCUS AREA 1: Monitoring

THEME ADDRESSED: Resource Management Approach

LEAD: Area Municipalities

PARTNERS: Region of Peel, Conservation Authorities

RATIONALE: A comprehensive monitoring program will enable managers to track trends in tree establishment and mortality, leaf area, species diversity and tree health. This information can then be used to refine targets, develop and evaluate urban forest programs, identify and manage risk, and prioritize management actions. As such, monitoring is an essential component of adaptive management. A monitoring interval between five and ten years will be sufficient to capture emerging trends and evaluate progress effectively. Monitoring intervals can be determined in the context of funding and resource availability, and should be aligned with the formal review of each Management Plan. Management Plans (including targets and objectives) should then be reviewed and updated accordingly (see Goal 3).

Photo Credit: Toronto Region Conservation Authority

ACTION: Monitor the structure, distribution and function of the urban forest using the methods and parameters applied in the baseline assessments conducted in 2008 for each area municipality in Peel Region (i-Tree Eco model and Urban Tree Canopy (UTC) cover mapping assessment). A suggested monitoring scenario consists of a cover mapping assessment (UTC) at a five year interval and a field-based assessment (i-Tree Eco) at a ten year interval. **(On-going)**

ACTION: Report on status and trends publicly in order to build and retain public support for urban forest conservation. A comprehensive understanding by the public of the benefits of the urban forest to public health and quality of life should be the objective of this action. **(On-going)**

FOCUS AREA 2: Applied Research and Development

THEME ADDRESSED: Resource Management Approach

LEAD: Urban Forest Working Group (Area Municipalities, Region of Peel, Conservation Authorities)

PARTNERS: Academic institutions, Canadian Urban Forest Network, Consultants, Environmental Non-governmental Organizations (ENGOs), Community Members

RATIONALE: The field of urban forest management is rapidly advancing as new research and development improves monitoring capabilities, spatial analysis, risk assessment, and management practices. The Area Municipalities and Region of Peel can emerge as leaders in the application and evaluation of new tools and management practices by collaborating with academic institutions, provincial and federal research agencies, and conservation authorities. Many of the most widely used tools of analysis (e.g. i-Tree Software) have been developed and applied in the United States; such tools can be more fully refined for use in a Canadian context. Risk assessment and management can also be improved by directing focus toward many of the emerging threats to the urban forest, including climate change and invasive pests. By including neighboring municipalities and organization from across the GTA in ensuing research partnerships, the capacity to share funds and gain the support of decision makers in upper levels of government will be improved.

In addition, the local knowledge and capacity possessed by community members is a valuable asset that should be integrated directly into the strategic management of the urban forest, as community members can both contribute to and apply research.

The Urban Forest Working Group will facilitate the identification of new techniques and technologies and will assist municipalities, groups and individuals in adopting (and adapting) them to ensure the sustained supply of ecological, economic and social benefits from Canada's urban forests. The outcomes of this objective are intended to promote interdisciplinary planning based on a sound understanding of ecological attributes and functions in urban settings.

ACTION: Identify critical research questions and information gaps that must be addressed in order to manage the urban forest effectively and mitigate the threats and impacts to this resource. **(Short term)**

ACTION: Identify potential research partners and explore new means of building connections among researchers, practitioners and community members. **(Medium term)**

ACTION: Identify new techniques and technologies through on-going communication with the Canadian Urban Forest Network (CUFN), academic institutions, Canadian chapters of the International Society of Arboriculture (ISA), Tree Canada, private consultants, environmental non-governmental organizations and other national and international agencies with an urban forest mandate. **(On-going)**

GOAL 7: Secure long-term funding for urban forest management

THEME ADDRESSED: Resource Management Approach

LEAD: Urban Forest Working Group (Area Municipalities, Region of Peel, Conservation Authorities)

PARTNERS: Ministry of Natural Resources, Environment Canada, Ministry of Health, Conservation Foundations

RATIONALE: Stable funding for urban forest management is necessary to ensure that existing and future residents of Peel Region can continue to benefit from the services provided by the urban forest in the long term. A lack of funding leads to an ad-hoc, reactive approach to management, which leaves the urban forest vulnerable to cumulative stress. To achieve the goal of stable funding, a shift in public and private investment is needed, whereby the urban forest is recognized and funded as essential infrastructure. The Urban Forest Working Group can seek partnerships that will create opportunities to leverage funding and resources; partnerships should be diverse and extend beyond the field of urban forestry to incorporate members of the health care and education sector.

ACTION: Develop a business case for the urban forest as natural infrastructure to secure funding from all levels of government. The business case should be built from a comprehensive cost-benefit analysis of the urban forest as a municipal asset. **(Medium term)**

ACTION: Research opportunities to leverage funding through new partnerships and collaboration. **(Medium term)**

ACTION: Develop an incentives program for tree planting and establishment on private property (e.g. energy rebates and stormwater fees). Explore the potential to build a revenue stream for financial incentives or subsidies gained from tree removal permit fees and penalties for by-law infractions. **(Medium term)**

GOAL 8: Provide comprehensive training, education and outreach to residents and members of the public and private sectors

FOCUS AREA 1: Residents

THEME ADDRESSED: Community Framework

LEAD: Urban Forest Working Group (Area Municipalities, Region of Peel, Conservation Authorities)

PARTNERS: Community groups, Landscape Ontario

RATIONALE: Residential property owners and tenants manage the large majority of the urban forest; as such their cooperation is essential to achieving all future urban forest targets and goals. Investing in education and outreach in order to engage residents as active stewards of the urban forest will provide the greatest results by way of enhancing the function and sustainability of this natural infrastructure.

Photo Credit: Toronto Region Conservation Authority

Outreach and education programs should endeavor to increase community awareness of the services provided by the urban forest and articulate the manner in which these services improve human health and well-being. Assistance can also be provided to residents for tree selection, placement, planting, maintenance and protection to ensure that potential benefits are maximized. It follows that partnerships between commercial growers, arborists, landscapers and community residents should be strengthened to ensure that residents can obtain the planting stock and tree care services needed.

ACTION: Conduct a detailed assessment of opportunities to enhance urban forest stewardship through public outreach programs. **(Medium term)**

FOCUS AREA 2: Municipal Government

THEMES ADDRESSED: Resource Management Approach, Community Framework

LEAD: Urban Forest Working Group (Area Municipalities, Region of Peel, Conservation Authorities)

PARTNERS: All Municipal Staff

RATIONALE: Municipal staff must be provided with the knowledge necessary to sustainably manage both natural and grey infrastructure. Objectives for all forms of infrastructure, whether natural or grey, should be valued equally. Training and information sharing sessions for departments and agencies that affect, or are responsible for, tree health and tree habitat can ensure that all staff members are working with the same vision and toward the same end. Relevant departments and agencies include municipal parks, public works, planning, transportation, property management, and health departments, as well as school boards.

ACTION: Facilitate training, education and professional development for all public sector staff that engage in urban forest management activities or whose operational mandate influences urban forest sustainability. **(On-going)**

FOCUS AREA 3: Industry

THEME ADDRESSED: Community Framework

LEAD: Urban Forest Working Group (Area Municipalities, Region of Peel, Conservation Authorities)

PARTNERS: Business Owners, Chambers of Commerce, Ontario Business Improvement Areas Association (OBIAA), Industry Members, Partners in Project Green and Landscape Ontario

RATIONALE: By protecting and maintaining trees in commercial and industrial areas, business owners and industry members can help to improve air quality, decrease stormwater flow over imperivous surfaces, and mitigate the heat island effect (see Box 1). In return for such stewardships efforts, these healthy trees will attract customers to commercial areas and potentially increase profit for business owners. Tree cover can also decrease repair costs for parking lots and other built surfaces. Increased tree cover in industrial lands can improve the aesthetic image of these areas as well as the community perception of industry members. Providing training in proper tree care techniques, as well as assistance in tree planting and establishment, will create opportunities to increase tree cover in a commercial or industrial setting. Expanding existing partnerships (e.g. Partners in Project Green) to further include objectives for tree establishment and maintenance will help to achieve this goal.

The horticultural and landscaping industry can continue to play an integral role in sustainable urban forest management by providing all customers with suitable, genetically diverse, non-invasive planting stock, as well as accurate information on tree selection, planting and care. Through collaborative efforts with Landscape Ontario, the Urban Forest Working Group can ensure that current threats, trends, and new research in urban forestry is communicated to industry members in Peel Region so that goals and actions are complementary among practitioners.

ACTION: Identify and pursue opportunities to build and expand partnerships with business owners and industry members for the purpose of increasing tree cover and improving tree health in the commercial and industrial areas of Peel Region. **(Medium term)**

ACTION: Identify and pursue opportunities to work with Landscape Ontario to increase awareness among members of the horticultural and landscaping industry of threats, trends and new research in urban forestry. **(Medium term)**

FOCUS AREA 4: Institutional Landholders

THEME ADDRESSED: Community Framework

LEAD: Urban Forest Working Group (Area Municipalities, Region of Peel, Conservation Authorities)

PARTNERS: Hospitals and Healthcare Providers in Peel Region, Peel District School Board, Dufferin-Peel Catholic District School Board, Universities and Colleges in Peel Region.

RATIONALE: Although institutional lands represent a relatively small amount of the total regional land area, these lands have the potential to contribute a significant amount to the total volume of services provided by urban trees in Peel Region. Hospital and campus landscapes are commonly maintained to provide a park-like setting with abundant open space ideally suited to tree establishment. Additional tree cover on hospital grounds will offer mental and physical health benefits and provide a more healing environment for patients. [2] Opportunities also exist to increase tree cover on public and private school grounds; tree cover in school grounds can protect students from ultra-violet radiation, provide interactive outdoor education opportunities, and reduce symptoms of Attention Deficit-Hyperactivity Disorder (AD/HD) and violent behavior. [3]

ACTION: Engage hospitals, universities and colleges in Peel Region in urban forest management by working with these landholders to develop tree management plans. **(Medium term)**

ACTION: Identify and pursue opportunities to work collaboratively with Peel District School Board and Dufferin-Peel Catholic District School Board to increase tree cover on school grounds. **(Medium term)**

School yard in Peel Region lacking tree cover.
Photo Credit: P. Tripodo

Tree cover in a Toronto school yard.
Photo Credit: M. Eastwood

[2] See for example: Ulrich, R. 1984. View through window may influence recovery from surgery. Science 224: 420-421
[3] Several programs are available that support and guide school ground greening, including the *Toyota Evergreen Learning Grounds* program, and Tree Canada's *Greening Canada's School Grounds* program.

