Urban Forest Management Plan

City of Thunder Bay, Ontario

December, 2011

DAVEY RESOURCE GROUP

A Division of The Davey Tree Expert Company of Canada, Limited

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December, 2011

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Section 1: Introduction and Background

1.1 Executive Summary

The City of Thunder Bay has a longstanding history of urban forest development and protection for the community. The excellent document, prepared by Forestry Section staff in 2009, titled "Phase 1: History of Current Status of Thunder Bay's Urban Forest Program" provides historical accounts of both Port Arthur and Fort William greening their communities, including a large-scale tree planting project of 100 Gilead Poplars at Waverly Park. In 1935, the Fort William Parks Board carried out pruning projects in Vickers and Dease Parks. It is noteworthy that the urban forest has played an important part in Thunder Bay's history. Despite its long history, only 1 percent of City trees exceeds 90 DBH (diameter at breast height). Maintaining large-stature trees is critical to community attractiveness, as well as providing a high degree of environmental benefits.

Thunder Bay's rich history of urban forestry, combined with the dedication of City forestry staff and community members, has laid the foundation for developing a comprehensive, efficient, and effective urban forestry program. One of the key challenges faced is the transition from largely reactive to proactive management. Moving to proactive urban forestry is very important for Thunder Bay to ensure long-term goals including cost-efficiencies are met, rather than reacting to immediate, costly demands for non-priority work. Though public response at the onset may pose some challenges, enhanced community satisfaction will come when long-term goals are the focus, supported by Council and City staff.

This plan provides the following goals and objectives:

- A vision for Thunder Bay's urban forest, developed with community input and support
- Recommendations for strategies to deal with urban forest management issues, with costs as applicable
- Comprehensive review of the current urban forest program including resources, priorities, successes, service gaps, and capital program
- Establishment of short- (5-year), medium- (10-year), and long-term (20-year) strategic management objectives
- A seven-year urban forest management work program for 2012–2018 (referred to as the Municipal Forest Action Plan).

Thunder Bay has been proactive in strategically planning to improve the community on a number of fronts. Great strides have been made over the past few years by dedicated staff and key stakeholders. An impressive array of plans prepared by City staff and affiliated organizations shows strong, interconnected support for the value of trees to the community. The following documents provide solid foundations upon which Thunder Bay can continue to improve the City by enhancing the urban forest.

- City of Thunder Bay Official Plan (under review)
    - Acknowledges the significant contribution of urban trees and forests to the quality of the urban environment.
- 2011-2014 City of Thunder Bay Strategic Plan
    - Promotes creating a more sustainable community environment through the completion and implementation of an Urban Forest Management Plan, which will preserve, enhance and expand the City's public forest resources.
- Zoning By-law
    - Sets out stringent requirements for landscape buffering on lands to be developed.

- EarthWise ®[1] Community Environmental Action Plan (2008)
  - Advocate for the preparation of an urban forestry master plan, better inventory system, increasing green space (including the planting of more trees), and maintaining biodiversity.
- Renew Thunder Bay (2009)
  - Advocates for urban reforestation as part of a five-year strategic plan.
- Clean, Green and Beautiful Policy
  - Promotes creating a cleaner, greener and more beautiful city, through a number of efforts including the planting of additional trees, protecting biological diversity and streetscaping.
- Urban Design Guidelines (under development)
  - Recommends increasing canopy cover along roadways in Thunder Bay.

The City's current urban forestry program budget is $705,003. Slightly over 68 percent of costs is related to pruning, removals, and planting of trees. The remaining costs are distributed amongst program administration, inspection, litter and storm cleanup, and other expenses. Comparisons to municipalities across Canada reveal that Thunder Bay's urban forestry program is currently funded in the lower range of per capita budgets.

Thunder Bay's urban forest provides total annual benefits to the community of $1.6M, or $85 per tree. The benefit-cost ratio for managing the urban forest exceeds 2:1; for every dollar spent, the community gets benefits of $2.21 returned. The benefits include stormwater runoff reductions; energy consumption savings; air quality improvement; carbon dioxide reduction, and aesthetic value increases for properties. An overview of the benefits is provided in Section 2.2, City of Thunder Bay Benefit-Cost Analysis.

[1] Earthwise is a registered trademark of Cambridge and North Dumfries Energy Solution, Inc.

Key recommendations of the Urban Forest management Plan are summarized as follows:

Table 1. Key Recommendations

Recommendations	Priority
Tree Inventory	
Increase diversity of Thunder Bay's urban forest. Best management principles recommend that no more than 20 percent of urban forest should be of a single genera; with not more than 10 percent of a single species.	High
Trees to be planted under overhead utility lines must be of species whose ultimate height at maturity does not exceed 6m.	High
Update the current tree inventory to provide more accurate and useful data upon which to base planning decisions. Current inventory did not take into account tree risk assessments, which is an industry standard primary tool for cost-efficient planning of cyclical pruning programs, and of critical importance to Forestry staff who are tasked with managing public safety.	High
Update the current tree inventory in advance of establishing a cyclical, or grid pruning program.	High
Invest in tree management software developed specifically for urban forestry management.	High
Structural pruning of young trees pays off well in the long run, with less costly pruning required, and less damage due to public property resulting from weak unions. Continue to promote the Citizen Pruner Program; it is an excellent community program which provides excellent returns.	High
Continue to invest in extending the health of Thunder Bay's larger trees by routine pruning and inspections. Larger trees provide the most benefits to the community, and are the most significant contributors to the urban canopy cover.	High
Costs of Managing the City of Thunder Bay's Urban Forest	
Systematically track all annual urban forest management costs more accurately	High
Municipal Forestry Management and Administration	
Recent/proposed re-organization of staff and tasks will create a more efficient and effective system of managing forestry activities, and should be adopted	High
All individuals who perform tree related activities should become Certified Arborists	High
Develop protocol that includes City Forester during construction planning for all City property projects	High
Update tree protection standards and enforce compliance	High
Recognize trees as a vital component of "Green Infrastructure" to be included on all municipal projects	High
Tree Planting	
Establish an overall citywide goal for tree canopy cover of 50 percent	High
Develop specific plans for the inclusion of appropriate tree planting on image routes	High
Tree Maintenance	
Develop a systematic, regularly scheduled tree maintenance program including cyclical pruning, young tree train and regular inspections	High
Establish a cyclical tree pruning program that will create efficiencies and reduce costs associated with pruning and removals	High
Ensure newly planted trees are watered regularly	High
Urban Forest Health	
Prepare a detailed emerald ash borer strategy that will prepare Thunder Bay for the arrival of this devastating insect	High
Managing Risk	
Undertake a systematic tree inventory that includes risk ratings performed by professional, certified arborists	High
Urban Forest Management Plan Implementation	
Create an annual State of the Urban Forest Report and present it to Council, the City Manager, and the citizens of Thunder Bay	High
Annually evaluate the Plan's implementation progress and adjust accordingly	High

The budget impact of Thunder Bay's proposed Municipal Forestry Action Plan, which is the implementation phase of the Urban Forest Management Plan, consists of two components. Capital resources will be needed for short-term projects which will enable the City to move toward a sustainable long-term urban forestry management program. Capital funding of $60K per year over 7 years is needed to achieve the efficiencies of a cyclical pruning program. After that period of time, efficiencies will result in lower operating costs and a healthier urban forest.

Operating budgets are documented separately, as ongoing long-term costs. The progress and accomplishments that the City Forestry Section has made to date with limited resources has been highly impressive, including building valuable partnerships with community groups, key stakeholders, and citizen volunteers. The contributions made by these partnerships are very significant to the City, and should continue to be valued and supported by the City of Thunder Bay.

Continued support of Thunder Bay's urban forest is a key factor is delivering the City's "Clean, Green and Beautiful" strategy, and is strongly supported by the community. Public response indicates enhancing the urban forest, particularly in urban areas, key wards and along image routes will improve liveability of the community and promote tourism.

1.2 Introduction

Thunder Bay is a medium sized city of approximately 109,000 residents, located on the north shore of Lake Superior. This City is unique in that it is surrounded by forests, which provide important economic benefits for the City. The urban forest is a major infrastructure asset for the City and a key component of the City's commitment to sustainability.

The City occupies an area of 323 square kilometres, of which 129 square kilometres is within the defined Urban Limit and 22 square kilometres is within the defined Suburban Residential area. The remaining land is defined as rural and is outside the scope of this project.

Within the Urban Limit, there are 960ha of designated park land, with an additional 29ha in the Suburban Residential areas. Within the Urban Limit, there are 625km of roads, with another 88km of roads within the Suburban Residential areas.

Thunder Bay's Urban Forestry Program is operated through the Parks Division, as part of the Cemeteries, Forestry and Horticulture Section. The Urban Forestry Program in Thunder Bay has done remarkable work in developing several valuable components of effective urban forestry programs. Some highlights are:

- 2009 Urban Forest Canopy Cover Study
- History of the Current Urban Forest Program, "Urban Forest Master Plan: Phase 1"
- Development of important public outreach programs such as Citizen Pruners, Tree Stewardship Program, and the Commemorative Tree and Bench Program
- Collegial alliances with municipal departments, utilities and community groups

The City is now wisely planning to move from largely reactive urban forest management, with the goals of achieving efficiencies, enhance public safety, and improve customer satisfaction.

1.3 Vision and Guiding Principles

The City of Thunder Bay's Urban Forest Management Plan (UFMP) is intended to be an all-encompassing, living document that influences all levels of urban forestry management from administration to daily operation. It will provide Parks with short- and long-term visions and identify strategic actions to attain these goals. The UFMP is a key document to develop a more efficient and effective program, resulting not only in a more sustainable urban forest, but a healthier, more livable city.

The recommended vision for Thunder Bay's Urban Forestry Program is:

> *"The City of Thunder Bay will have a sustainable, safe, healthy, and diverse urban forest that optimizes public and environmental benefits."*

This vision was developed by synthesizing input received from the community, including the public and key internal and external stakeholders during the consultation process. Appendix A provides public survey results, including those received through the City website, as well as provided at the public open house on September 20, 2011. It is noteworthy that this public open house drew over 50 attendees, an unusually large turnout for Thunder Bay, exceeding even the turnout for the City Strategic Plan. It is well apparent that the urban forest is a very important issue for citizens of Thunder Bay.

A second survey was developed for key internal and external stakeholders, and was provided at meetings on May 5 and 6, 2011, where information regarding the community vision of Thunder Bay's urban forest was discussed.

To accomplish this vision, the utilization and co-operation of professionally trained urban forestry staff, appropriate municipal legislation, Council support, efficient management of City resources, and public education and support is critical. To date, few Canadian municipalities have undertaken such a comprehensive plan, positioning Thunder Bay as a leader in sustainable community planning.

The success of the UFMP will rely heavily on strong community support. The City of Thunder Bay shows leadership by requesting input to the Plan from community stakeholders, elected officials, City staff, and citizens. As with any large-scale vision, a plan must be built upon the foundation of strong community support in order to be effective. Ongoing guidance in implementation will be received through various focus groups and advisory committees comprised of urban forest specialists, technicians, planners, community members, contractors, developers, and academia among others.

Thunder Bay identified a framework for developing the UFMP. The UFMP involves three main phases. Phase I includes a document that Thunder Bay developed which identified the present status of urban forestry in Thunder Bay. This document, along with discussions and review of information provided, was used as a foundation for much of the background information in the Urban Forestry Management Plan.

Phase II encapsulates community input from various meetings and surveys, and develops the vision.

Phase III describes the development of a plan (in response to issues brought up in Phase II) and helps to define a course of action to meet the goals and objectives.

Figure 1, as developed by the City of Thunder Bay Forestry staff, shows the process for developing the Urban Forest Management Plan.

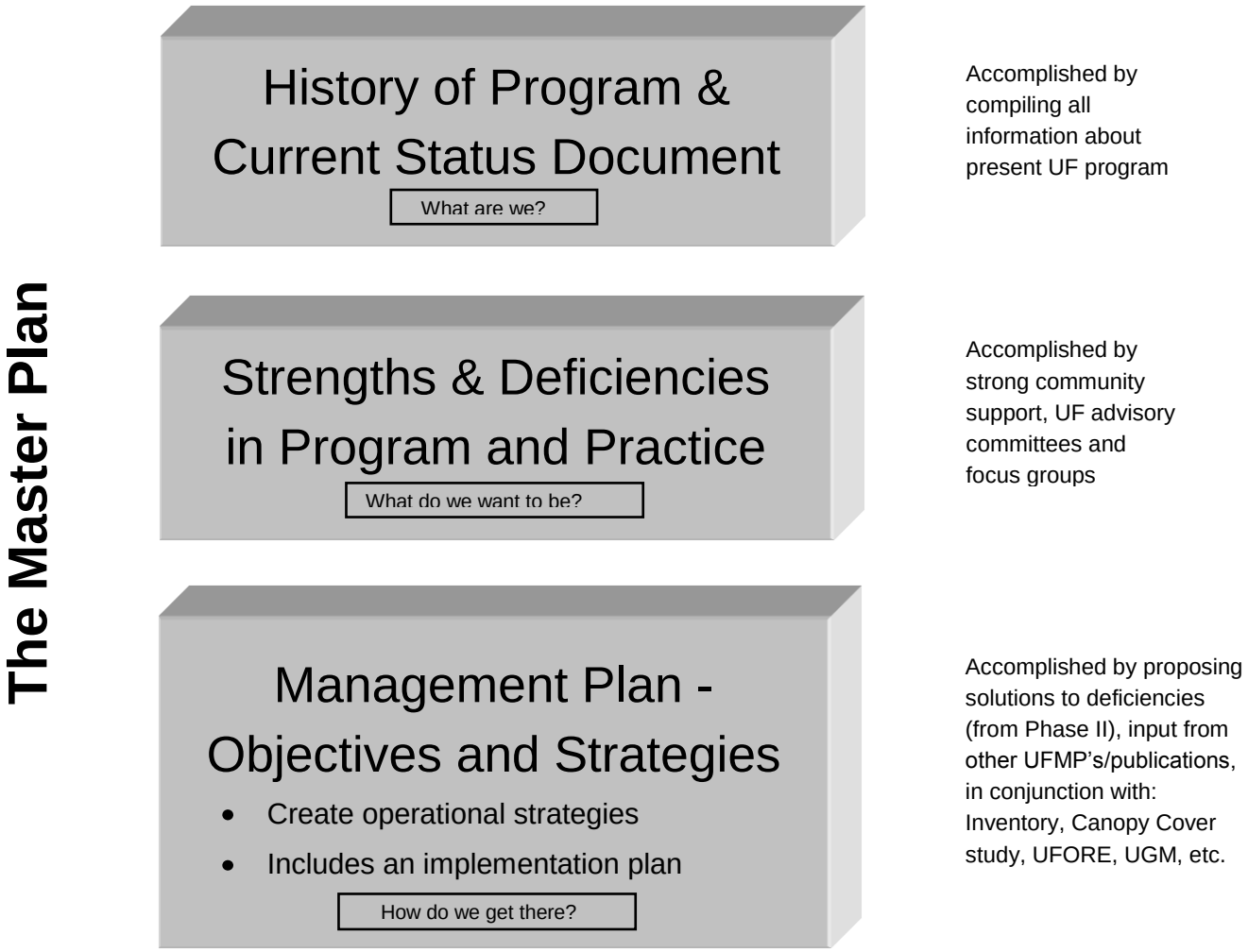


Figure 1. Process for Developing the Urban Forest Management Plan

1.4 Thunder Bay's Urban Forest History

Much work was done by the City of Thunder Bay Forestry staff to research and document the long history of urban forestry in the City. The following is a brief synopsis of the 2009 document*, History and Current Status of Thunder Bay's Urban Forest Program.*

The City of Thunder Bay was incorporated in 1970 through the merger of two adjacent towns—Port Arthur and Fort William, and the townships of Neebing and McIntyre. There were numerous historical accounts of both Port Arthur and Fort William greening their communities with trees even as early as the late 19th century, although the term urban forestry had yet to be defined. In 1886, records indicated that a large-scale tree planting project involved the planting of 100 Gilead Poplars at Waverly Park. In 1935, the Fort William Parks Board carried out pruning projects in Vickers and Dease Parks, to give each species the necessary amount of growing space. Although historical records like these are sparse over the past 130 years, it was apparent that the urban forest played an important part in Thunder Bay's history.

In the latter half of the 20th century, tree planting projects on boulevards and City parks frequently took place, but there was no long-term vision guiding these initiatives. Like most mid-sized Canadian cities in that time, few resources were devoted to wide-scale urban forest planning. As a result, the City's urban forest was in direct need of management that included effective and consistent tree planting, maintenance of maturing trees, and removals of over-mature and hazardous ones.

In 1995, the City of Thunder Bay began employing consistent services of a local consulting forester to provide direction to operations staff and management in how to properly manage this resource. The consultant identified barriers that would need confronting if a healthy and sustainable urban forest were to be attained. The greatest barrier was a poor public opinion of trees in the City. In addition, the City's media rarely covered urban forest issues and, when it did, it was poorly portrayed.

The consultant began the process of educating people about the benefits of trees, using every opportunity, and a variety of methods, to help change the negative public perception. An emphasis was placed on building relationships with different sectors, increasing interdepartmental ties, strengthening media partnerships, and educating City Council and Administration. Part of the process of connecting with the community came through the launch of an Urban Forestry Advisory Committee in 1996. This committee, through frequent meetings, helped provide extra guidance for the Forester and Parks Division.

In 2000, a community tree advocacy group was launched called Trees Thunder Bay (TTB). Within a few years, and with over 2,000 supporting members on paper, TTB was successful in drumming up support for urban trees. They created a more positive profile for urban forestry in the eyes of the public and City Council. Also at this time, the first statement regarding the management of the urban forests was added to the City's Official Plan; a guiding document that acknowledged the need for deliberate management of the City's green infrastructure.

Now that trees had gained a greater profile, funding was allocated to complete the City's first street tree inventory. The inventory management system, designed by the University of Toronto, was carried out from 1999 to 2001. The inventory revealed that there were 20,000 boulevard trees and 10,000 available planting spots, which caught the attention of Council.

In the spring of 2001, the consultant was hired full-time as the City Forester. In the fall of the same year, however, a significant turning point arrived for urban forestry in Thunder Bay. The Forester position which was created only months before was in jeopardy of being eliminated, due to budget considerations. Through an uproar of community concern, the public rallied in support of keeping the City Forester position. It then became clear that the public understood the need to have trees professionally managed.

The City Forester continued to develop allies, knowing this would be extremely valuable in her role to educate the general community and to protect and sustain the urban forest. In 2001, the City Forester was asked to serve as the Parks representative on the Public Utilities Coordinating Committee to ensure that tree concerns were addressed in the same manner as other public infrastructure. Thunder Bay Hydro became a stronger partner by working closely with the City Forester and ultimately hiring a utility arborist service to properly prune trees in proximity to hydro wires.

Communication was strengthened with the Environment Division which received a capital budget to provide vapo-rooter service to a limited number of homeowners who were experiencing root and sewer conflicts. This enabled the Division to minimize damage to trees during sewer maintenance. In addition, relations were fortified with City Engineer inspectors and construction contractors which helped to ensure trees were protected during municipal construction projects.

Although advances were being made in the development of a healthy urban forest program, many challenges were still being faced. Even though an agreement was in place for the Environment Division to notify the City Forester of trees in conflict with water lines, trees were regularly being removed as the solution to conflicts without repairs being conducted to the sewer. In 2003, Council placed a moratorium on the removal of trees so that removals were the last option, not the first option. The sewer had to be repaired first, and alternative options to tree removal be investigated as a last resort. Through this process, options such as hydro-vacs, vapo-rooting, pipe liners, and rerouting water lines were then implemented whenever possible to prevent unnecessary removal of trees.

To help establish a greater awareness of the value of trees, a two for one tree commitment was put in place by the City Manager in 2002. This commitment made it mandatory that every tree that was removed by Transportation and Works had to be replaced on a two for one basis. This commitment raised the profile of urban trees as a component of municipal infrastructure and quickly led to preserving and protecting trees in the planning, repair, and construction of roads and utilities.

In 2005, a Public Tree By-law was implemented to authorize and regulate the planting, care, maintenance, protection, preservation, and removal of public trees on municipal property, and to ensure the sustainability of the urban forest at various sites in the City of Thunder Bay. At this time, a dedicated urban forestry webpage was added to City's website, which also helped the public understand the new Tree By-law and the need to protect this green infrastructure.

The creation of the Tree Stewardship Program (TSP) helped to advance urban forest education and sustainability in the City. The TSP, which was conceived by Trees Thunder Bay and developed by the Parks Division, provided an accelerated tree planting program at a subsidized rate to home and business owners. By means of a Green Streets Canada Award in 2006, the first TSP coordinator was hired to establish the program.

Through the years, the urban forestry program continues to address the issues that challenge urban forest sustainability. Although reactive management and other obstacles still remain, there have been great advancements in changing the community paradigm and developing solid foundation upon which an urban forest master plan can be built. Through the UFMP and in conjunction with the public, other City departments and stakeholders and media support, the urban forest will continue to provide great benefits to enhance the economic, environmental, and livability of Thunder Bay's community.