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Glossary

Biotic and abiotic elements: Biotic elements are the living elements of an ecosystem; abiotic elements are the nonliving elements of an ecosystem.

Brownfield: Derelict, dysfunctional or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. They have the advantage of having infrastructure in place and a variety of potential uses which can contribute to urban intensification, community revitalization, economic development and jobs, and/or new housing to take the pressure off greenfields.

Canopy cover: The percent of a given area that is covered by tree canopies (and potentially shrubs).

Carbon sequestration: The process of removing carbon from the atmosphere and depositing it in a reservoir. As a tree grows, it removes, or sequesters, carbon dioxide from the atmosphere.

Carbon storage: Carbon that is currently held in tree tissue (roots, stems, and branches). When a tree dies, much of the stored carbon is released back to the atmosphere through decomposition.

Carbon sink: A natural or artificial reservoir that accumulates and stores some carbon-containing chemical compound for an indefinite period.

Climate change adaptation: An adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, to moderate harm or exploit beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.

Climate change mitigation: Human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Criteria air contaminant: An air pollutant for which acceptable levels of exposure can be determined and for which an ambient air quality standard has been set. Examples include: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, PM10 and PM2.5.

Ecosystem services: The benefits people obtain either directly or indirectly from ecological systems. They include regulating services such as climate stabilization and flood control, and nonmaterial assets such as aesthetic views or recreational opportunities.

Existing TC: The amount of tree canopy present when viewed from above using satellite imagery.

Exotic invasive species: Exotic species are not native to a region but have been introduced either accidentally or intentionally. They become invasive when they out-compete native species for available resources, reproduce prolifically, and dominate regions and ecosystems.

Externality: An externality is a side effect of an economic transaction whose damages or benefits are not taken into account in the price of the transaction. Water pollution from industries is an example of a negative externality.

Family: One of eight taxonomic ranks used to classify organisms in biology. It is the taxon directly above *genus*.

Genus: One of eight taxonomic ranks used to classify organisms in biology. It is the taxon below *family* and above *species* (plural, *genera*). In accordance with the binomial system of nomenclature developed by Carolus Linnaeus, the first part of an organism's name designates the genus and the second part indicates the specific epithet. For example, *Quercus alba* is the scientific name for white oak; *Quercus* (oak) is the genus and *alba* (white) is the specific epithet that indicates the distinct species. All oak species share the same genus (*Quercus*).

Grey field: Economically obsolescent, outdated, failing, and/or underused real estate assets or land.

Grey infrastructure: Grey infrastructure consists of roads, sidewalks, buildings, parking lots, and utilities.

Impervious cover: Impervious cover or surface describes a hard surface area that does not permit water to penetrate into the natural soil. Impervious cover includes roads, buildings, and other paved surfaces.

Intensification corridor: Intensification areas identified along major roads, arterials or higher order transit corridors that have the potential to provide a focus for higher density mixed-use development.

Leaf area density: The total upper surface area of all leaves in a given study area, divided by the total size of the study area.

Microclimate amelioration: In the context of urban forestry, this refers to the capacity of trees to modify or improve the climate in a small, specific area. For example, a tree can lower the air temperature in a localized are by providing shade and transpiring water through leaf stomata.

Natural heritage feature: Natural heritage features and areas include significant wetlands, significant coastal wetlands, fish habitat, significant woodlands south and east of the Canadian Shield, significant valleylands south and east of the Canadian Shield, significant habitat of endangered species and threatened species, significant wildlife habitat, and significant areas of natural and scientific interest, that are important for their environmental and social values as a legacy of the natural landscapes of an area.

Natural heritage system: A system made up of natural heritage features and areas, linked by natural corridors which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species and ecosystems. These systems can include lands that have been restored and areas with the potential to be restored to a natural state.

Natural infrastructure: Natural infrastructure is our natural life support system. It provides the foundation for all ecosystem services within the landscape. It sustains life, promotes health, and shapes culture. It includes natural features such as bedrock, topography, soils, groundwater, surface water features, forests and specialized ecosystems such as prairies and alvars. In settled areas, natural infrastructure extends from city gardens to rural agricultural lands, urban tree cover to natural forests, urban bio-swales to dynamic river systems.

Natural regeneration: Renewal of the forest achieved either by natural seeding or from the vegetative reproduction of plants on the site.

Possible TC: Includes both impervious possible tree canopy and vegetation possible tree canopy. Impervious possible tree canopy is asphalt or concrete surfaces - excluding roads and buildings - that are theoretically available for the establishment of tree canopy. Vegetated possible tree canopy is grass or shrub area that is theoretically available for the establishment of tree canopy. This estimate does not consider land use preferences.

Resilient: A resilient natural system resists damage and recovers quickly from stochastic disturbances such as fires, flooding, windstorms, insect population explosions, and human activities such as deforestation and the introduction of exotic plant or animal species.

Service delivery area (SDA): Geographies intended to support service planning and delivery by providing service providers with data that is relevant to the local geographies they serve. SDAs were drafted based on homogeneous, socioeconomic census characteristics and determined through broad consultation with the service provider community. SDAs reflect service providers' reports of how and where residents' actually access services. SDAs are comprised of census dissemination areas (the smallest standard geography for census data) and have varying population thresholds for each municipality.

Species: One of eight taxonomic ranks used to classify organisms. *Species* is the basic unit of classification that describes a group of organisms with a common gene pool. It is the taxon below *genus.* In accordance with the binomial system of nomenclature developed by Carolus Linnaeus, the first part of an organism's name designates the genus and the second part indicates the specific epithet. For example, *Quercus alba* is the scientific name for white oak; *Quercus* (oak) is the genus and *alba* (white) is the specific epithet that indicates the distinct species.

Urban heat island (UHI) effect: Occurs in urban and suburban areas where surface temperatures are significantly warmer than nearby rural areas.

Urban intensification: A planning process that, by encouraging development at higher densities than currently prevail in an area, can achieve objectives of the compact city. This process involves the re-use of brownfield land, more intensive use of urban buildings, sub-divisions, and conversions of existing development, and an increase in the density of population in urban areas.

APPENDIX A: Benefits Provided by the Urban Forest

The urban forest provides a number of valuable ecosystem services. A non-exhaustive discussion of the relevant services is offered here.

Air Quality

Urban air pollution negatively impacts human health. Exposure to common transport-related air pollutants, such as particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO), has been linked to various health problems, including: inflammation of the respiratory tract; exacerbated allergic reactions in asthmatics; adverse outcomes in pregnancy; and increased mortality risk due to heart attack, cardiopulmonary and respiratory complications (Kuna-Dibbert and Krzyzanowski, 2005). These risks are not equally distributed across the population. Rather, children and elderly persons with pre-existing chronic disease have shown increased susceptibility to the adverse effects of exposure to air pollutants.

By significantly reducing the amount of airborne pollutants, trees can mitigate the potential health problems associated with poor air quality. Trees reduce the amount of airborne particulate matter by intercepting and storing large airborne particulate on outer leaf, branch, and bark surfaces (Nowak et al., 2006). In addition, trees improve air quality by binding or dissolving water-soluble pollutants onto moist leaf surfaces. Other gaseous air pollutants, such as carbon monoxide and sulphur dioxide, are removed primarily by leaf stomatal uptake (Smith, 1990).

Ground level ozone (O_3) is not emitted directly but is created by chemical reactions between oxides of nitrogen and volatile organic compounds (VOCs) in sunlight. Although trees are a source of VOC emissions, the net effect of tree cover on the landscape is usually positive with respect to O_3 formation (Cardelino and Chameides, 1990; Taha, 1996). Because VOC emissions are temperature-dependent and trees have been found to lower air temperatures, increased tree cover can lower overall VOC emissions and, subsequently reduce ozone levels in urban areas (Nowak and Dwyer, 2007). Furthermore, increasing tree cover over parking lots can reduce VOC emissions by shading parked cars and thereby reducing evaporative emissions (Scott et al., 1999). Thus, urban trees, particularly species that emit low levels of VOCs, can contribute to the reduction of urban O_3 levels (Nowak et al., 2000). It should be noted that VOC emissions do vary by species, air temperature and other environmental factors (Guenther et al., 1994).

Carbon Dioxide Reduction and Energy Conservation

Urban forests also play a role in climate change mitigation by reducing atmospheric carbon dioxide (CO_2) concentrations. This is achieved by sequestering and storing carbon as woody biomass, carbon sequestration and storage, reducing greenhouse gas (GHG) emissions by conserving energy used for space heating and cooling, or displacing GHG emissions by using urban tree residue as bio-energy fuel.

Trees reduce atmospheric CO_2 levels through photosynthetic uptake and subsequent carbon sequestration in woody biomass. During photosynthesis, atmospheric CO_2 enters the leaf through surface pores, combines with water, and is converted into cellulose, sugars, and other materials in a chemical reaction catalyzed by sunlight. Most of these materials then become fixed as wood, while a small portion are respired back as CO_2 or are utilized in the production of leaves that are eventually shed

by the tree (Larcher, 1980). Nowak (1994b) found that the net annual carbon sequestration by trees in Chicago equaled the amount of carbon emitted from transportation in one week in the Chicago area. Furthermore, the amount of carbon emitted by the U.S. population over a 5.5 month period was equal to the estimated carbon storage by urban trees in the United States (Nowak and Crane, 2002).

Trees that are adjacent to buildings can reduce the demand for heating and air conditioning through their moderating influence on solar insolation and wind speed. In addition, trees ameliorate climate by transpiring water from their leaves, a process that has a cooling effect on the atmosphere. Thus, the effective placement of a tree or shrub can lower building temperatures. Simpson and McPherson (1999) report that by planting two large trees on the west side of a house, and one large tree on the east side of a house, homeowners can reduce their annual air conditioning costs by up to 30%. Potential GHG emission reductions from urban forestry are likely to be greatest in regions with large numbers of air-conditioned buildings and long cooling seasons. However, in colder regions where high energy demands are high during winter months, trees that are properly placed to create windbreaks can also substantially decrease heating requirements and can produce savings of up to 25% on winter heating costs (Heisler, 1986). This reduction in demand for heating and cooling in turn reduces the emissions associated with fossil fuel combustion (Simpson and McPherson, 2000).

Utilizing urban tree biomass as feedstock for bio-power plants eliminates GHGs that would have been emitted by combusting fossil fuels. The most common way to convert tree biomass to energy is by burning wood fuel to produce heat that powers turbines. However, the cost effectiveness of utilizing removed city trees as a bio-energy feedstock has not yet been well-researched. According to the California Climate Action Registry (2008) there can be costs associated with initial processing at the removal site, transporting to a transfer station, processing facility, or bio-energy facility, storing in open piles, and handling, usually through a combination of automatic conveyors and driver-operated front-end loaders. Research is also underway to develop more efficient processes for converting wood into fuels such as ethanol, bio-oil, and syngas (Zerbe, 2006).

Stormwater Management

When stormwater hits impervious surfaces, the water is heated and various pollutants, including lawn fertilizers and oils on roadways, are picked up by the runoff. Water quality problems then arise when large volumes of polluted stormwater flow into receiving waters, posing threats to temperature sensitive species and providing suitable conditions for algal blooms and nutrient imbalances (Kollin, 2006). Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows. The urban canopy also filters pollutants that eventually flow to receiving waters. Once runoff is infiltrated into soils, plants and microbes can naturally filter and break down many common pollutants found in stormwater.

Tree roots also increase the rate at which rainfall infiltrates soil as well as the capacity of soil to store water, thereby reducing overland flow. Transpiration through tree leaves then reduces soil moisture, increasing the soil's capacity to store future rainfall. By increasing infiltration rates, urban vegetation also limits the frequency of sewer overflow events by reducing runoff volumes and by delaying stormwater discharges. In addition, tree canopies reduce soil erosion by diminishing the impact of rainfall on barren surfaces.

The trees and woody shrubs that comprise urban riparian buffers also improve water quality through filtration of sediment and contaminants, vegetative uptake of soluble nutrients, and infiltration of

overland runoff from surrounding fields and hillslopes. Removal of over half the phosphorus, nitrogen and sediment inputs is typically achieved within the first 15 m of buffer width (Osborne and Kovacic, 1993; Castelle *et al.*, 1994). Woody riparian vegetation also stabilizes banks and moderates stream temperature by providing shade.

Land use change associated with urbanization can negatively impact hydrologic processes. A summary of recent literature provided by Endreny (2005) concludes that conversion to urban cover results in the following: a reduction in stormwater interception as a consequence of the loss of tree and vegetative cover; a decrease in infiltration as a consequence of soil compaction and an increase in impervious cover; and, a decrease in evaporation due to reduced soil water volumes. The result is then an increase in peak runoff magnitude from precipitation events, which can scour and destabilize many urban channels (Riley, 1998). Although many models have been created to examine the effects of land use change on urban hydrology, i-Tree Hydro, created by the USDA Forest Service, is the only model designed to explicitly examine tree effects on stormwater. This model was therefore utilized in this study.

Social and Mental Health Benefits

Although more difficult to quantify, the urban forest provides a variety of important social benefits. Urban trees have been shown to reduce neighborhood crime levels. For example, Kuo and Sullivan (2001) found that apartment buildings with high levels of greenery witnessed 52 percent fewer crimes than those without trees. This research suggests that trees reduce crime in two ways: first, frequent encounters with nature can help to soothe violent temperaments; second, trees deter crime by increasing surveillance on city streets, as people tend to use treed spaces more than treeless spaces.

Hospital patients were found to recover from major surgery more quickly and with fewer complications when provided with a view of trees (Ulrich, 1984). Trees and urban parks also improve mental health and over all well-being by conveying a sense of calm and facilitating relaxation and outdoor activity. In addition, trees effectively reduce noise levels by absorbing unwanted sound (Aylor, 1972; Cook, 1978).

Girls living in a Chicago public house development that had greener, more natural views scored better on tests of self-discipline than those living in more barren but otherwise identical housing. The study tested children on three component abilities of self-discipline: concentration, inhibition of impulsive behavior, and delay of gratification. Girls with green views scored higher on average than girls with less green views on all three tests (Faber Taylor *et al.,* 2002).

Faber Taylor and Kuo (2009) tested children with Attention Deficit-Hyperactivity Disorder (AD/HD) in a controlled setting after they had walked in one of three environments that differed from one another in the level of greenery: a park, a neighborhood, and a quiet downtown area. The findings confirmed that the attention of children with AD/HD functions better after spending time in more natural settings

Residential common areas with trees can also help to build strong neighborhoods. In a study conducted at a Chicago public housing development, residents of buildings with more trees and grass reported that they knew their neighbors better, socialized with them more often, had stronger feelings of community, and felt safer and better adjusted than did residents of more barren, but otherwise identical, buildings (Kuo *et al.,* 1998).

Traffic and Pedestrian Safety

Research suggests that trees may improve driving safety. Drivers seeing natural roadside views demonstrated lower levels of stress and frustration compared to those viewing all-built settings (Parsons *et al*. 1998). A study conducted by Mok *et al*. (2006) found a 46% decrease in crash rates across urban arterial and highway sites after landscape improvements were installed. Similarily, research conducted by Naderi (2003) found that placing trees and planters in urban arterial roadsides reduced mid-block crashes by 5% to 20%.

Economic Benefits

A healthy urban forest is a municipal capital investment that will appreciate in value over time. As urban forests grow, their environmental, social and economic benefits increase. The process of valuation of the goods and services provided by the urban forest and surrounding natural system is currently receiving considerable attention across all fields of conservation. A comprehensive assessment of this area of research is beyond the scope of this review; therefore, only a few key examples of this research are offered here.

DeGroot *et al.* (2002) proposed a framework for the valuation of ecosystem functions, goods and services that is based on the synthesis of complex ecological structures and processes into a more limited number of ecosystem functions that provide ecosystem goods and services valued by humans. This framework can be used at various scales; for example, to calculate the natural capital assets within the TRCA jurisdiction, a watershed, or an individual site.

The Pembina Institute and Credit Valley Conservation (2009) estimated the value of ecosystem goods and services in the Credit River Watershed using a benefit transfer methodology that focused on the non-market value of ecosystem services; this non-market value was derived from a "willingness to pay" approach.[4] The report found that the value of the natural capital provided by the urban forest in the watershed was estimated at 18.7 million dollars annually.[5] This estimate included the value of the following services: climate regulation; gas regulation; water supply; pollination; recreation; and amenity and cultural.

There are numerous challenges associated with ecological valuation. For example, many ecosystem services are difficult to measure directly (e.g. gas exchange) and therefore require the use of surrogates or indicators (Cuperus *et al.*, 1996; Bond and Pompe, 2003). Furthermore, in the absence of local jurisdictional data, the best matching default values and parameters must be selected in order to calculate the value of ecosystem services. Consequently, values derived are often generalized for a large geographic area and are not site-specific. Thus, this field of research is still rapidly evolving in an effort to address these challenges.

A direct economic benefit of urban vegetation is observed in the relationship between tree cover and property value. Both residential tree cover and proximity to green space have been associated with higher property values in residential neighborhoods (Dombrow *et al*., 2000; Anderson and Cordell, 1988). The Center for Urban Forest Research (2005) estimates that properties with trees are valued five

[4] An individual's willingness to pay for an ecosystem service can be used to assign a value to a particular ecological good or service. Please see Pembina Institute and CVC (2009) for a more detailed discussion of this approach.
[5] This value was considered the minimum lower bound of the natural capital value.

to fifteen percent higher than comparable properties without trees. Furthermore, research shows that shoppers in well-landscaped business districts were willing to pay more for both parking and goods and services (Wolf, 1999).

Urban tree cover can also increase the longevity of grey infrastructure thereby reducing the frequency of costly repairs. McPherson and Muchnick (2005) have demonstrated that tree shade is correlated with reduced pavement fatigue, cracking, rutting, shoving, and other distress. Subsequently, infrastructure maintenance costs can be reduced by increasing tree cover over asphalt. For example, repaving could be deferred ten years on a well-shaded street and potentially 25 years on a heavily shaded street.

An emerging valuation scheme in which urban forestry has begun to receive attention is the global carbon market. While carbon accounting through carbon offset programs has become a relatively well established protocol, in the past such programs generally operated outside the realm of urban forestry. In 2008 the California Climate Action Registry released the *Urban Forest Project Reporting Protocol Version 1.0*; this protocol was subsequently updated and rereleased as version 1.1 in March 2010. The Protocol provides guidance to account for and report greenhouse gas emission reductions associated with a planned set of tree planting and maintenance activities to permanently increase carbon storage in trees (Climate Action Reserve, 2010). This protocol is applicable to urban forest GHG projects undertaken by municipalities, educational campuses and Utilities. Only projects operating within the United States are eligible at the time of release of this report.

Wildlife Habitat

As rural forests are replaced with urban development, wildlife species are displaced or removed from the landscape completely. Construction activities destroy habitat and result in animals abandoning the area - eliminating these species both from the site, and from adjacent areas (Schaefer 1996). In Peel Region and southern Ontario as a whole, few large and connected woodlands remain to serve as habitat for native and migratory fauna species. Consequently, the urban forest now plays an increasingly important role in biodiversity conservation and habitat provision for these species.

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APPENDIX B: Summary of Stakeholders Workshop

Date: November 10, 2010, 9:00 am – 4:00 pm
Location: Loafer's Lake Recreation Centre, Brampton

INTRODUCTION AND OBJECTIVES

Objectives of the workshop:

- To present findings and draft recommendations from Technical Reports to stakeholders
- To develop the framework of the Strategy
- To build a constituency around implementing the Strategy

Welcome provided by Simone Banz, Region of Peel

Introduction of Participants:

The Workshop was organized and facilitated by Toronto and Region Conservation Authority (TRCA) staff, including Lionel Normand (Project Manager), Meaghan Eastwood (Coordinator) and Ziya He (Technician) with assistance from student volunteers Amanda Suksagar and Michelle Attard.