Section 2: 2011 State of Thunder Bay's Urban Forest

2.1 Historical Documents Developed

Examination of historical documents provided valuable insight leading to detailed analysis of the current state of the urban forestry program. In brief, documents examined included, but are not limited to:

- 2000-2001 street tree inventory (with updates)
- 2009 Thunder Bay Urban Forest Canopy Cover Project
- Trowbridge Forest Stewardship Plan
- Various City park landscape plans
- City guidelines and specifications
- Urban Forestry programs including community partnerships
- Official City Plan, Strategic Plan, EarthWise® Community Environmental Action Plan (2008), Re-New Thunder Bay Plan and Corporate Report
- GIS layers and aerial photos

Major components are discussed in detail as follows:

2.2 Current Tree Inventory Composition

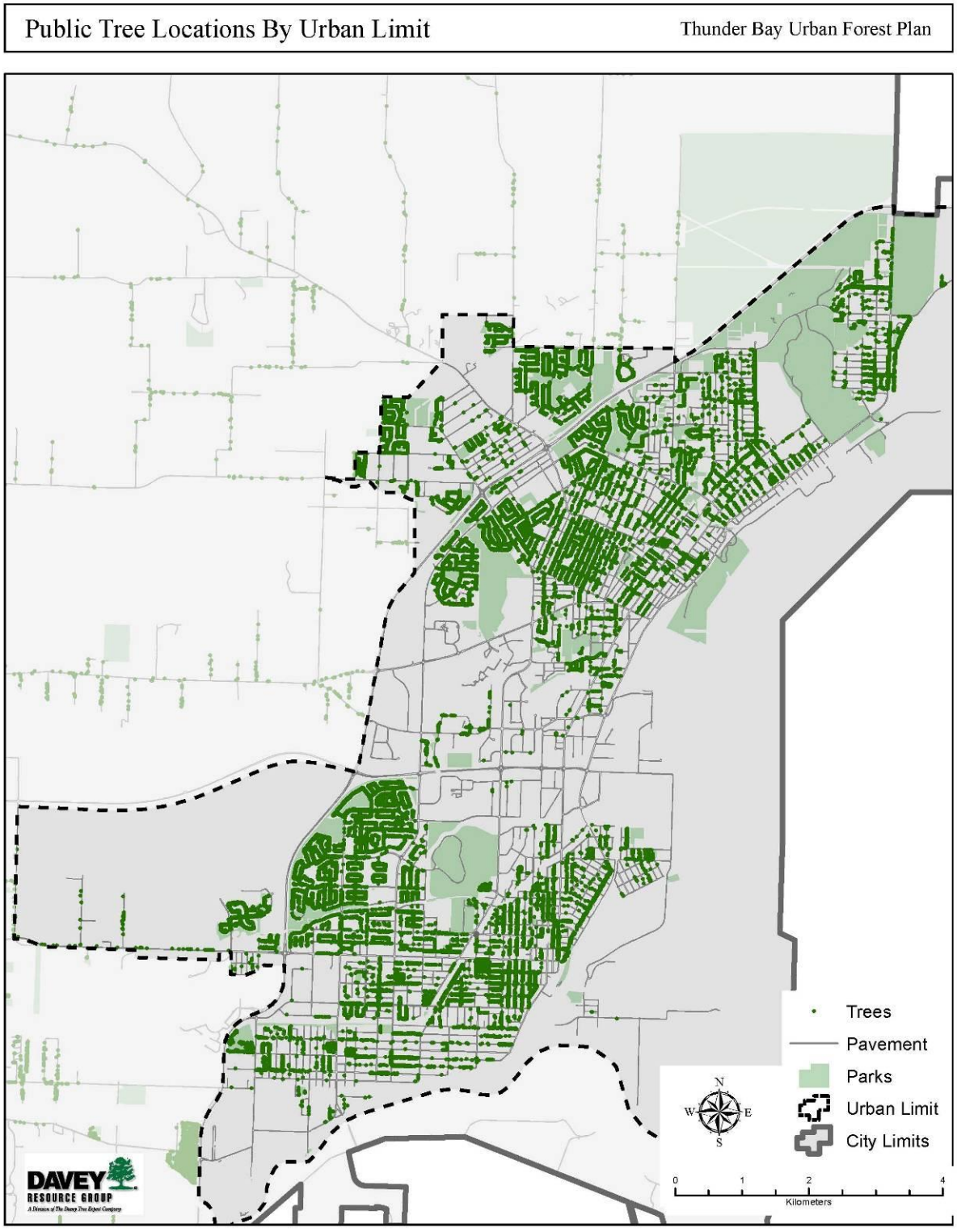
Thunder Bay's urban forest is a complex system of trees influenced by the urban environment. Understanding this inter-relationship is critical to optimal decision-making about tree maintenance and planting activities.

Silver maple trees along Riverview Drive are examples of street trees that are included in the tree inventory.

The City's tree inventory was performed by City staff in 2000/2001 to gather accurate information about the location, species, size, condition of the tree population, and to catalog other site information such as conflicts with utilities.

The inventory included 18,270 sites. The sites collected included only trees (no shrubs, or stumps) located in areas maintained by the City including street right-of-ways (ROWs) and some park boundaries. Plantable site information is available, but is not included in this analysis. A map of inventoried trees, which focuses on the urban limits of the City is shown in Map 1. The inventory continues to be a work-in-progress with additional data being added as funding is made available to hire an intern plus seasonal help such as summer students to collect further data, specifically park tree data.

The tree inventory data was analyzed to assess the structure of Thunder Bay's managed tree population. The tree species present, size ranges, and their conditions tell much about an urban forest's composition, distribution, and health. Inventory frequency reports can be found in Appendix B.



Map 1. Inventoried Trees Within Thunder Bay's Urban Limits

2.2.1 Genus and Species Distributions

Genus and species compositions are the percentages of tree genera and tree species in relation to all inventoried trees. Genus and species distributions are important parameters for managing urban forest sustainability and the tree population's ability to respond to threats from invasive pests and diseases.

The inventory of Thunder Bay's urban forest found 64 species representing 29 genera. Figure 2 shows that *Fraxinus* (ash) and *Acer* (maple) were the dominant genera, with 5,243 ash and 4,361 maples. Table 2 shows that of the top 10 occurring species, 2 are ash and 2 are maples. *Fraxinus pennsylvanica* (green ash) and *Acer sacharinum* (silver maple) represented 26 percent and 18 percent of the City-managed tree population, respectively. Green ash and silver maple both exceeded the commonly accepted urban forestry principle that no one species should represent more than 10 percent of the total tree population and no single genus should represent more than 20 percent of the total tree population. *Fraxinus* sp. is particularly noteworthy as the City faces significant potential threat from emerald ash borer (EAB), an invasive pest which is currently sweeping across northern U.S. and Ontario. Devastating losses of ash trees result, significantly impacting communities and resulting in millions of dollars in tree removals.

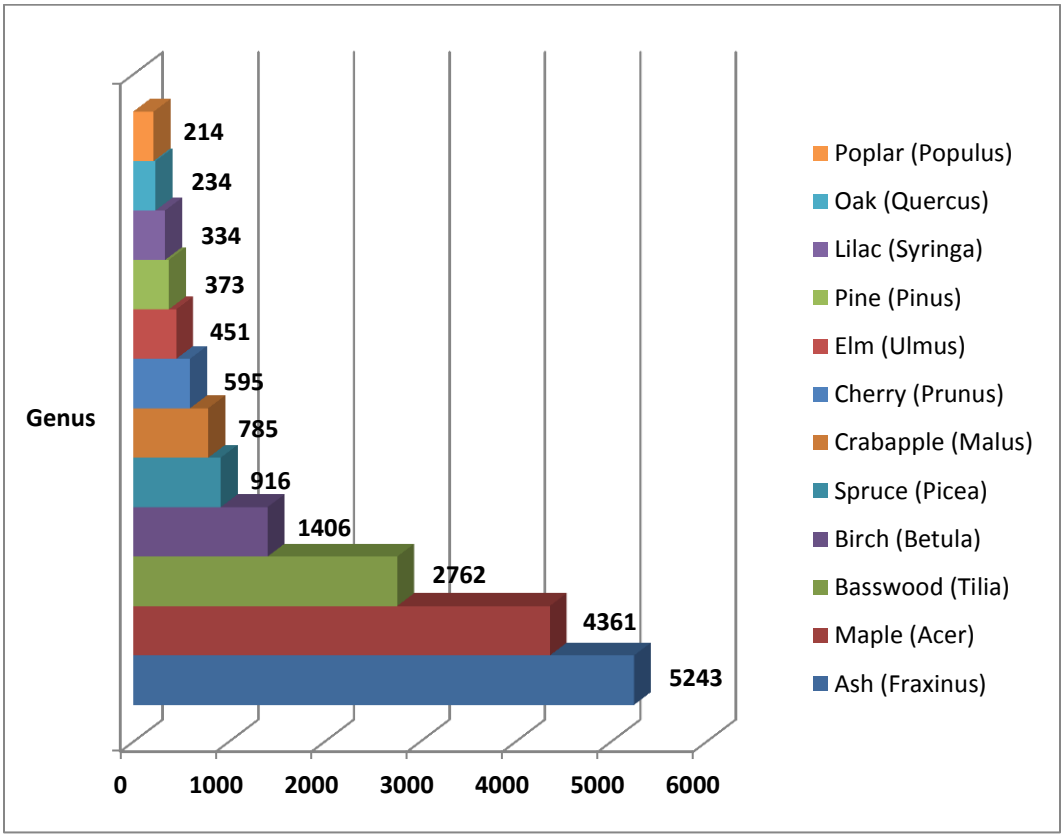


Figure 2. Distribution by Genus

Table 2. Top 10 Species Populations

Scientific Name	Common Name	Number	Percentage of Street Trees
Fraxinus pennsylvanica	green ash	4,661	26%
Acer saccharinum	silver maple	3,245	18%
Tilia americana	American basswood	1,440	8%
Betula papyrifera	paper birch	1,406	8%
Tilia species	linden	1,197	7%
Picea glauca	white spruce	772	4%
Malus 'hybrid (Spring Snow' or 'Pink Spire')	crabapple	732	4%
Fraxinus nigra	black ash	537	3%
Acer negundo 'Baron'	Manitoba maple	502	3%
Ulmus americana	American elm	383	2%
Total		**14,875**	**81%**

Issues

- More diversity required. High percentage of some tree species may predispose the urban forest to potential losses should exotic pests be introduced to the area. Twenty-six percent of Thunder Bay's urban forest is comprised of *Fraxinus pennsylvanica*, with another 3 percent as *Fraxinus nigra*. Eighteen percent is *Acer saccharinum*, and a further 3 percent is *Acer negundo*.
- Large trees are planted under overhead utilities resulting in interference and costly pruning.

Recommendations

- 1. Increase diversity of Thunder Bay's urban forest. Best management principles recommend that no more than 20 percent of urban forest should be of a single genera; with not more than 10 percent of a single species. That being said, Thunder Bay faces some challenges with increasing diversity, due to its severe climate. Tree species tables, recommended for Thunder Bay's climate, includes both tried and true species, and options to experiment with planting in protected areas are included in Tables 11-17.
- 2. Trees to be planted under overhead utility lines must be of species whose ultimate height at maturity does not exceed 6m.
- 3. Maples should be planted only when historic character warrants it, until the genus and species distribution adjusts through the planting of other species as a part of an improved planting program. Ash should not be planted at all until the threat of EAB has passed.
- 4. City staff should regularly check the status of tree trials conducted by the Western Nursery Growers Group for new introductions that show good hardiness. http://www.prairietrees.ca/, and current information re: invasive species updates.

2.2.2 Tree Condition

Generally, tree condition is assessed by analyzing the percentages of excellent, very good, good, fair, poor, critical, and dead trees. Condition is important to tree management because it provides information that helps determine the general health of the population, anticipate maintenance needs, and estimate associated tree care costs.

Thunder Bay's tree condition was rated based on a modified version of the International Society of Arboriculture's (ISA) tree condition rating system which ranges from excellent to dead conditions. City Forestry staff have correctly indicated that the 2000-2001 inventory no longer provides accurate assessments of tree conditions. It is important to note that inventories represent a "snapshot" in time, and an older inventory such as Thunder Bay's will no longer accurately reflect current conditions. Also tree condition data gathered in 2000-2001 may be questionable due to collection methodology. As an example, 85 percent of Thunder Bay's trees were considered to be in good condition in the inventory; however, it is apparent that the percentage of trees rated in good condition has since declined significantly. There were 1,359 (7 percent) trees rated in fair condition and less than 1 percent of trees were rated in poor or worse condition. There were 39 trees found to be in excellent condition.