Thirty-eight stakeholders participated in the workshop, including:

Stakeholder	Affiliation	Title
Alice Casselman	Association for Canadian Educational Resources (ACER)	President
Mara Samardzic	Building, Industry and Land Development-(BILD) GTAH & Peel	Planning and Policy Analyst, Gov't Relations
Ed Fagan	City of Brampton	Forestry Supervisor
Gary Linton	City of Brampton	Manager of Central Operations (Horticulture, Forestry & Cemetery Services), Parks Maintenance and Operations
Michael Hoy	City of Brampton	Environmental Planner
Ken Gilmer	City of Brampton	Emergency Measures Coordinator
Werner Kuemmling	City of Brampton	Planning Design and Development, Open Space
Brian Baird	Town of Caledon	Manager, Parks, Public Works and Engineering
Dr. Aviva Patel	Credit Valley Conservation	Terrestrial Specialist
Mike Puddister	Credit Valley Conservation	Director, Restoration & Stewardship
Paul Tripodo	Credit Valley Conservation	Urban Ecologist
Doris Chee	Hydro One Corporation	Landscape Architect
Janet McKay	Local Enhancement & Appreciation of Forests (LEAF)	Executive Director

Allyssa Thienes	Malone Given Parsons Ltd.	Planner/Urban Designer
Nory Takata	Town of Markham	Parks Planner
Andy Wickens	City of Mississauga	Manager Parks and Forestry
Brian Chan	City of Mississauga	Transportation and Works, Storm Drainage Coordinator
Eva Kliwer	City of Mississauga	Planner
Samantha Chung	City of Mississauga	Forest Ecologist
Bohdan Kowalyk	Ministry of Natural Resources	District Forester
John McNeil	Town of Oakville	Manager Forestry & Cemetery Services
Tracy Appleton	Peel District School Board	EcoSchools
Janet Wong	Region of Peel	Planner, Planning Policy and Research
Liz Brock	Region of Peel	Technical Analyst, Transportation, Public Works
Mark Head	Region of Peel	Manager, Planning Policy and Research
Simone Banz	Region of Peel	Manager, Planning Policy and Research
Louise Aubin	Region of Peel	Manager, Environmental Health
Arnold Mostert	City of Pickering	Coordinator, Landscape and Parks
Rike Burkhardt	City of Toronto	Planner, Urban Forestry, Ravine Protection
Clifton Coppolino	Toronto and Region Conservation Authority	Stewardship Coordinator, Etobicoke/Mimico Watershed
Colleen Cirillo	Toronto and Region Conservation Authority	Project Coordinator, Green Infrastructure Ontario Coalition
Dena Lewis	Toronto and Region Conservation Authority	Manager, Terrestrial/Aquatic Ecology
Joanne Jeffery	Toronto and Region Conservation Authority	Manager, Stewardship and Outreach Education Programs
Leilani Lee-Yates	Toronto and Region Conservation Authority	Senior Planner
Dr. Andy Kenney	University of Toronto	Senior Lecturer and Coordinator, Masters of Forest Conservation Program
Sadia Butt	University of Toronto	
Dr. Tenley Conway	University of Toronto, Mississauga	Assistant Professor, Geography
Alex Satel	Urban Forest Innovations Inc.	Arborist

OPENING EXERCISE

Why is an urban forest study timely?

Participants were asked to list the reasons why this urban forest study and Strategy were timely. This would be used to identify as a group our common agreement of the need for the Strategy prior to engaging in detailed discussions throughout the day. Reasons are listed here:

- Can't manage what we don't know – require baseline data

- Time to involve the community – there are new community members (new Canadians) that need to be introduced to the urban forest
- Climate change
- Urgency
- Helps us focus our resources – targeted outreach
- Opportunity to break down barriers
- Examine the urban forest from a landscape level
- Little policy support at higher level, but increasing recognition in Official Plans
- People want to steward the urban forest (human capital) – need direction
- Urban intensification – limited space
- Involve residents adjacent to natural system
- Convince politicians
- Tree planting and establishment is a cost effective climate change mitigation strategy
- Study provides answers to questions being asked by politicians and public – can now be confident in our answers
- It's about time
- Connection to community health being made
- Multiple services provided to community – we now have ability to quantify services – cost / benefit analysis
- Challenge will be communicating importance beyond workshop attendees
- Tools are now available that facilitate the analysis
- Aging infrastructure
- Allow us to determine a vision for the future
- Enable developers to be proactive

Outcome: participants agreed that there is a need, even urgency, for a formal urban forest strategy.

VISION STATEMENT EXERCISE

As a group, first the important elements for a vision were identified, discussed and listed. Then seven working groups each drafted a vision statement as written below by incorporating the elements (bolded).

1) Giving priority to maintaining, and enhancing a healthy, accessible, resilient urban forest, with **full participation of the entire community to plant, grow, and steward trees,** using innovative, collaborative partnerships**.**

2) The urban forest in Peel Region is healthy, green, beautiful and inspiring to the community. It's larger than it was yesterday and growing every day. **It protects us and gives us life.**

3) A sustainable urban forest is one that is **healthy** and connected. Management of the urban forest takes a long-term approach. **Stewardship** and education are key components. Supports a wide variety of **ecosystem services**. (Vision should be non-technical and easy to read).

4) Giving people a **place to reconnect** with each other in a growing, healthy, **safe**, and hospitable urban forest.

5) **We envision a healthy urban forest that grows with the community providing diverse benefits for all.**

6) To recognize the **common commitment and responsibility** to effectively achieve urban landscapes that **integrate green infrastructure** in such a way to ensure a sustainable future.

7) The community is **fully committed** at all levels to the **stewardship** of the urban forest, in order to ensure it provides a **sustainable supply of ecological, social and economic services.**

Outcome: Following the workshop TRCA staff worked to capture the key messages and themes in the stakeholders' statements to develop a composite, final vision for the urban forest in the Region of Peel, as written below. The outcome was then circulated back to stakeholders in the meeting notes for comments and selected as the Strategy's vision statement.

> ***Our vision is for a healthy and resilient urban forest that provides diverse and sustained benefits to all and is grown from a shared commitment by all members of the community to the stewardship and care of this vital infrastructure.***

PRESENTATION OF TECHNICAL RESULTS

Meaghan Eastwood presented a review and discussion of the technical results and preliminary recommendations. Questions and a discussion followed regarding the technical results, including the following points:

- Ability to predict leaf litter volume would be useful.
    - Metric could be used to encourage leaf compost be highlight the potential contribution made by trees to individual/municipal compost
    - Leaf litter identified as a possible reason that residents dislike trees in yards
- Draw connection to inventoried areas impacted by ice storm
- General discussion around need for Canada / Ontario based research centre that could refine and assist with delivery and implementation of i-Tree tools:
    - Calibrate based on municipalities requirements; it is up to us and we need to identify the appropriate research areas
    - Province must take leadership role
    - MNR already engaged; need to support middle management
    - Study will be repeated; will be beneficial to pursue this
    - Should be federal as well - current mandate not clear on this issue
    - Use results at GTA level to gain/ acquire more interest in this area
- Can be creative in the presentation of results in order to reach a broader audience (user-friendly presentation).
- General discussion about the vision for / definition of the urban forest:
    - Definition must include more than just tree cover
    - Careful to not simplify down to the point where definition becomes short-sighted

Outcome: Participants were informed of the state, function and distribution of the urban forest in Peel as a prerequisite for afternoon discussions on needed actions.

CRITERIA AND INDICATORS

Dr. Andy Kenney introduced the framework of "Criteria and Indicators of Urban Forest Sustainability" (See Appendix C) that was used in the Technical Reports. The framework also provided the structure for the afternoon work sessions. Stakeholders selected criteria that should be considered for implementation in the first five years of the Regional Strategy. Eight were selected, as follow:

1. General Awareness
2. Tree Inventory
3. Municipality-wide Fundraising
4. City-wide Management Plans
5. Native Vegetation
6. Relative Canopy Cover
7. Public Agency Collaboration
8. Species Distribution

Outcome: The eight criteria selected from the standard framework provided focal points for discussions on actions. More importantly, this would provide direction for the development of goals and actions in the Strategy to be implemented by stakeholders of the urban forest in Peel.

AFTERNOON EXERCISE

Members of the Technical Working Group (TWG) were assigned to one of seven tables and asked to lead the discussions on the implementation of the eight selected criteria. The discussions covered the municipality's current status under each criterion (using the framework's indicators), urban forest promotion opportunities and limitations, and actions needed (collaboration, funding, education, policies, etc). The results, summarized below, were then shared and discussed further by all participants.

General Awareness:

- Status: Moderate
- Barrier:
    - Manicured mindset that prevails across private and public land – must move towards a naturalized urban environment
    - Lack of clear goals
    - Municipal practices don't provide good example of desired behavior (overly manicured)
    - Lack of coordination
- Opportunities:
    - Set goals for tree cover, either at the Regional level, or at the Area Municipal level
    - Set goals for trees planted per year
    - Education for kids – building from the bottom up; engage kids through school yard naturalization
    - Education for staff as well
    - Setting up neighbourhood competitions to generate interest
    - Must also take ownership of care and maintenance
    - Expand LEAF's backyard tree planting program to Peel

- Lots of existing programs that can be "piggy-backed" on (e.g. SNAP, new resident's education package, community planting events)

Tree Inventory:

- Status: Moderate
- Need more detailed data, or any data at all
- Need to broaden the type of inventory – Emerald Ash Borer
- Utilize Emerald Ash Borer as an opportunity to gain support for resource management
- What is the right amount of inventory to gain support?
  - How do we design an effective sample?
- Opportunities:
  - Standardized approach to data collection
  - Software that facilitates inventory collection
  - Education: communicate value of green infrastructure in the protection of grey infrastructure
  - More successfully engage Council and build interest in urban forestry
  - Must secure long-term commitment and funding for updating inventories regularly and revisiting sample plots
  - Ensure effective inventory design by asking the questions:
    - Do the data collected answer the questions being asked?
    - Are the data sets adequately robust?
    - Is the inventory sustainable?
- Best management practices: Canadian Urban Forest Network (CUFN) List Serve

Municipality-wide fundraising:

- Status: Low
- Barriers:
  - Lack of qualified staff; utilizing volunteers can comprise quality of data
  - Competition for taxes; funding decisions are political
  - Funding priorities on legislated activities, such as health and safety. Urban forests are not recognized through legislation, thus funding will only be available if the value (healthy and safety) of the urban forest is understood.
  - Zoning by-laws do not fulfill urban forest objectives; once building permit is issued tree by-law doesn't apply
- Needs:
  - Repeat i-Tree Eco every 5 yrs in order to track trends; must put request for funding in now for 2015 (need to think ahead if building into capital budget)
  - Provincial direction for standards for trees (e.g. annual inspection of lights)
  - Legislative mandate
  - Long-term funding for maintenance and capital projects to implement the Strategy
  - Development standards, guidelines and regulations that include tree protection and tree planting minimum requirements that would be implemented through site plan control and subdivision development.
  - Mandatory canopy cover targets under Planning Act
- Opportunities:
  - Lobby province through AMO to gain legislative support
  - Green Design Guidelines; incentive programs only last as long as the grant

- Provincial Environmental Tax – provides environmental tax revenue to municipalities to fund green initiatives (AMO lobby)
- Tax incentives for managing private woodlots; i.e. Managed Forest Tax Incentive Program (MFTIP) at the local level. For example, suggest providing a management plan that is approved by a certified arborist and demonstrate best management practices to meet local canopy cover target = 25% back on taxes.
- Cost-benefit analysis
- Utilize enforcement fees collected for development that is encroaching on woodlands; need monitoring and staff to support this
- Create a market for Non Timber Forest Products (NTFPs) in the urban forest
- Raise profile of urban forest management at provincial level through GTA-wide partnerships
- Break down silos
- Education for staff on best management practices
- Make integrated budget discussions to identify opportunities, increase efficiency, reduce redundancy, and redirect funding where possible
- Collaboration with Peel Health
  - Public health funding allotted to preventative care solutions via urban forest
  - Currently focusing on built form: opportunity to highlight trees
  - Redirect pollution reduction efforts to tree maintenance (e.g. programs to reduce sulfur dioxide = funding for urban forest)
  - Urban heat island connection – use existing mapping
  - Channel funding for cancer research and heart and stroke research towards urban forest
  - Data sharing with public health organizations
  - Illness Cost of Air Pollution (ICAP) Model and other modeling tools used by public health could be harmonized with i-Tree Eco model
- Shade Guidelines (Toronto): example of connections that need to be made

City-Wide Management Plan

- Status: Low
- Barriers:
  - Lack of funding and support
  - Competition for space and objectives for land management
  - Lack of funding to dedicate staff for Management Plan development
  - Ownership and responsibility for actions outlined in Management Plan
- Needs:
  - Funding for coordinated efforts
  - Consider objectives of different groups
  - Must be sensitive to the existing roles, responsibilities and relationships for Region and Area Municipalities
  - Dedicated staff that focus solely on consultation and outreach for Management Plan design
- Opportunities:
  - Gain Council support by:
    - Providing a cost-benefit analysis using the results of Urban Forest Technical Reports
    - Building a business case for urban forest management

        - Using “plain” language
    - Region can lead by example on regional lands
    - Utilize existing working groups and committees (rather than create more)
    - Ensure all stakeholders have participated in design of Management Plan in order to increase “buy-in” and support during implementation
    - Provide tool-kits to municipal departments that assist in garnering support from staff

Native Vegetation:

- Status: moderate to good
- Barriers:
    - Stresses (many natives will not tolerate)
    - Public perception (i.e. exotic is beautiful)
    - Cultural values placed on native vegetation
    - Lack of information about invasive species
    - Provenance of native species
- Action Items:
    - Public lands
        - Build use of native vegetation into maintenance plans
        - Manage invasive plants
        - Identifying native seed sources
        - Conservation Authorities and municipalities must lead by example
    - Private lands:
        - Policies that require use native species during subdivision design
        - Development standards for growing conditions and growing space: allow for the greater use of native plants (that are less tolerant of typical stressors)
        - Outreach to private land owners and corporations to encourage them to become leaders in the community
    - Both:
        - Nursery outreach: looking forward to future requests
        - Seed sourcing
        - Propagation programs from natives (ensure that supply can meet demand)
        - Integrating messaging around native species with other issues like climate change, public health, or water use.

Relative Canopy Cover:

- Status: Not provided
- Need to refine and designate “true potential plantable space”
- Select a mid-term target
- Attention to nursery and seed stock
- Policy
    - Tree preservation by-laws
    - Heritage Tree Programs
    - Require Development Plans to outline shade targets
    - Inter departmental collaboration and coordination
- “Dog and pony” shows of results of studies
- Push council to adopt recommendations
- Re-allocating staff to urban forest objectives

- Monitoring to determine success
- Incentives to plant and maintain trees
- Corporate sponsorship

Public Agency Cooperation:

- Status: Not provided
- Who's Involved*:*
  - Federal / Provincial
  - Regional governments
  - Lower-tier government
  - Conservation Authorities
  - Utilities (Hydro)
  - Niagara Escarpment Commission
  - NGOs (e.g., Ontario Urban Forest Council, etc)
  - City Departments (Engineering, Planning, Operations, Roads, Parks, etc.)
- Needs:
  - "environmental departments"
  - Streetscape manual
  - Regional policies that lower-tier municipalities can strive towards, work together around
  - Working groups with dedicated leadership, kept on task and with direction
  - Higher level of government (i.e. Provincial Government)to oversee and promote public agency cooperation, supported by a broad-based Environmental Master Plan Governing Document, as issues across municipalities and regions are similar
  - Unify different initiatives so that we have a single and clear representation at multiple scales (one body representing the entire group)
  - Need a ground-swell of public support that will sustain the importance of trees beyond political time frames; public education to ensure pressure is always placed on decision makers.
  - Public cooperation between agencies promoted by broad-based municipal technical teams
  - Move towards policy direction that is based on holistic decision making
  - Break down silos
- Barriers:
  - Socio-economic differences within GTA and beyond
  - Departments andgroups not working effectively together
  - Different perceptions of the value of trees
  - Property rights and development
  - Development charges / taxes

Species Distribution:

- Status: low / moderate
- Barriers:
  - Access to models/ tools of analysis
  - Costs / funding for research?
- How do we achieve objective?
  - Broaden list of possible species to plant (diversify planting list)
  - Public education incentive

- Increasing staff
- Careful data interpretation
- Connect with nurseries
- Funding for staff
- Public information sessions

Outcome: The suggestions, ideas and discussions generated together with the results of the technical analyses and interpretation, provided the foundation for developing specific actions in the Strategy, specifically in the Strategy's Part 2: Peel Region's Urban Forest Tomorrow.

Closing remarks by Simone Banz, Region of Peel

APPENDIX C: Criteria and Indicators for Sustainable Urban Forest Management

Source: Kenney, W.A., van Wassenaer, P.J.E., A.L. Satel. 2011. Criteria and Indicators for Strategic Urban Forest Planning and Management. Arboriculture & Urban Forestry 2011. 37(3): 108–117.

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

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

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

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

APPENDIX D: Detailed Review of Resource Management Approach

Federal Policy and Programs

Limited support for urban forest research and management has been provided at the federal level. To address this gap, Tree Canada and the Canadian Urban Forest Network (CUFN) are working to raise the profile of urban forestry at the national scale. In 2004 these organizations and partners released the *Canadian Urban Forest Strategy: 2004-2006.* The most recent iteration of this Strategy was released in 2010. The Strategy provides a common national level vision as well as a framework for the development and implementation of actions associated with the following core themes: national urban forestry infrastructure; communications and public education; research; techniques and technology for urban forest planning and management; and professional development.

Urban forests gained formal national recognition when the Canadian Council of Forest Ministers (CCFM) addressed, albeit briefly, the urban forest in the *National Forest Strategy 2003 – 2008* and the Strategy's successor document, *A Vision for Canada's Forests: 2008 and Beyond*. The CCFM states:

Urban populations also have a significant influence on the management of Canada's forests. Most Canadians live in urban and suburban settings and they value what forests provide, especially urban forests where many people have learned to appreciate nature and all it has to offer. These forests and trees also contribute significantly to their collective well-being by reducing the negative effects of air pollution, conserving energy, reducing soil erosion, and providing wildlife habitat and a place for recreation and spiritual renewal. For all of these reasons, healthy urban forests are an essential component of sustainable forest management (Canadian Council of Forest Ministers, 2008).

Tree Canada is currently the only organization with a mandate for urban forest conservation that receives funding from the Federal Government, with the exception of the emergency funding provided by the federal government and provincial agencies in response to specific crises (e.g. pest outbreaks).

Provincial Policy and Programs

Provincial forestry policy currently focuses on commercial forest production and the management of forests at a rural landscape scale. At present, there are no policies that pertain specifically to urban forestry. However, there are several policies that influence urban forest management through urban planning and design; few specifically address urban forestry as a management priority.

Grow Green: Ontario's Climate Change Action Plan

As part of Ontario's Climate Change Action Plan, the provincial government has committed to planting 50 million trees across southern Ontario by 2020. The *Grow Green* program recognizes that new urban forests in southern Ontario will act as a **carbon sink** and provide shade, subsequently reducing the demand for cooling during the summer. This program will see the government work with community groups and private landowners to plant trees on public and private properties. In addition the *Urban Greening Initiative*, under the same parent program, provides funds to public agencies, institutional

landowners and community organizations undertaking volunteer-driven tree planting projects. To date, this initiative has been facilitated by Evergreen.

The Environmental Commissioner of Ontario (ECO) has stated that the target of 50 million new trees planted by 2020 will not provide sufficient forest cover, mitigate woodland biodiversity loss from invasive species, and mitigate the effects of climate change. The ECO recommends that the Ministry of Natural Resources (MNR) "lead a coordinated afforestation strategy for southern Ontario, with a target of planting 1 billion native species" (Environmental Commissioner of Ontario, 2010).

The Planning Act

The *Planning Act* is the basis for land use planning in Ontario. As it relates to the urban forest, the Act allows the provincial government to promote sustainable economic development in a *healthy natural environment* within the provincial policy framework.

The Planning Act has also been established to:

- provide for a land use planning system led by provincial policy;
- integrate matters of provincial interest into municipal planning decisions;
- provide for planning processes that are fair by making them open, accessible, timely and efficient;
- encourage co-operation and coordination among various interests; and
- recognize the decision-making authority and accountability of municipal councils in planning.

The Planning Act does not speak specifically to the urban forest. However, it does provide a number of tools through which urban forest considerations can be integrated (e.g. official plans, subdivision of land, site plan control). Furthermore, all scales of land use planning and development have a direct impact on this resource. Specifically, urban development has the potential to affect biodiversity, the amount and quality of natural spaces, tree canopy cover and leaf area, air quality, local temperatures and micro-climates, water quality, and the flora and fauna connections on the landscape. More directly, urban planning and development is decisive in determining the size and quality of tree habitat and growing space at the site level. Such considerations will directly determine the health and longevity of each urban tree.