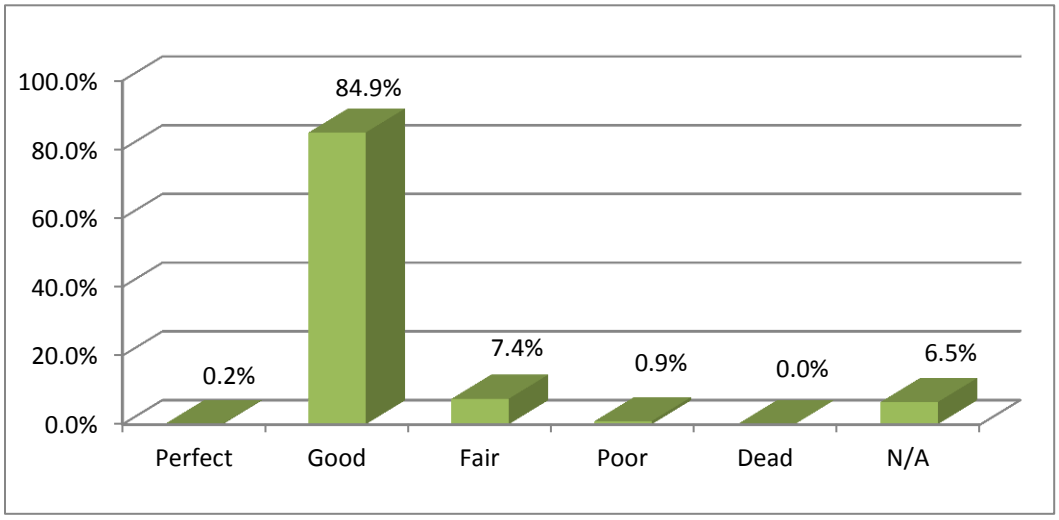


Figure 3. Thunder Bay's Tree Condition Occurrence

Issue

- Existing tree condition data in the inventory has been found to be inaccurate.

Recommendations

- 5. Update the current tree inventory to provide more accurate and useful data upon which to base planning decisions. Current inventory did not take into account tree risk assessments, which is an industry standard primary tool for cost-efficient planning of cyclical pruning programs, and of critical importance to Forestry staff who are tasked with managing public safety. A numerical risk rating system will provide clear direction for assigning work priority. A dynamic inventory system that can be updated periodically as trees are re-inspected is a very strong and important tool for recording pest incidence and referencing past threats, as well as planning for future pest threats such as EAB.
- 6. Update the current tree inventory in advance of establishing a cyclical, or grid pruning program. Tree inventories could be phased to align with City budget process, *e.g.,* street tree inventory of approximately 20,000 trees could be phased over 2 or 3 years.
- 7. Invest in tree management software developed specifically for urban forestry management. Consider software that allows public calls to be tracked, and work order generated automatically, as well as report capability to assist with prioritization of work.
- 8. Structural pruning of young trees pays off well in the long run, with less costly pruning required, and less damage due to public property resulting from weak unions. Continue to promote the Citizen Pruner Program; it is an excellent community program which provides excellent returns.
- 9. Tree inventories should be updated at intervals of not more than 10 years, to capture changes in tree structure, health and potential issues.
- 10. Ensure inventory is updated as removals occur to provide ease of preparation of tender documentation for contractors for stump removals.
- 11. The small percentage of trees found in poor or dead condition indicates that Thunder Bay has done a good job addressing trees when considered hazardous and in need of immediate pruning or removal. The City should continue to improve its population's tree condition by correcting all trees with serious structural deficiencies that pose risk, and those trees showing very poor health, through appropriate tree maintenance activities and by removing and replacing all poor and dead trees.

2.2.3 Size Class Distribution

Size class distribution is the proportion of trees by size, also described as the population's relative age. Size class distribution affects the benefits trees provide to the community and the sustainability of the urban forest. An ideal size class distribution has a higher percentage of young (1 to 15cm DBH) trees with percentages of established, maturing, and mature trees decreasing as the diameter increases. An ideal tree population distribution provides for an even flow of functional benefits as well as more predictable tree maintenance expenditures.

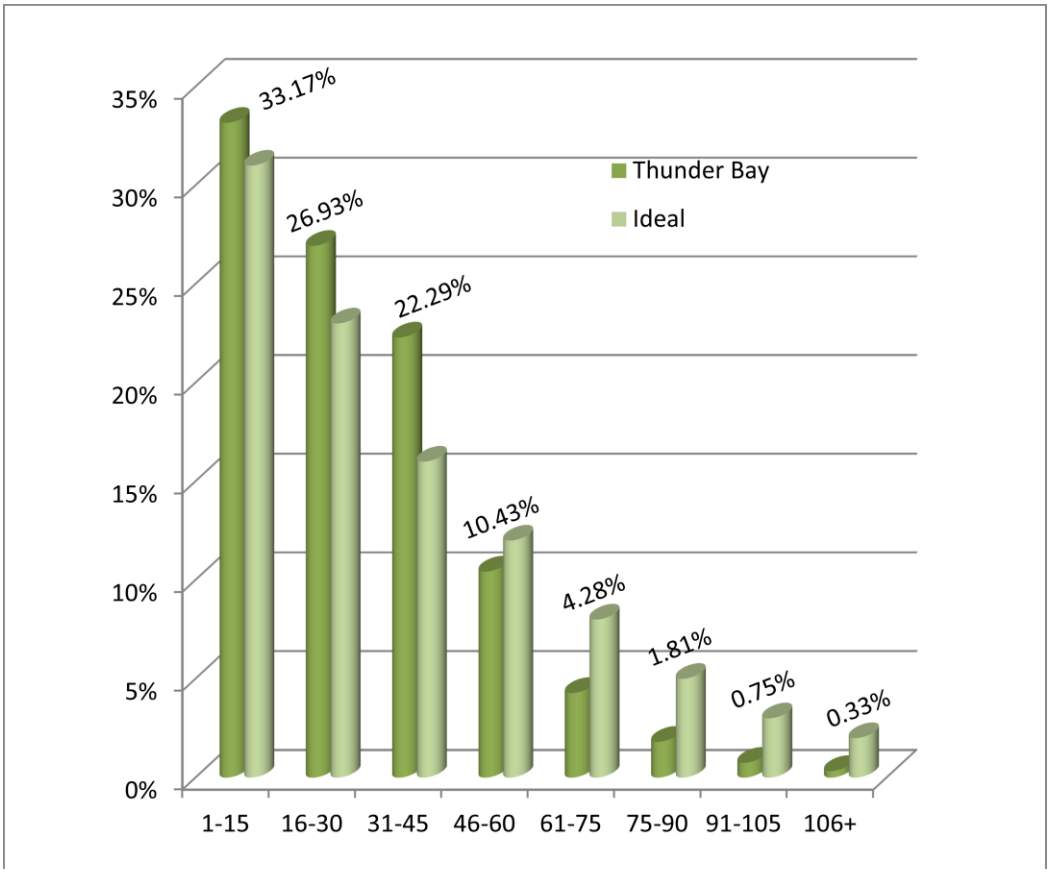


Figure 4. Thunder Bay's Size Class Distribution Compared to an Ideal Distribution

The two major trends observed were that the majority (33 percent) of Thunder Bay's inventoried trees are young (1 to 15cm DBH) and that mature trees (greater than 60cm DBH) only comprised 7 percent of the inventoried tree population (Figure 4). Thunder Bay's distribution trends toward the ideal distribution for planning purposes; however, to optimize the potential benefits the tree population can provide, the urban forest should have higher percentages of large-stature, mature trees which provide greater environmental benefits.

Issue

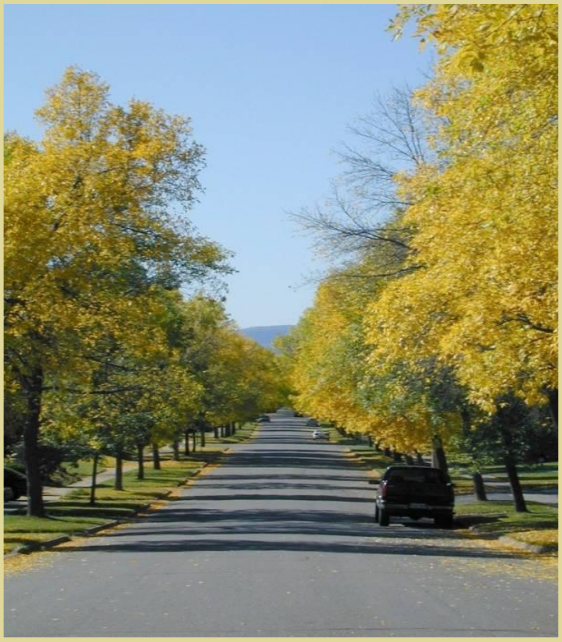
- Thunder Bay's urban forest has 80 percent trees less than 45cm DBH, and only 1 percent of trees greater than 90cm DBH.

Recommendations

- 12. Continue to invest in extending the health of Thunder Bay's larger trees by routine pruning and inspections. Larger trees provide the most benefits to the community, and are the most significant contributors to the urban canopy cover. While some individuals may take the position that significant pruning of older trees may be unappealing to the eye, the environmental benefits of older trees still outweigh the aesthetic concerns.
- 13. The size class distribution of the inventoried tree population illustrates that Thunder Bay has done a good job planting young trees. However, with only 7 percent mature trees, investment in larger trees needs to be a priority. The planting of large-stature trees should continue.
- 14. Continue to update tree species selection lists. As new cultivars are developed or existing species are identified as tolerant of Thunder Bay's harsh climate, they should be added to the list. Alternatively, factors may develop that create the need to remove species that are currently on the list, such as insect or disease threats. While the list should be used as guidance for what is acceptable in certain planting situations, there may be good cases made to consider additional species for use.
- 15. Select species for future plantings that are tolerant of the Thunder Bay growing environment, including those that exhibit stronger tolerance for extended dry periods.

2.3 City of Thunder Bay Benefit-Cost Analysis

The Benefit–Cost analysis provides an important tool for City staff, elected officials, and citizens to make informed decisions about funding urban forestry.



Large-growing street trees like these* Fraxinus pennsylvanica *(green ash) provide many benefits.

City trees provide to Thunder Bay a multitude of environmental benefits. Trees are environmental assets: they mitigate stormwater runoff, conserve energy, improve air quality, and reduce carbon dioxide levels. Appendix H provides a detailed review of urban tree benefits. They also provide other aesthetic benefits such as economic, social, psychological, and wildlife enhancements. The information presented in this chapter used the City's tree inventory and the i-Tree Streets model to assess and quantify the important, multi-faceted functions of the City tree resource and to place a dollar value on the annual benefits they provide. These annual benefits are a "snapshot" of environmental benefits produced by trees during one year. i-Tree Streets calculates the benefits produced by the City's street trees—an accounting based on the best available science that provides a platform from which management decisions can be made. A discussion concerning the methodology used to quantify and price these benefits can be found in Appendix C.

2.3.1 Benefits Provided by City of Thunder Bay's Street Trees

The i-Tree Streets model is considered a high level of data analysis, developed by the United States Forest Service with partners. The model, which is peer reviewed and highly acclaimed, can be used by the City of Thunder Bay to make informed decisions surrounding the urban forest. Beyond statistical calculations of public tree inventory data, i-Tree Streets provides conclusive data and rationale for the City's Parks Division to promote its "green infrastructure" management program to elected officials, staff, allied organizations, and the community the program serves—the citizens of Thunder Bay. The i-Tree Streets analysis was performed to quantify stormwater mitigation, energy consumption savings, aesthetics and other public values, air quality improvement, and carbon sequestration. Table 3 presents the total annual benefits provided by trees that are currently included in Thunder Bay's tree inventory and depicts them as a percentage of the total. The benefits are provided by category and include the total annual benefits. All benefit analysis reports are included in Appendix D.