Provincial Policy Statement

The *Provincial Policy Statement (PPS)* is issued under the authority of Section 3 of the *Planning Act* and came into effect in March 2005. The PPS provides direction on matters of provincial interest related to land use planning and development, and promotes the provincial "policy-led" planning system that addresses the complex inter-relationships among environmental, economic and social factors in land use planning.

While the PPS does direct municipalities to protect natural features through the maintenance, restoration, and improvement (where possible) of **natural heritage systems** and associated functions, it does not specifically address the urban forest outside of the key **natural heritage features**. As such, the urban forest is afforded only partial consideration under the PPS. To assist in bringing urban forests more formally into the provincial agenda, in 2010, TRCA, LEAF and other urban forest practitioners submitted a letter of recommendations for the 5-year review of the PPS. The specific recommendations to the province for integrating the urban forest into the PPS complement its vision and policies: building strong communities: wise use and management of resources; and protecting public health and safety.

Similarly, the Region of Peel, through the PPS review process, also recommended that provincial government formally address urban heat islands and associated health impacts by incorporating into existing policy landscaping designs (e.g. urban tree cover) that provide for increased shade, enhanced air quality, and reduced heat islands effects.

Growth Plan for Greater Golden Horseshoe

The *Growth Plan for the Greater Golden Horseshoe* was prepared under the *Places to Grow Act, 2005*. The plan is a framework for implementing the Government of Ontario's vision for building stronger, prosperous communities by better managing growth in the region to 2031. Central to this plan is the creation of a more compact urban form, achieved by increasing intensification of the existing built-up area. Accordingly, growth will be directed to urban growth centres, **intensification corridors**, major transit station areas, as well as **brownfields** and **grey fields**. Furthermore, cities and towns will be encouraged "to develop as complete communities with a diverse mix of land uses, a range and mix of employment and housing types, high quality public open space and easy access to local stores and services" (Ministry of Public Infrastructure and Renewal, 2006).

Such changes to urban design will present both challenges and opportunities for urban forest management. As intensification efforts capitalize on existing open space and other pervious surface cover, high-quality growing space for urban trees will be at a premium, as potential and existing tree habitat may be placed in direct competition with other forms of above and below ground infrastructure. In order to secure a place in future intensification schemes, the urban forest must be valued as vital natural infrastructure, equal in value and function to grey infrastructure. Furthermore, the need to accommodate growth will lead to added pressures on the urban forest resource as demand for services such as **microclimate amelioration**, stormwater management, pollution abatement and sun protection increase with a growing population in the Region. Thus, to ensure the continued and enhanced provision of such services, the urban forest must figure prominently in the design stages of new development and growth at all scales.

Regional Policy and Programs

Region of Peel Official Plan

The Region of Peel Official Plan (ROP) is Regional Council's long-term policy direction for protecting the environment, managing resources, and directing growth. The ROP provides direction for future planning activities and for public and private initiatives aimed at improving the existing physical environment. The ROP promotes and recognizes an ecosystems approach and recognizes the importance of ecosystem features and functions, the interrelationship between features and the contributions they make to a healthy environment and community well-being.

The Region of Peel has recently adopted amendments to its Regional Official Plan (ROPA) and recognized the importance of the urban forest as part of the natural system. Also recognized in the ROP is the contribution made by the urban forest to climate change mitigation and adaptation, air quality, and community health and well-being. Specifically, section 2.5.2 of the ROP was amended by adding the following direction: "…work jointly with the agencies and Area Municipalities to develop urban forest strategies and to encourage and support programs and initiatives that maintain and enhance the urban forest canopy" (ROPA 21B). Sustainable urban forest management practices are complemented by

section 2.5.3 *Invasive Species Management,* which seeks "to minimize the impacts of invasive species through the proper management and control of non-native invasive species to promote native species plantings in the Region"(ROPA 21B).

The ROP also recognizes that "active management, *securement* and *stewardship* of the Regional Greenlands System [is] necessary to ensure the sustainability and ecological integrity of its natural heritage features and areas." The Greenlands System consists of Core Areas, Natural Areas and Corridors, and Potential Natural Areas and Corridors. The ROP has been amended to include a new policy in Section 7.6 to review the natural heritage systems policy framework and develop a Regional Greenlands Strategy that will address future natural heritage systems planning needs (ROPA 21B).In addition, Regional Council has expressed a commitment to update sustainability policies and create new energy policies (as stated in ROPA 20); this will be achieved in part by preparing green development standards. Including targets for urban forest cover in such development standards will directly contribute to Regional sustainability through the environmental benefits provided by trees.

Peel Climate Change Strategy

The City of Brampton, Town of Caledon, CVC, City of Mississauga, Region of Peel, and TRCA have come together to develop a Climate Change Strategy for Peel Region. The Peel Climate Change Strategy establishes a strategic framework that will guide the six partners in climate change mitigation and adaptation action. Focus is placed on the following themes: (1) acknowledging and exploring the potential impacts of climate change on a local level; (2) developing mitigation strategies to reduce greenhouse gas emissions; and (3) crafting adaptation strategies to protect communities from the various risks posed by climate change, as well as to prepare them for the potential opportunities.

The Strategy addresses the key sectors potentially affected by, or contributing to, climate change in Peel Region, including, but not limited to: public infrastructure, energy, transportation, emergency management, natural heritage, agriculture, public health, buildings, and manufacturing. The Strategy will help partners to focus their current work and to clearly identify roles and responsibilities for future actions. The Strategy specifically recognizes the urban forest in a number of actions pertaining to both mitigation and adaptation of local and global climate change. For example, as a means of increasing resilience to local impacts of climate change the Strategy directs partners to "undertake specific initiatives, such as implementing best practices related to urban forestry, which are intended to maintain and restore natural habitats, trees and naturalized spaces within the urban system." (Region of Peel, 2011)

Peel – Caledon Significant Woodlands and Significant Habitat Study

The Peel - Caledon Significant Woodlands and Significant Wildlife Habitat Study report provides an analysis of criteria and thresholds for identifying significant woodlands and significant wildlife habitat in Caledon and the Region as a whole. The study is designed to assist both the Region and the Town in addressing provincial policy interests related to significant woodlands and significant wildlife habitat. The Study has helped inform policy development in the Region and, in doing so, contributes to meeting ecological health and biodiversity objectives. The Study ensures that significant woodlands that are part of the urban forest will be identified and given consideration in decisions on the future growth of the Region.

Municipal Policy

City of Mississauga

Mississauga's updated Strategic Plan, *Our Future Mississauga*, identifies "Living Green" as one of the five "Strategic Pillars for Change". Specifically, under the Living Green umbrella, the plan outlines the following strategic goals:

- To lead and encourage environmentally responsible approaches;
- To conserve, enhance and connect natural environments; and
- To promote green culture.

The Strategic Plans lists "expand the tree canopy" as one of the strategies needed to respond to the threats of climate change as well as the environmental issues associated with urbanization. The Living Green Action Plan lists ten strategic actions needed to achieve the Living Green vision. Four of these actions have direct implications for the urban forest. These actions are:

- Plant one million trees in Mississauga.
- Implement a city boulevard beautification program to foster civic pride and raise environmental awareness (focusing on the use of native species).
- Pro-actively acquire and/or enhance land along the waterfront and in natural areas for recreational ecological value.
- Implement an educational program that promotes "living green".

Mississauga Official Plan (adopted by Council in September 2010) will bring the City into conformity with all provincial requirements, incorporate the results of various City initiatives and establish a policy framework that will guide the City's development in the coming decades. Section 6.4 of the Official Plan specifically addresses the urban forest, providing a strong foundation and direction for sustainable urban forest management in the municipality, stating that "[t]rees are a fundamental component of a healthy city and sustainable community. As such, trees are a valuable asset to the City and contribute to community pride and cultural heritage" (City of Mississauga, 2010). Section 6.4.4 further sets out the following actions that are intended to protect and enhance the urban forest:

a. developing and implementing a strategic planting program, specific to distinct geographic areas within the city;
b. developing and implementing a strategic pro-active maintenance program pertaining to trees on public land;
c. providing sustainable growing environments for trees by allocating adequate soil volumes and landscaped areas during the design of new development and infrastructure projects;
d. ensuring that development and site alteration will not have negative impacts on the Urban Forest;
e. increasing tree canopy coverage and diversity, by planting trees appropriate to the location;
f. regulating the injury and destruction of trees on public and private property;
g. promoting the management and enhancement of the Urban Forest on Public and Private lands;
h. providing public education and stewardship;
i. providing strategic partnerships with regulatory agencies to address invasive alien species and diseases; and
j. compliance with by-laws pertaining to tree preservation and protection.

There are three By-laws that apply to the governance of trees in the municipality: the Tree Permit By-law; the Street Tree By-law; and the Encroachment By-law. The City of Mississauga's Tree Permit By-law (By-law 474-05) regulates the removal of trees on private property. The By-law states that property owners require a permit to remove 5 or more trees that are 15 cm in diameter or larger from their private property in a calendar year. Thus, the removal of up to 4 trees of any size is allowed without a permit.

The City's Street Tree By-law (By-law 91-75) regarding the protection and preservation of City owned trees along road right-of-ways is currently being updated to better reflect the needs of the municipality.

The Encroachment By-law (0057-2004) is intended to allow the City to effectively address encroachments by adjacent landowners onto City property. Under the by-law, an *Encroachment* is defined as: "…any type of vegetation, man-made object or item of personal property of a person which exists wholly upon, or extends from a person's premises onto, public lands and shall include any aerial, surface or subsurface encroachments."(City of Mississauga, 2004) Through effective enforcement of the Encroachment By-law, a total of 3.5 acres of parkland has been reclaimed through the Encroachment Management Program.

The Natural Areas Survey identifies and inventories over 140 natural areas within the City including woodlands, wetlands, creeks and streams, and recommends strategies and guidelines for their future protection. Completed over a 3 year period, the study consists of 4 phases: review of existing reports and databases; survey of public opinion on environmental issues; site visits to 144 remnant natural areas; and development of databases for the natural areas. The City plans to utilize and expand on this work to create a Natural Heritage Strategy Plan in partnership with TRCA and CVC.

City of Brampton

The City of Brampton's *Official Plan* addresses urban forest management in section 4.5 Natural Heritage and Environmental Management. A key objective of the Natural Heritage and Environmental Management policies is to:

> *Recognize the environmental/ecosystem benefits, habitat function, microclimates, urban design and general aesthetics that the City's woodland and urban forest provides and in this regard maximize the protection, retention, restoration, enhancement and linkages between existing woodlands, trees, hedgerows to other natural heritage and other vegetative features such as valleys, watercourses, etc. within the City (Section 4.5 Natural Heritage and Environmental Management)* (City of Brampton, 2006).

Under Section 4.5.8 Woodlands and the Urban Forest, the following statement provides further direction to policies pertaining to the urban forest in the Official Plan:

> *In a developing municipality like the City of Brampton, the protection of natural woodlands and the conservation of urban forest communities is very important because of their environmental features, functions and linkages as well as the aesthetic qualities and visual relief this vegetation provides...In evaluating the significance of vegetation within the urban forest, their individual values as well as their contributions to the ecosystem as a whole must be considered. In the context of Brampton, the urban forest refers to the mix of the remnants of native forest cover and planted trees and vegetation on all private and public lands in and around the built-up areas. The urban forest is valued for its ecological,*

social and economic benefits (Section 4.5.8 Woodlands and the Urban Forest) (City of Brampton, 2006).

Outlined in section 4.5.8 are the twelve policies that provide direction for the protection, restoration and enhancement of the urban forest and woodlands on public and private property in the City of Brampton. Please see the City of Brampton Official Plan for the full description of these policies.

In 2009 the City of Brampton initiated the development of the *Environmental Master Plan* (EMP). The purpose of the EMP is to define a sustainable environmental framework to address Brampton's municipal responsibilities related to public health and safety, corporate programs and operations, community (land use) planning and services, and environmental protection and conservation. The urban forest will play an integral role in achieving sustainability at a municipal and neighbourhood scale and can therefore be incorporated into the future goals of the EMP at all scales. Finally, the *Flower City Strategy* focuses on increasing recognition and civic initiatives by coordinating and linking together all aspects of the City that will enhance and promote its image as the Flower City; urban trees figure prominently in the goals of this Strategy.

Two By-laws are applied in the governance of urban trees. First, the *Tree Preservation By-law* 38-2006 prohibits the destruction or injury of all trees greater than 40cm dbh located on private property. The *Woodlot Conservation By-law* 402-2005 prohibits the destruction or injury of trees; several exemptions to this prohibition apply.

Town of Caledon

With the exception of the communities of Bolton, Caledon East, and Mayfield West, the majority of the Town of Caledon is classified as rural land use. As such many of the policies and programs pertaining to tree preservation pertain to woodland management. The Peel - Caledon Significant Woodlands and Significant Wildlife Habitat Study is described in section 3.2. The *Woodland Conservation By-law* prohibits the destruction of any tree in a woodland. The Town also provides programs that assist property owners in the management of woodlands, including the Native Tree Seedling program and tree planting workshops.

Conservation Authority Programs

Conservation Authorities are mandated under Ontario's Conservation Authorities Act to regulate and manage development, water, terrestrial resources and recreation opportunities within regulated fill lines. Watershed-based management in Peel Region is shared between five conservation authorities: TRCA; CVC; Conservation Halton; Nottawasaga Valley Conservation Authority; and Lake Simcoe Region Conservation Authority. Approximately 98 percent of Peel Region falls within the jurisdictional boundaries of CVC and TRCA.

Strategic Plans

TRCA's *Living City Strategic Plan* (TRCA, 2005) addresses four objectives: Healthy Rivers and Shorelines; Greenspace and Biodiversity; Sustainable Communities; and, Business Excellence. The Living City vision is for a community "where human settlement can flourish forever as part of nature's beauty and diversity".

The *Credit Valley Conservation Strategic Plan* (CVC, 2006) was released in 2006 and then updated in 2008. The Strategic Plan outlines 30 environmental issues in CVC's jurisdiction; each issue is weighted in importance according to a set of criteria. The issues are further grouped according to three categories of priority, among which climate change is considered to be of the highest priority. Many of the issues, including climate change, bear directly on the urban forest. Specifically, sustainable urban forest management can be incorporated into the strategic management of the following priority 1 issues: deteriorating urban environment; disease and pests; biodiversity; energy conservation; fragmentation, corridors and connectivity; invasive species; soil quality and quantity; and air pollution.

Watershed Plans

The *Humber River Watershed Plan: Pathways to a Healthy Humber* (TRCA, 2008) is intended to inform and guide municipalities, provincial and federal governments, TRCA, non-governmental organizations and private landowners as they update their policies and practices for environmental protection and stewardship. The Watershed Plan provides a set of principles and 30 objectives with specific targets for watershed condition. Management strategies provided fall into the following categories: protect and expand the terrestrial natural heritage system; build sustainable communities; and recognize the distinctive heritage of the Humber through an enhanced regional open space system. The successful implementation of the watershed plan will have direct and far-reaching benefits for the urban forest and the Region as a whole.

In 2002, TRCA released *Greening Our Watersheds: A Strategy for the Etobicoke and Mimico Creeks Watersheds*. A more recent report, *Turning over a new leaf: The Etobicoke and Mimico Creeks Watersheds Report Card* (TRCA, 2006), identified the need for additional information to address specific data gaps. Thus, the *Etobicoke and Mimico Creeks Watersheds Technical Update* is currently being developed with the following objectives: to compile new or updated technical information; to characterize current conditions and issues; and to update the strategic management recommendations and implementation priorities for these watersheds.

The Credit River Water Management Strategy Update (CVC, 2007) provides an assessment of the impacts of past and future urban development and climate change scenarios on the water resources of the Credit River, and outlines a recommended management alternative that will help to minimize or avoid negative environmental impacts in the future.

In 2008 CVC initiated the Lake Ontario Shoreline Study (LOISS) as a means of taking an integrated approach to the management of the shoreline and adjacent natural areas in its jurisdiction. Through a multi-phase approach this study will achieve the following objectives: compile technical data related to shoreline natural features and functions; recommend approaches to water and natural resource management based on sound science and innovation: and integrate local initiatives with those at the Lake Ontario and Great Lakes basin scale.

Subwatershed Plans

TRCA has also developed subwatershed plans within the Town of Caledon. The Centreville Creek subwatershed plan encompasses the community of Caledon East; the Etobicoke Headwaters subwatershed was not part of the Caledon urban forest study but will be developed in the near future

(e.g. the Mayfield West community) and should be kept in mind for the next round of urban forest studies in Peel.

CVC has initiated several subwatershed and watershed studies in Peel Region. The purpose of these plans is to achieve an understanding of the functions of each watershed as well as the impacts of land use change on these functions. Results from these plans will guide planning, management and restoration of natural and urban systems found within each watershed. Subwatershed studies are conducted in multiple phases over a number of years. Currently CVC has initiated studies for Sheridan Creek (2007), Cooksville Creek (2007) and Fletcher's Creek (2010).

Natural Heritage System Strategies

Recognizing the need to protect the broader natural system rather than just **significant areas** in order to maintain healthy ecosystems, TRCA created the Terrestrial Natural Heritage System Strategy (TNHSS) (TRCA, 2007). Developed between 2001 and 2006, the TNHSS seeks to protect and restore a targeted land base to provide for a robust terrestrial natural heritage system in TRCA's watersheds. The goal is to assist municipalities in identifying natural heritage systems as part of growth planning as well as private landowners in their land stewardship activities. The TNHSS was used in the development of watershed plans and is being considered for inclusion in Municipal Official Plan updates. The primary role of the urban forest in meeting the objectives of the Strategy is through the management of the matrix influence. The "matrix" refers to the land uses surrounding and outside the natural system, which exert either a positive or negative influence on habitat patches.

In 2006, CVC launched the Terrestrial Ecosystem Enhancement Model (TEEM) program for the purpose of developing a Natural Heritage System for the Credit River Watershed. Following the completion of Phases 1 and 2 of this program, CVC has characterized existing conditions using a GIS-based Landscape Scale Analysis. This analysis represented the first step in developing a Natural Heritage System for the Credit River watershed by first identifying existing natural and semi-natural features on the landscape, and next by analyzing their relative importance for **ecosystem function** and the provision of ecosystem services such as clean air, climate regulation, a pure and abundant supply of water, and flood control (CVC, 2009).

Future work will focus on developing a Natural Heritage System for the Credit River watershed designed to improve the healthy functioning of the watershed's ecosystems. In particular, focus will be placed on improving functional linkages among natural areas. The Natural Heritage System will identify opportunities for stewardship, restoration, protection, or securement that will maintain, restore, and enhance biodiversity and ecosystem function in the Credit River watershed.

APPENDIX E: Detailed Review of Community Framework

Regional Programs

Teach Green in Peel

Teach Green in Peel is an online database that helps teachers in the Region find locally-relevant environmental education resources and programs. Two programs relate directly to the urban forest. The first is the High School Tree Planting Program offered through CVC's Conservation Youth Corps program. Students grade 10 and up have the opportunity to attend outdoor classes, participate in tree planting events and a variety of experiential learning activities. The second program is offered by the Riverwood Conservancy.

Municipal Programs

Brampton Clean City

Brampton Clean City is a committee supported by Council that is made up of citizen volunteers that promote environmental awareness, build community pride, and coordinate opportunities to educate youth and adults about their environment. The committee focuses on the delivery of greenspace clean-up programs and educational workshops.

Conservation Authority Programs

TRCA Stewardship and Outreach

In Peel Region the Etobicoke-Mimico Watersheds Coalition has been established by the TRCA to help achieve the watershed revitalization objectives of the Watershed Plan. "Trail Stewards" projects engage citizens, community groups, schools and businesses in the improvement of the health of creeks and surrounding areas. Native tree and shrub planting and installing wildlife habitat structures are among the activities offered to restore and enhance forest, meadow and wetland habitats. Projects offer educational workshops, interpretive walks and community events.

TRCA's *Healthy Yards Program* provides watershed residents with the inspiration, information and tools required to create beautiful and sustainable yards. Emphasis is placed on the use of native tree and shrub species, as well as tree planting for energy conservation. The *Private Land Tree Planting Program* provides technical and financial support to landowners to restore and improve their properties through the planting of native trees, shrubs and seedlings. The TRCA also assists woodlot owners in the preparation and implementation of a Forest Management Plan, as part of the *Managed Forest Tax Incentive Program* (MFTIP) provided by the Ontario Ministry of Natural Resources (OMNR).