Attempting to quantify benefits from trees is a progressive step in justifying City resource allocation to the urban forest. Despite the utility of i-Tree Streets in accomplishing forest benefit modeling, it should be noted that the i-Tree model used for the City of Thunder Bay may not represent fully the climatic conditions of this region, including, for example, the temperature moderations due to Lake Superior. The i-Tree Streets software was developed to model U.S. climate zones and air quality statistics, and is the only modeling tool available for this purpose. Hence, air quality benefits may also slightly differ from those values used in the model. Default values for the reference city were converted to Canadian dollars but unchanged to reflect Thunder Bay's air quality indices. Potential minor regional variations do not lessen the value of i-Tree analysis as an excellent source of information for good decision making. The annual total benefits provided by Thunder Bay's urban forest, based on existing inventory data is provided both graphically and in numerical format, as follows:

Table 3. City of Thunder Bay's Total Annual Benefits by Category

Benefit Category	Benefit Total ($)	Benefit per Tree ($)	Percent of Total Benefits
Stormwater	$552,362	$30	36%
Energy	$455,908	$25	29%
Aesthetic/Other	$403,056	$22	26%
Air Quality	$77,383	$4	5%
CO_2	$67,178	$4	4%
Total	**$1,555,887**	**$85**	**100%**

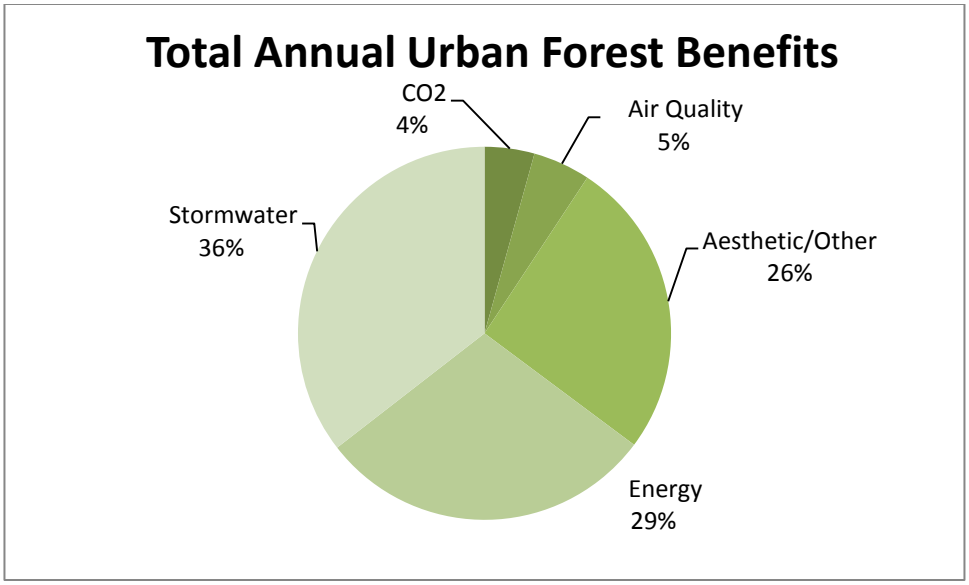


Figure 5. Thunder Bay's Total Annual Benefit Relative Percentages

2.3.2 Stormwater Runoff Reductions

Trees reduce the volume of stormwater runoff in neighborhoods and ultimately community-wide. This function and benefit is especially important in developed settings with increased quantities of impervious surfaces (roads, driveways, homes, parking areas) and in areas in close proximity to surface waters. A tree's surface area, particularly leaf and trunk surfaces, intercept and store rainfall. The tree's root system absorbs soil infiltration, thereby decreasing runoff. Trees also reduce stormwater runoff by intercepting raindrops before they hit the ground, thus, reducing soil compaction rates and improving soil absorptive properties. Additionally, trees intercept suburban contaminants such as oils, solvents, pesticides, and fertilizers which are often part of stormwater runoff, reducing pollutant discharges into vital waterways.

The City of Thunder Bay street tree resource intercepts 78,606 cubic meters of stormwater annually, for a savings of $552,362 or $30 per tree. The population of silver maples currently provides the greatest total benefit accounting for 42 percent ($230,620) of the stormwater management savings. Silver maples also provide the greatest single tree benefit ($71 per tree).

2.3.3 Energy Consumption Savings

The energy savings that trees provide can be attributed to climate changes, shading, and wind reduction. Ambient air is cooled when leaves use solar energy during transpiration. Air movement in an urban setting is influenced by tree spacing, crown spread, and vertical distribution of leaf area. These key factors also reduce the amount of radiant energy absorbed by buildings and other hardscapes, cooling the air during hot summer months and helping to heat during winter. The energy savings are realized by lower cooling and heating costs.

City trees provide annual electric and natural gas savings equal to 2,383 Megawatt-hours ($175,161) and 319,830. Therms ($280,747), respectively. The City of Thunder Bay saves a total of $455,908 per year and has an average annual savings of $25 per tree. The population of silver maple currently provides the greatest total benefit accounting for 30.8 percent ($140,312) of all energy savings. Silver maple also provides the second greatest single tree benefit ($43), where the top benefit per tree comes from American elms saving $44 per tree in energy costs.

2.3.4 Aesthetic Value and Other Benefits

It may seem difficult to place a dollar value on the benefits trees provide to the overall ambiance of a community and the well-being of neighborhood residents and visitors. However, trees provide beauty to the landscape, privacy to homeowners, and refuge for urban wildlife, and these can be quantified. Studies support differences in property values reflected by the willingness of buyers to pay for the benefits associated with trees.

Aesthetic benefits, property value, social benefits, economic benefits, among other non-tangible related benefits, provide the City of Thunder Bay an estimate of $403,056 annually, for an average of $22 per tree. The population of silver maples provides the greatest single tree benefit ($49).

2.3.5 Air Quality Improvement

Urban environments benefit greatly from the presence of public trees. Trees release oxygen through photosynthesis and absorb gaseous pollutants in the form of ozone (O_3) and nitrogen dioxide (NO_2). Ozone reduction is also attributed to the trees' shading effect on hardscape surfaces, their cooling effect on ambient air from the transpiration process, and their contribution to reduced emissions from power generation. Trees intercept volatile organic compounds (VOCs), sulfur dioxide (SO_2), and small particulate matter (PM_{10}), such as dust, ash, dirt, pollen, and smoke, from the air. Trees also emit air pollutants called biogenic volatile organic compounds (BVOCs) that contribute to the formation of ozone. The i-Tree Streets model takes this whole process into account.

Thunder Bay's inventoried tree resource absorbs and averts 13,525kg of air pollutants annually. The City experiences net air quality improvement benefits equal to $77,383 per year, averaging $4 per tree. The population of silver maples currently provides the greatest total air quality benefits accounting for 33 percent ($25,690 annually) of all air quality enhancements. Silver maples also provides the greatest single tree benefit ($8 per tree).

2.3.6 Carbon Dioxide Reduction

Carbon dioxide (CO_2) is used during a tree's photosynthesis process to produce the natural building blocks necessary for tree growth. This process takes carbon dioxide from the atmosphere and holds it as woody and foliar biomass. This is referred to as carbon sequestration.

Thunder Bay's City tree resource reduces a net 2,500,540 kg of CO2 per year valued at $67,178 with the average savings per tree at $4. The population of silver maples currently provides the highest sequestered CO2 benefit, accounting for 39 percent ($26,437) of the total annual savings and the greatest single tree benefit at $8 per tree.

2.3.7 Summary of Total Annual Benefits

City of Thunder Bay's inventoried trees in the urban limits provide $1,555,888 of annual benefits to the community and its environment. It is expected that the annual benefits may be much higher, however, as not all City trees are accounted for in the inventory, including natural woodlots. Table 3 shows environmental services from City trees provide the largest benefit accounting for 74 percent of the total annual benefits. Environmental benefits include energy savings which account for 29 percent of the total annual benefits, stormwater mitigation which accounts for 36 percent, air quality improvements which account for 5 percent, and carbon dioxide reduction which contributes 4 percent of total annual benefits. Aesthetics, or annual increases in property value, contribute the remaining 26 percent of quantifiable benefits to the City per year. Leaf surface area, tree population, and canopy cover determine an urban forest's ability to produce benefits. The more canopy cover the community has, the more benefits it will yield.

Large-growing trees consistently supply the most benefits per tree. They intercept large volumes of water, provide great amounts of shade, and absorb massive amounts of air pollution. Table 4 shows individual species' total annual benefit and their average annual benefit per tree. Silver maples provide the greatest benefit overall and benefit on a per tree basis.

Table 4. City of Thunder Bay's Total Annual Benefits per Top 10 Species

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Average Benefits Per Tree
silver maple	$140,312	$26,437	$25,690	$230,620	$160,477	$583,536	$180
green ash	$111,509	$16,090	$18,965	$109,941	$103,139	$359,644	$77
paper birch	$51,088	$6,266	$9,132	$50,409	$32,375	$149,271	$106
harvest gold linden	$38,320	$5,045	$6,032	$37,675	$23,560	$110,632	$92
American basswood	$25,691	$2,989	$3,955	$20,090	$14,025	$66,750	$46
American elm	$16,846	$1,737	$2,945	$19,351	$10,755	$51,634	$135
Manitoba maple	$14,279	$2,341	$2,457	$18,075	$13,284	$50,436	$100
white spruce	$12,049	$1,060	$1,418	$21,122	$10,505	$46,154	$60
pink spire crabapple	$8,533	$902	$1,337	$3,711	$2,381	$16,864	$23
black ash	$3,086	$448	$483	$2,653	$4,933	$11,604	$22
Citywide Total	**$455,908**	**$67,178**	**$77,383**	**$552,362**	**$403,056**	**$1,555,888**	**$85**

While the i-Tree Streets model provides valuable information about the overall value of tree benefits, there are also many details that can be learned from analysis of the data and results. Complete analyses of the i-Tree benefits are included in Appendix D.

A review of this analysis provides the ability to create what-if scenarios and plan for potential responses to these scenarios. For example, the analysis reveals that silver maple provides average benefits of $180 per tree. This is the highest per tree average of all species and is directly related to the typically large canopy that mature silver maples provide. Silver maples also provide a total of $230,620 in stormwater benefits and $140,312 in energy benefits; largely driven by the spreading canopy that intercepts rainfall, reduces the need for larger stormwater management systems, and cools the surrounding air. Additionally, silver maples comprise 17.8% of the total inventoried tree population, yet accounts for 37.5% of the total value of all tree benefits.

These figures place silver maple squarely at the top of the list in terms of being a valuable species for Thunder Bay in terms of the calculated benefits that it provides. However, many urban foresters agree that silver maple can be a problematic species when it reaches maturity as it tends to become relatively weak, has a tendency for storm damage, and has trouble dealing with wounding. As replacement species are considered for silver maple, Thunder Bay should consider species based on its physical traits and its potential for creating economic benefits based on the i-tree Streets model. Selecting tree species should include a review of both the physical characteristics and the potential for a species to provide long term economic benefits as well.

Section 3: Costs of Managing the City of Thunder Bay's Urban Forest

The costs associated with managing Thunder Bay's inventoried trees are an investment back into the community. In 2010, the City's total related expenditures for inventoried trees were approximately $705,003. This represents only 0.3 percent of the City's total institutional budget. Approximately $38.59 per tree is spent annually. Approximately 109,000 people live in the City and $6.47.per citizen is spent on trees.

Table 5 indicates that Thunder Bay spends more money on tree pruning than any other category (29 percent). The second greatest cost is tree removal (28 percent), with administration (18 percent) and planting (11 percent) coming in third and fourth, respectively.

Table 5. Cost Categories for Urban Forestry Related Activities (2010)

Cost Category	Amount	Percent of Total
Pruning	$204,150	29
Tree removal and disposal	$198,978	28
Planting	$74,000	11
Program administration	$125,499	18
Inspection/answering service requests	$43,482	6
Other expenses	$33,306	5
Establishment/irrigation	$10,000	1
Litter/storm clean-up	$8,564	1
Litigation	$5,637	<1
Pest and disease control	$1,387	<1
Total	**$705,003**	**100**

3.1 Net Benefits and Benefit-Cost Ratio Discussion

According to the benefits presented in this chapter, trees make good sense, but are the collective benefits worth the costs of management? In other words, are trees a good investment for the City of Thunder Bay? To answer that question, we must compare the benefits city trees provide to the cost of their management.

The sum of environmental and economic benefits provided to the City of Thunder Bay is $1,555,887 annually at an average of $85.16 per tree and $14.27 per capita (Table 6). When the City of Thunder Bay's annual expenditures of $705,003 are considered, the net annual benefit (benefits minus costs) returned by City trees to the City is $850,884. The average net annual benefit for an individual City tree is $46.57, which also translates to $7.81 per capita.

Applying a benefit-cost ratio (BCR) is a useful way to evaluate the City's investment in its trees. The BCR summarizes the overall value compared to the costs of a given project. Specifically, BCR is the ratio of the cumulative dollar benefits provided by the City's trees, compared to the costs associated with their management. The City of Thunder Bay receives $2.21 in benefits for every $1.00 that is spent in its forestry program (Table 6). Appendix D provides a summary of the City of Thunder Bay's total annual benefits, annual costs for managing their City tree population, and net annual benefits.

Table 6. Net Benefits and Benefit-Cost Ratio (2010)

Benefit/Cost	Total ($)	$/Tree	$/Citizen
Total benefits	$1,555,888	$ 85.16	$14.27
Total costs	$705,003	$38.59	$6.47
Net benefits	$850,884	$46.57	$7.81
Benefit-cost ratio	**$2.21**	**-**	**-**

3.2 Management Implications

Thunder Bay's i-Tree Streets analysis supports justification for more focused attention toward efficiencies, and increased funding for urban forestry planning, design, management, and maintenance at the City of Thunder Bay. Given the relatively good benefit-cost ratio, the City should examine its resource allocation, and shift to a planting and proactive tree preservation and maintenance focus. Although the current tree inventory does not include all public trees, the current annual benefits of inventoried trees alone show that the forestry division's budget is a good investment for the citizens of Thunder Bay. When data from the additional trees captured by an updated inventory is included, the benefit-cost ratio will likely increase further.

Implementing a comprehensive tree management program, including cyclical pruning and new tree establishment, is the first step to ensure that benefits produced by the City's trees far surpass the cost of managing them and that tree benefits will continue to flow steadily to the community. The 2000-2001 inventory indicated that 85 percent of the City of Thunder Bay's inventoried trees were considered to be in good condition, and trees in fair condition accounted for 7 percent of the population. It is realistic to think that the current percentage of trees in good condition will be much lower over time if budget limitations allow only reactive pruning and removals now and in the future. While these figures indicate a strong commitment to tree management, the City of Thunder Bay should strive to eliminate all dead and dying trees, replace poor performing trees, cyclically maintain the remaining population, and plant underutilized species to improve species diversity and reduce the impact of species-specific pests or diseases.

Planning to enhance City of Thunder Bay's trees will require careful consideration of budget and time. Short and long-term goals must be kept in mind and routine maintenance must be performed on a cyclical basis to ensure good health and condition of trees as they mature, and to reduce long-term costs.

Thunder Bay has a relatively young tree population. This being the case, the City should ensure that these young trees are cared for in order that they yield maximum benefit over a lengthened lifespan. Large-crown mature trees are the top benefit producers; hence, emphasis should be placed on planting and ensuring their longevity. A balance must always be sought with achieving the most productive urban forest in terms of measurable benefits while striving to achieve population diversity. A diverse population is a more pest-resistant population. Planting and maintaining large-stature trees will increase overall canopy cover and leaf area, thereby increasing benefits.

Planning for a greener and healthier city can begin by including urban forestry in all City improvement project discussions and considering creative ways to ensure that City trees are kept healthy, well maintained, and safe, for the betterment of community life.

Issues

- Thunder Bay's urban forestry program annual expenditures (costs) are not as accurately accounted for as desirable. Also, not all public trees are inventoried, both situations affect the accuracy of the benefit-costs calculation
- Currently, the greatest benefit-producing species in the City are green ash and silver maple. Both have real and significant management challenges (EAB, storm damage, high risk potential, etc.) that indicate they will likely be targeted for removal in the near and mid-term future.

Recommendations

- 16. Systematically track all annual urban forest management costs more accurately.
- 17. Complete the inventory of all public trees including parks, and update attributes of existing trees in the inventory to reflect growth differences from the 2000-2001.
- 18. Re-run the i-Tree Streets benefit-cost analysis in 2-3 years with the more accurate and complete information incorporating updated inventory records.
- 19. Begin a focused effort to plant and maintain large-canopied trees. Larger species sustain the environmental benefits.
- 20. In the transition period between planting new large canopied trees and encouraging the growth of existing shade trees currently in the small to medium-diameter ranges, preserve as many mature silver maple and green ash trees as practical and as risk tolerance allows.

Section 4: Municipal Forestry Management and Administration

4.1 Staffing

Municipal urban forestry planning activities are handled by a small group of employees within the Parks Division. The Parks Division is part of the City's recently realigned Infrastructure and Operations Department. There are currently two full-time positions and one temporary position responsible for urban forestry planning and programs. The connection among the three is loosely defined in the Park Division's Table of Operations (Appendix G) but is typically referred to as the Urban Forestry Section. Within the Urban Forestry Section, the full-time City Forester manages the City's urban forestry activities and reports to the Manager of Parks. A consulting arborist is retained for specific tasks as deemed appropriate by the City Forester.

The City Forester assists with the use of a resistograph to determine the presence of internal decay on a street tree.

Responsibilities of the City Forester include working with the Urban Forestry Program Specialist (full-time position) and the Tree Inventory Intern (temporary position). All are housed in the same office as the Manager of Parks in the Parks Division offices at Victoriaville Civic Centre.

A Parks Operations crew cleans up storm-damaged trees.

The Urban Forestry Section is also supported by staff performing additional, valuable functions such as the Co-ordinator of Parks Planning, and Parks Services, whose activites often require informal or formal team approaches and interaction to ensure quality results.

Additionally, there are two Park Operations Sections that handle much of the fieldwork including tree removals, pruning, and other maintenance activities of trees on public property. While no direct chain of command exists between the Park Operations Sections and the City Forester, there is a connection in that the City Forester makes the determination of need for some tree work such as removals or assessments. A work request is then created that is passed along to one of Parks Supervisors. Parks Operations staff are also independently involved in pruning and stumping, without direct input from the City Forester.

The Park Operations Sections include North and South. The dividing line between Parks North and Parks South is Harbour Expressway. The Parks North yard is located at 645 Cumberland Street and the South Parks Yard is at 610 Mountdale Avenue.

The number of staff who regularly perform tree work varies between sections based on workload and ranges from 11 in the Parks South Section to 17 in the Parks North Section. These positions include a Leadhand and several Parks workers. Included in these numbers are two tree truck operators, one located in Parks North, and the other in Parks South. Operational sections primarily perform tree related work during the months of April through November and are re-assigned to other tasks from December through March, with the exception of Parks South which intermittently performs tree work, weather, and schedule permitting.

Some work requests such as tree removals and pruning, and all tree plantings are handled by contracted services. In 2010, contractors performed 77 of the 421 removals, 147 of the 1,213 pruning services, and planted all the 335 trees. Tree planting numbers are lower than the number of removals and may result in an overall reduction of tree canopy as removed trees are typically larger diameter and all new trees are not expected to survive to a mature age. Requests for tree pruning or removals are sometimes routed to Thunder Bay Hydro, the electric utility with authority for tree work along its right-of-way and easements. Thunder Bay Hydro is a private local distribution company owned by the City of Thunder Bay and run by the Thunder Bay Hydro Board. A strong working relationship exists between the utility and the Urban Forestry Section. While there is no official protocol, the utility supports and provides assistance to the City's urban forestry activities that are mutually beneficial to both programs

Issue

- Indirect supervision and lack of accountability for operational efficiencies and quality service

Recommendations

- 21. Recent/proposed re-organization of staff and tasks will create a more efficient and effective system of identifying urban forestry needs, scheduling, and completing assigned tasks. Staff performing forestry work should report to the proposed Leadhand/Arborist position, and there should be clear channels of authority and responsibility for tasks assigned by the City Forester to the Leadhand/Arborist and forestry crews within the Parks Division. New structure as proposed should be adopted and implemented as soon as feasible. Refer to Appendix G.
- 22. Create a solid identity for the Urban Forestry Section. This begins with increased visibility of the name of the group of individuals who perform urban forestry activities. In order to facilitate effective utilization of existing staff, the name "Urban Forestry Section" should be used in all correspondence and planning documents.
- 23. The recently created Supervisor – Forestry, Cemeteries and Horticulture position, and the proposed Leadhand/Arborist positions will provide additional arboricultural expertise and direct supervision of municipal crews that plant, prune, and remove trees. Creating these position will bring a strong emphasis to the operational side of urban forestry activities. It may also create the need to reallocate job duties of the City Forester and the Urban Forestry Program Specialist that will emphasize the planning of municipal construction projects (sewer, water, roads, and sidewalks), permitting, inspection of publicly owned trees.

4.2 Training and Education of Staff

Some training is provided to Parks Operations staff and Urban Forestry Section staff. Workshop training includes relevant topics such as hazard tree assessment, chainsaw certification, and proper pruning techniques. Consultants are occasionally brought in to provide training to staff. The City Forester occasionally travels to professional workshops and conferences to receive training. A dedicated budget item does not currently exist that is dedicated to staff development.

Issue

- Staff training is undervalued, sporadic, and produces less than optimal outcomes.

Recommendations

- 24. All individuals who perform tree related activities (either planning or performing arboriculture activities) should become Certified Arborists, or Certified Tree Workers (Climber Specialist or Aerial Lift Specialist), through the International Society of Arboriculture or Ministry of Training, Colleges and Universities (MTCU). Future training should be geared toward topics that will allow staff to achieve certification.
- 25. Continue a planned and documented safety program related to operation of arboriculture equipment, including but not limited to, aerial lift inspections, aerial lift safety, aerial rescue, first aid, and working near energized lines per Electrical & Utilities Safety Association (EUSA). Regular safety training sessions should continue to be provided to all staff who work regularly with, or near, any arboriculture equipment, or on arboriculture work sites.
- 26. Train a minimum of one, three-person crew in advanced tree climbing skills. This can reduce the need for contractual services and adds a level of safety in the event of emergency response situations.