The *Sustainable Neighbourhood Retrofit Action Plan* (SNAP) is partnership-based pilot project led by the TRCA in collaboration with the Regional Municipalities of York and Peel, and the municipalities of Brampton, Toronto and Richmond Hill. SNAP projects are currently being implemented in communities

in Brampton, Toronto, and Richmond Hill. The purpose of each SNAP project is to identify ways to accelerate the transformation to urban sustainability and increase the community's contributions to climate change mitigation and adaptation. The actions plans will highlight the role that the urban forest can play in meeting multiple sustainability objectives such as urban heat island mitigation, stormwater management, and air pollution removal.

CVC Stewardship and Outreach

Green Cities promotes the protection and restoration of the natural environment on all urban lands in the Credit Valley Watershed, including residential, corporate/business, institutional and public lands. Within this program, *Your Green Yard* provides workshops and information on various aspects of environmental landscaping for residents, as well as information for residents living near natural areas. Businesses, corporations and institutions can participate in the *Greening Corporate Grounds* program by undertaking ecological landscaping projects, such as planting native plants. CVC also works with urban municipal partners on planting and other greening activities on public lands, with the help of CVC Conservation Youth Corps students and other volunteers.

Community Organizations

EcoSource

EcoSource is an environmental education organization serving youth, adults and families. Originally based in Mississauga, programs are now offered throughout Peel Region. A variety of programs are available, including educational workshops, urban agriculture projects, professional development certification for teachers, and community learning gardens. While the organization does not specifically focus on the urban forest, it could easily be incorporated under the core purpose, which is "to inspire personal accountability for the viability of the planet" (EcoSource, 2010).

Peel Environmental Youth Alliance

Peel Environmental Youth Alliance (PEYA) is a network of youth aged 13 to 24 working together to make positive changes for the environment in Peel Region. PEYA helps students and their respective environmental clubs organize and deliver stewardship activities in schools and across the community. For example, on the annual Region-wide Stewardship Day, students and teachers plant trees at sites throughout the region and learn about the environment and natural heritage.

The Riverwood Conservancy

The Riverwood Conservancy (TRC) is a volunteer- and member-based charity that provides programs and services to the community in nature and environmental education, stewardship of the Riverwood Park, and gardening and horticulture. TRC offers two environmental outdoor education programs: the Education Naturally program for elementary students; and the Exploration Naturally program for high school students. These programs provide courses on a range of environmental topics, including urban forest stewardship. TRC also engages community members in various stewardship activities, such as tree planting.

Association for Canadian Educational Resources (ACER)

ACER develops, delivers and supports programs and resources that educate and enable community members to undertake accurate monitoring and reporting of biodiversity in forest ecosystems. Measure Up is ACER's tree monitoring program, with sites set up across the Region in natural forests, urban forests, and school yards. ACER also coordinates volunteer and student tree planting events.

Green Industry Partnerships

Green Infrastructure Ontario Coalition

The Green Infrastructure Ontario Coalition (GIO) was founded in 2009 by Local Appreciation and Enhancement of Forests (LEAF), TRCA, Green Roofs for Healthy Cities, Landscape Ontario, Ontario Parks Association, and Evergreen Brickworks. GIO's mission is to develop a provincial vision and legislation to create green jobs, clean the air and water, conserve energy and increase access to local, sustainably produced food within our urban areas through significant investment in, and protection of, green infrastructure. GIO's work highlights the role played by the urban forest in achieving healthy and sustainable communities and will encourage the provincial government to equip municipalities with the tools needed to provide suitable protection to the urban forest during planning and development.

Partners in Project Green

Partners in Project Green is a partnership between TRCA, Greater Toronto Airports Authority, the Region of Peel, City of Toronto, City of Mississauga, and City of Brampton, that is working collaboratively with local businesses to create an 'eco-business zone' around Pearson International Airport. Partners in Project Green delivers programming that helps businesses reduce energy and resource costs, uncover new business opportunities, and address everyday operational challenges in a green and cost-effective manner. Through the Green Parking Lots Program and the Employment Land Planting Program support is provided to businesses to build sites that address land use challenges and are better integrated with the natural environment.

APPENDIX F: Summary of Strategic Goals and Actions

GOAL	LEAD	ACTION	TIMEFRAME
1. Facilitate partnerships and coordinate action across Peel Region (Themes: Resource Management Approach, Community Framework)	Region of Peel and Area Municipalities	a. Develop and lead an interagency Urban Forest Working Group that will build focus and consistency across departments and agencies. The Working Grouping will convene monthly during the initial stages of Strategy implementation, and then at regular intervals deemed appropriate by Working Group members thereafter.	Short Term
		b. Develop annual work plans for the purpose of achieving the goals outlined in this Strategy.	Short Term
		c. Conduct a comprehensive review of the Strategy at regular five year intervals by completing the following tasks: • Evaluate progress made towards achieving each strategic goal, Regional and Area Municipal targets, as well as the objectives outlined in *Criteria and Indicators for Strategic Urban Forest Management and Planning* (Kenney *et al.,* 2011); • Address barriers to up-take and implementation of goals and actions; • Identify new threats and emerging trends; and • Incorporate recommended solutions.	On-going
2. Develop urban forest targets (Theme: Resource Management Approach)	Region of Peel and Area Municipalities	a. Develop regional and area municipal urban forest targets in collaboration with Conservation Authorities and other stakeholders.	Short Term
3. Develop urban forest management plans (Theme: Resource Management Approach)	Area Municipalities	a. Develop and implement comprehensive Urban Forest Management Plans that fully addresses the operational actions and resources required to achieve a healthy and resilient urban forest.	Short Term
		b. Review and update Management Plans at regular five year intervals to ensure that management activities are adapting to changing conditions. This action should be directly informed by the monitoring program outlined in Goal 6.	On-going

GOAL	LEAD	ACTION	TIMEFRAME
4. Create a comprehensive urban forest policy framework (Themes: Resource Management Approach, Community Framework)	Urban Forest Working Group	a. Integrate the goals identified in the Strategy and targets, once defined, into Regional and Area Municipal Official Plans to recognize the contribution of both the extensively and intensively managed urban forest to quality of life.	Medium Term
		b. Integrate the goals identified in the Strategy, as well as targets and directions from Urban Forest Management plans into public initiatives. These initiatives include, but are not limited to, the following policies and programs: • Peel Climate Change Strategy • Region of Peel Green Development Standards • Peel Public Health's 10-Year Strategic Plan • Region of Peel Energy Management Plan • Area Municipal By-laws • Area Municipal Environmental Master Plans • Regional, Area Municipal and Conservation Authority Natural Heritage System Strategies • Conservation Authorities' Watershed and Subwatershed Plans • Peel District School Board Curriculum • Conservation Authority Educational Programs • EcoSource Programs	Medium Term
		c. Develop new municipal standards and guidelines for sustainable streetscape and subdivision design that will meet the following objectives: • Provide adequate soil quality and quantity for tree establishment and long-term growth; • Eliminate conflict between natural and grey infrastructure; and • Ensure suitable species diversity at street segment, block and neighbourhood scales.	Medium Term
5. Gain formal support from upper level government for sustainable management of the urban forest as natural infrastructure (Themes: Resource Management Approach, Community Framework)	Urban Forest Working Group	a. Encourage the Association of Municipalities of Ontario (AMO) and the Federation of Canadian Municipalities (FCM) to approach provincial and federal agencies to provide stronger support and direction for urban forest policies, programs and initiatives.	Short Term
		b. Engage the Provincial and Federal Governments to provide funding for urban forest research and development.	Medium Term
		c. Engage the Provincial Government to provide policy direction within the Planning Act as well as guidance to support a healthy urban forest for the full range of ecosystem services it provides to the community.	Medium Term

GOAL	LEAD	ACTION	TIMEFRAME
6. Implement effective monitoring and research programs (Theme: Resource Management Approach)	Area Municipalities	a. Monitor the structure, distribution and function of the urban forest using the methods and parameters applied in the baseline assessments conducted in 2008 for each area municipality in Peel Region (the i-Tree Eco model and Urban Tree Canopy (UTC) cover mapping assessment). A suggested monitoring scenario consists of a cover mapping assessment (UTC) at a five year interval and a field-based assessment (i-Tree Eco) at a ten year interval.	On-going
		b. Report on status and trends publically in order build and retain public support for urban forest conservation. A comprehensive understanding by the public of the benefits of the urban forest to public health and quality of life should be the objective of this action.	On-going
		c. Identify critical research questions and information gaps that must be addressed in order to manage the urban forest effectively and mitigate the threats and impacts to this resource.	Short Term
		d. Identify potential research partners and explore new means of building connections among researchers, practitioners and community members.	Medium Term
		e. Identify new techniques and technologies through on-going communication with the Canadian Urban Forest Network (CUFN), academic institutions, Canadian chapters of the International Society of Arboriculture (ISA), Tree Canada, private consultants, environmental non-governmental organizations and other national and international agencies with an urban forest mandate.	On-going
7. Secure long-term funding for urban forest management (Themes: Resource Management Approach)	Urban Forest Working Group	a. Develop a business case for the urban forest as natural infrastructure to secure funding and support from all levels of government. The business case should be built from a comprehensive cost-benefit analysis of the urban forest as a municipal asset.	Medium Term
		b. Research funding opportunities and partnerships.	Medium Term
		c. Develop an incentives program for tree planting and establishment on private property (e.g. energy rebates and stormwater fees). Explore the potential to build a revenue stream for financial incentives or subsidies gained from tree removal permit fees and penalties for by-law infractions.	Medium Term

GOAL	LEAD	ACTION	TIMEFRAME
8. Provide comprehensive training, education, and support for residents and members of the public and private sector (Themes: Resource Management Approach, Community Framework)	Urban Forest Working Group	a. Conduct a detailed assessment of opportunities to enhance urban forest stewardship through public outreach programs.	Medium Term
		b. Facilitate training, education and professional development for all public sector staff that engage in urban forest management activities or whose operational mandate influences urban forest sustainability.	On-going
		c. Identify and pursue opportunities to build and expand partnerships with business owners and industry members for the purpose of increasing tree cover and improving tree health in the commercial and industrial areas of Peel Region.	Medium Term
		d. Identify and pursue opportunities to work with Landscape Ontario to increase awareness among members of the horticultural and landscaping industry of threats, trends and new research in urban forestry.	Medium Term
		e. Engage hospitals, universities and colleges in Peel Region in urban forest management by working with these landholders to develop tree management plans.	Medium Term
		f. Identify and pursue opportunities to work collaboratively with Peel District School Board and Dufferin-Peel Catholic District School Board to increase tree cover on school grounds	Medium Term