Additional training is needed to reduce damage caused by city tree crews.

- 27. Explore partnering with Thunder Bay Hydro on mutually valuable training topics, such as proper pruning practices. Inclusion of City staff with well-trained Hydro professionals would improve staff engagement, and quality results. City staff should not be included in any training for work within 3.3m of utility lines, as they must not perform those tasks.
- 28. The City Forester should work towards achieving and maintaining the ISA Municipal Specialist designation.
- 29. The City Forester should attend an annual urban forestry conference to learn from speakers, peers, and colleagues. Information learned should then be presented to Forestry staff.

- 30. Increase networking and opportunities to interact. Partner with local agencies, organizations, and surrounding communities to increase capacity by increasing knowledge and reducing initial program start-up costs. Good examples of interaction and idea sharing can be found through the Illinois EAB Wood Utilization Team at http://illinoisurbanwood.org. While the group was formed as a result of wood residue loads created by the loss of ash trees from EAB, it has many novel ideas for communities with wood residue needs.
- 31. Create a specific budget line item that provides dedicated funds for training and professional staff development
- 32. Explore government funding assistance to employers available through arborist apprenticeship programs (*e.g.,* Humber College arborist program). Refer to: www.servicecanada.gc.ca/eng/goc/apprenticeship/incentivegrant/program.shtml.

4.3 Equipment

Each of the Parks Operations Sections maintains equipment for use in tree related activities. Each section shares the following equipment:

- Two aerial lift trucks with chipper bed (housed at North and South locations)
- One tree spade
- Root pruner - Vermeer
- Stump grinding machines (one remote operated, and one older machine)
- Chippers (two newer machines and two spares shared by all districts)
- Three-ton truck with a chip box
- Additional equipment is available from other City divisions

In addition to the equipment mentioned above, there is a large assortment of chain saws, power tools, and hand tools to accomplish typical arboricultural tasks. There are no in-house climbers; thus, no climbing equipment is kept on hand.

Issue

- Accountability for equipment and maintenance records is not within the Urban Forestry Section.

Recommendations

- 33. Continue planned regular inspections and maintenance of all forestry equipment to comply with all safety standards and requirements, including aerial lifts, aerial rescue including ropes, chainsaws, chippers, stumpers, trucks, air spades, root pruner, and hand tools. Document all inspections and provide backup records to Lead Hand / Arborist.
- 34. Designate Lead Hand/Arborist as responsible for equipment maintenance, and to keep records of such.
- 35. Maintain a supply of climbing materials to properly equip any municipal tree climbing crews.

4.4 Workflow Processes

This section considers the flow of work requests from initial contact to end service provision. The most requested activities of tree removals, plantings, and maintenance are outlined below. Appendix G illustrates the workflow processes for various activities.

The current primary workflow within the Urban Forestry Section includes the use of a computerized information management system. The Hansen System Information Technologies asset manager software is used to record, assign, and track requests for service. Using this system, protocols were developed for handling multiple request types. Flowcharts of the workflow process is found in Appendix G. The type of work requested and performed falls into the following categories.

Yearly totals of forestry operational activities are provided by the Parks Division's Hansen System. Table 7 provides the annual totals from 2006 through 2010.

Table 7. Annual Total of Urban Forestry Services

		Year				
Activity	**Code**	**2006**	**2007**	**2008**	**2009**	**2010**
Approval tree plant	PKATP	15	8	6	6	4
Approval tree stewardship program	PKATS	60	75	101	70	64
Commemorative tree and bench program	PKCTB	n/a	n/a	3	3	19
Tree plant	PKTP	213	213	149	162	189
Contractor tree plant	PKCTP	103	51	26	137	59
Tree trim	PKTT	655	661	561	723	1066
Contractor tree trim	PKCTT	36	63	70	85	147
Tree removal	PKTR	299	413	338	347	344
Contractor tree removal	PKCTR	14	59	31	71	77
Contractor bolt and/or cable	PKCBC	13	9	6	2	19
Contractor fertilization	PKCF	5	1	0	8	4
Contractor tree spray	PKCSP	54	28	18	14	16
Miscellaneous	PKMI	72	264	81	76	95
Contractor miscellaneous	PKCMI	6	4	8	16	22
Tree stump	PKTST	213	222	219	219	222
Contractor tree stump	PKCST	2	7	11	2	2
Tree assessment	PKTA	239	256	314	513	550
Tree reassess	PKR	22	43	48	44	40
Infraction	PKI	2	1	2	4	3
Total		**2,023**	**2,378**	**1,992**	**2,502**	**2,942**

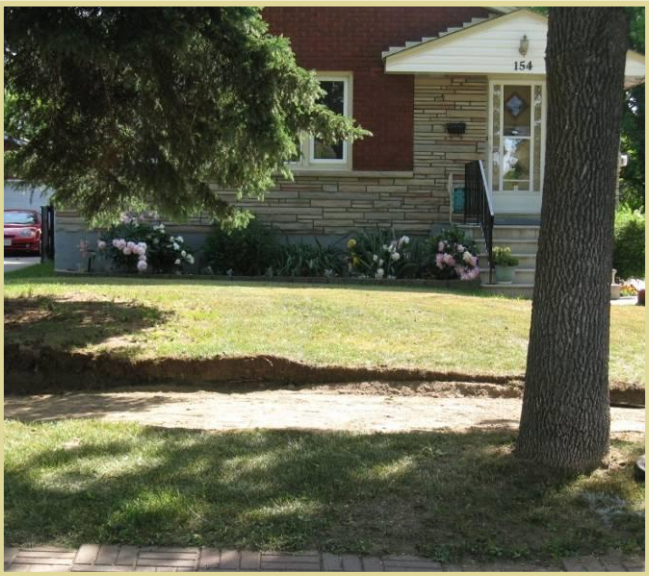
Recent increases in the number of tree assessments and tree trimming and removals account for a large portion of the increase in activities from 2006–2010. Workflow priorities will change if the City adopts a systematic tree pruning system. Residents will still be able to call in and request service, but if an inspection determines that the request does not involve a hazardous limb or tree, the service may be deferred until the next pruning cycle.

While citizen requests for service account for much of the workload in the Urban Forestry Section, additional requests for service are received from other municipal departments such as Roads Division, Environment Division, and Engineering Division. Requests from these divisions are scheduled and tracked using the Hansen system.

4.5 Interdepartmental and Utilities Cooperation

The expertise contained within the field of urban forestry spans several disciplines of study and municipal departments. Developing respect for other disciplines, creating clear channels of communication, and creating clear definitions of authority and expectations will continue to foster partnerships and community improvements.

Thunder Bay's Urban Forestry Section has developed very good working relationships with other City departments, which is often difficult to achieve due to conflicting priorities. City staff should be applauded for their collegial focus on public service delivery. Requests for tree service or requests for arboricultural expertise are received from other municipal departments such as the Roads Division, Environment Division, Engineering Division, and Planning Division.



Street and sidewalk improvement activities can have an impact on trees.

4.5.1 Roads Division

The Roads Division is part of the Infrastructure and Operations Department. The Urban Forestry Section periodically receives a list of addresses with trees that are overhanging sidewalks and streets, or obscuring traffic signs and signals. Once received, they are handled as high-priority requests.

The Roads Division generally contacts the City Forester when sidewalk repairs are planned near street trees. Although an improvement in efforts made to protect public street trees during repairs has been noted in the past few years, efforts vary by crew and additional education efforts are needed. Also, if a tree is lost as a result of the project, Roads will provide two trees as replacement. There are many stormwater drainage ditches along roads. The Roads Division frequently maintains these ditches and will remove trees to improve water flow.

Other issues include the damage to trees that occurs during snowplow operations.. Continued education of staff is warranted.

4.5.2 Environment Division

This Division is also part of the Infrastructure and Operations Department, handling municipal services that include sewer, water, and refuse. Repair and replacement activities that occur to a very dated infrastructure of sewer and water lines will often create damage and loss of public trees. Project planning often involves input from the City Forester, but tree loss still occurs. As with the Roads Division, activities associated with Environment Division activities result in the replacement of two trees for each one lost.

4.5.3 Engineering Division

This Division is also part of the Infrastructure and Operations Department of Thunder Bay and is responsible for the long-range planning, design, construction supervision, and records management for storm drainage systems; sanitary sewage collection and treatment; water supply, treatment, and distribution; and roads and bridges. The Engineering Division also tracks repairs made to the streets by outside agencies. Local improvement projects on public lands are also planned in this division.

The City Forester is consulted when projects and permits handled by this division impact public trees. Recommendations are made at the design stage of a project to allow for tree protection to be part of the design process. Additionally, pre-construction meetings that include a review of tree protection requirements are held with the City Forester and contractors on municipal projects. Some projects require limb or root pruning prior to the project and the cost of this work is covered in the project contract. The Engineering Division has project inspectors assigned to projects during the construction phase. The City Forester provides informal "tree education" for the inspectors and sometimes inspects tree protection measures at a project site.

When tree planting occurs as part of an Engineering project, the City Forester provides input to the staff and tree planting contractors. Included is the inspection of planted trees to ensure survival after two years. The values of newly planted trees that do not survive should be charged to the bid bond for the project.

The Engineering Division prepares and publishes the City's *Engineering Development Standards* with the most recent edition being published in 2011. A section of text and drawings references the planting and protection of trees during municipal development projects and development on private property. Drawings M-104-1 through M-104-3 provide specifications for tree planting and drawing M-104-4 provides specifications for tree protection. Drawing M-104-5 provides specifications for sidewalk/boulevard tree pits.

While the standards provide a consistent reference for work to be performed, some updates are required to make the standards current.

4.5.4 Planning Division

The Planning Division is located in the Development Services Department, providing information regarding planning related issues as well as having responsibility for land use planning functions. The Division also processes subdivision/condominium applications, and negotiates Site Plan Agreements, Development Agreements, and Notification Agreements for private property.

Residents along a street or in a given neighborhood can request improvement to existing sidewalks or curbs, or can request tree installations. If these improvements include the loss of public trees, plans include the planting of replacement trees where appropriate.

Urban Forestry activities interact with this Division on issues related to site plan control on private lands. The Coordinator of Parks Planning thoroughly reviews all landscape components and consults with the City Forester as required. This often includes reviewing the landscape component of a proposed development for proper species, placement, and maintenance. Landscaping required as part of a site plan development must be maintained forever, but enforcement of this provision has been problematic.

New developments are subject to standards that require the planting of trees on adjacent street rights-of-way and also require the planting of new trees on subdivided lots. In cases where lots are created and infrastructure is installed, tree planting may be delayed until home construction is complete. If home construction is delayed for some time, a payment is made to the City and trees are planted after the home is built.

There are currently few standards or requirements for the protection of trees during private land development. Creating new standards that protect trees will help the City to maintain its current canopy coverage and provide environmental benefits. The challenge of creating new standards that impact development can be met with opposition, but a thoughtful dialogue within the planning arena can determine if additional tree protection standards would be desired in Thunder Bay.

4.5.5 Thunder Bay Hydro

An excellent working relationship exists between Thunder Bay Hydro's Forestry Department and the City's Urban Forestry Section. The collaboration with Thunder Bay Hydro began early in the development of the City's urban forestry program. One of the first cooperative ventures was training that the utility provided to their own staff and contractors to reduce the incidence of tree topping and move towards a directional pruning technique that is widely accepted throughout the industry. The utility now has a long-range plan for line clearance pruning that includes the use of proper arboricultural standards. The City refers pruning work on street trees to Thunder Bay Hydro if the proximity to energized lines is an issue. This referral process is part of the City's workflow and is broadly accepted by the utility. Thunder Bay Hydro attempts to perform as much work as possible with existing staff; however, contracting to Utility Arborists is sometimes necessary. A Forestry Coordinator, who is a Certified Arborist through the Ministry of Training, Colleges, and Universities (MCTU) and is a Registered Professional Forester, manages the Thunder Bay Hydro forestry and vegetation management program. The electric utility typically operates with 2 contracted crews with 3 individuals per crew. Crew members are qualified to work in proximity to energized lines and at least one member of each crew is a MCTU Certified Utility Arborist.

Issues

- City staff damage trees during municipal operations such as snowplowing, or construction.
- Tree protection standards are inadequate and offer limited protection.
- City Forester is not always consulted on road/sidewalk repair projects.
- Project managers need to enforce tree protection standards.
- Trees are not always considered as important infrastructure.

Recommendations

- 36. Develop protocol that addresses inclusion of the City Forester during construction planning for all City property projects (*e.g.,* sidewalk repairs or sewer work) and requiring reasonable steps for tree protection and replacement during the project planning and construction phases. The policy should include guidelines for regular inspections of tree protection measures on project sites by City Forester.
- 37. Update tree protection standards contained in the City's Engineering and Development Standards. Tree protection standards should emphasize the protection of critical root zones and restrict the use of trunk protection planking to only the most extreme sites where other root protection measures are utilized and no other options exist except equipment operating close to a tree's trunk. Protecting only the trunk will leave roots vulnerable to soil compaction and contamination. A good reference is the ANSI A300 Standards.
- 38. Trees should be recognized as a vital component of "Green Infrastructure" and included on all municipal projects.

- 39. The small team of urban forestry staff who have made great strides in improving Thunder Bay's urban forest despite challenges of inadequate resources should be recognized as a professional service who provides input and is consulted on all tree related issues in the City.
- 40. Develop a policy to address the loss of trees from municipal operations such as snowplow operations. Although municipal operations are considered critical functions, there should be a policy about replacement of trees that are damaged or lost. 2:1 replacement of trees lost during municipal operations is recommended.
- 41. Individuals, including staff and contractors involved with municipal construction projects, should be provided training about tree protection during construction activities.
- 42. Project managers should receive additional training regarding tree protection measures. Project managers need to be held accountable for enforcing tree protection on construction projects.
- 43. City Forester should present an educational session regarding tree protection to the Engineering and Development and Construction staff, potentially at a future conference or workshop.

Section 5: Municipal Forestry Operations Evaluation

A comprehensive evaluation of the current state of Thunder Bay's municipal urban forestry program was undertaken per the City's directive to improve efficiencies, service delivery, and ensure public safety. Primary operational tasks include tree planting, maintenance (*e.g.,* pruning) and removals.

5.1 Tree Planting

While Thunder Bay currently has not yet established a specific goal in terms of overall canopy cover, they do have an active tree planting program that is guided largely by citizen requests for new trees at their residence. A directed and aggressive program of planting trees in identified, high-priority areas can increase canopy cover in areas with limited tree canopy and add trees to primary boulevards and high-image routes in Thunder Bay.

There is much support for tree planting in Thunder Bay, from both internal and external stakeholders. Recent documents that support additional well-planned tree planting in Thunder Bay include the following:

- EarthWise® Community Environmental Action Plan (2008)
  - Advocate for the preparation of an urban forestry master plan, better inventory system, increasing green space (including the planting of more trees), and maintaining biodiversity
- Renew Thunder Bay (2009)
  - A five-year strategic infrastructure plan that advocated urban reforestation
- City of Thunder Bay Strategic Plan (2011-2014)
  - Promotes creating a cleaner, greener, and more beautiful city including the planting of additional trees and advocates for an Urban Forest Management Plan.
- Clean, Green & Beautiful – Thunder Bay's program to enhance the profile of the City

A strong base of support exists in Thunder Bay for expanding the urban forestry program, including an increase in tree planting efforts. This support was strongly evident during the interviews held with staff and elected officials, the public meeting, and several stakeholder groups during the information gathering phase of this plan (Appendix A).

The Parks Division maintains a capital budget account for tree planting. The budget was $50,000 each year from 2005 through 2008 and was then raised to $120,000. The City's expenses for tree planting in 2010 was $74,000. A total of 335 trees were planted at an average cost of $221 per tree. Contractors are being utilized exclusively to plant trees in order to meet planting goals. The tender includes the supply of the tree and planting, but no follow-up maintenance for boulevard trees. Specifications for the supply and planting of trees are included in the form of tender included requirements that trees meet the current *Canadian Standards for Nursery Stock*. The City also requires all developers and contractors to follow their recently updated *Guidelines and Specifications for the Planting of Municipal Shrubs and Trees* for all planting on public property (Appendix G.) The guidelines include a requirement for a two-year warranty on all planted trees.

5.1.1 Current Status of Tree Planting Operations in Thunder Bay

Tree planting on municipal property occurs in the following ways:

- Property owner requests
- Planned landscape projects or natural area plantings in parks
- Planned landscape projects in conjunction with road improvements or construction
- Replacement trees for those lost during road improvements or other municipal improvements
- Subdivision/development agreements for tree planting and Site Plan Control Agreements

Boulevard Tree Planting

There are currently three options available to property owners from which to choose:

- Property owners may call City to be put on waiting list for a 50 mm caliper tree, planted at no cost to the homeowner. A two-year backlog is common.
- Property owners may also arrange for the planting of a 50mm tree and pay the full cost. Wait time is typically one year or less.
- Property owners may also participate in the Tree Stewardship Program (TSP) by paying for a portion of the cost (currently $125) and have a tree planted the following season. This program provides a cost-shared option for accelerated tree planting, and includes a public outreach component that encourages stewardship of the new trees and other boulevard trees.

When a homeowner requests a tree, they are informed of the options, and the resulting request is then entered in the City's Hansen information management system so that the request can be scheduled and tracked.

As tree requests are assembled over a period of time, the City Forester or Urban Forestry Program Specialist meets with each property owner, and inspects the site to determine appropriate species and location. The locations are then checked for both public and private utilities to avoid potential conflicts. An attempt is made to spread out the number of utility inspections to assist the utility staff's workload. Once utility locations are verified, information is provided to tree planting contractors.

Once a list of acceptable locations is determined and species lists are created, the City Forester orders trees and tenders out the supply, delivery, and planting of trees. Parks staff workload necessitated the use of contractors to plant trees, to improve public service response. Some tree planting occurs through volunteer activities each year. Earth Day events, Arbour Day events, Scouts, and Cadets all provide opportunities for tree planting in public places. The contractor provides each homeowner with information about watering and follow-up care. Homeowners are responsible for watering trees. The City has no budget or system in place to water newly planted boulevard trees in residential areas.

There are several situations in which tree plantings are administered outside of the Parks Division. When road re-construction occurs, streetscaping is administered by Engineering and costs are included in the capital budget. The overall design for streetscaping is approved by the Parks Division and the City Forester is involved in the planning and planting process. Two-year warranties are required for trees planted as part of a streetscaping project.

Tree planting is also administered outside of the Parks Division during the planning and development of new subdivisions. New street trees are required as part of the subdivision agreement plan approval process and may be required in site plan control agreement. Arrangements can be made with developers to provide funds in lieu of new trees in the development. This avoids the planting of required trees on empty lots when home construction may not occur until a few years later. The funds are earmarked for new trees after home construction takes place.

Issues

- Time spent on administering three program choices for property owners may not be the most efficient use of the scarce time resources for Urban Forestry Section staff.
- City staff do not have the time and resources to plant trees.
- No follow-up watering is provided for boulevard trees.

Recommendations

- 44. Reduce the number of potential options for tree planting request types from property owners. The current choice of three options may increase program management costs. The Tree Stewardship Program is a valuable and effective program which should be retained. Two programs at the most should be offered to property owners.
- 45. Update City Forestry website to include cut-off date for placing request for tree to be planted on boulevards. The annual tree planting program is an efficient means of single tender preparation.
- 46. Continue to contract out street tree planting via City tender process. Provisions should include wording for experienced, qualified contractors; watering for a two-year post planting period; and a two-year guarantee period with replacement plantings should the tree not pass inspection by City Forester/Urban Forestry Program Specialist.
- 47. City Forester/Urban Forestry Program Specialist should continue to inspect the work of tree planting contractors to ensure compliance with contract specifications including the City's *Guidelines and Specifications for the Planting of Municipal Trees and Shrubs.*
- 48. Watering is critical for tree establishment. Ensure newly planted trees are watered regularly during the critical period of establishment of two years. Options include contracting out, or staff watering. Although communication to residents to encourage them to water street trees may provide some positive action, the City should not rely on effective watering by volunteers. Watering should be included as a requirement of contracted tree planting services.
- 49. Develop a system for entering newly planted tree locations in the City's current inventory system. Homeowner requests are typically entered into the Hansen recordkeeping system. Ensure that all newly planted trees are recorded in to a GIS data base and that maintenance needs and work accomplishments are tracked. Newly planted trees should be inspected by the City Forester or Arborist immediately after planting and again at the end of the guarantee period. After that, new trees should be placed on a young tree maintenance program starting in the third year after planting.
- 50. Update tree planting standards contained in the City's *Engineering and Development Standard*s and in the *Guidelines and Specifications for Planting Municipal Trees and Shrubs*. The specifications and diagrams should include information about identifying and exposing the root flare at the time of planting. A good reference is the ANSI A300 Standards.

- 51. Maintain a separate inventory of trees on private developments that were planted per requirements of the City's site plan control process. Record in the inventory planting dates to trigger periodic inspections to verify survival of trees and develop a protocol for Divisional responsibilities to determine whether the Parks Division, or Planning Division will monitor the plantings.
- 52. Develop options to improve viability of trees planted as part of new developments. The City should vigorously enforce tree planting and survival requirements in subdivisions and require contractors to provide supplemental watering of newly planted trees on these sites.
- 53. Clean, Green and Beautiful® offers funding opportunities for valuable community initiatives. It is recommended that the Urban Forestry Specialist prepare proposals for considerations including unique, innovative programs developed by City staff to market new urban forestry initiatives. Examples of suggested programs are:
    - 'Play in the Shade' - a program to plant trees near park sports fields and play structures. This would be a new initiative developed by the Forestry Section of Thunder Bay, which would be positively received by the community, and invariably will spread to other communities. Children could also be encouraged to water the trees with leftover bottled water, promoting stewardship and education.
    - 'Clean air for Growing Minds' – a program to plant trees on City boulevards in the immediate vicinity of schoolyards. Planting on City property outside schoolyard fences reduces vandalism while providing the benefits of shade, improved air quality, noise absorption, and aesthetics. Involving the school children in the plantings would also encourage stewardship and environmental education.
    - 'Growing Gators' – a program to acquire and affix tree 'gator' watering bags to newly planted trees. Tree 'gators' have proven to be a reliable method to help improve survivability of newly planted trees. An ideal program would include the purchase of a trailer with water tank, and pump, which could be towed behind a small truck or lawn tractor. A summer student could water trees throughout interconnected park areas and sports fields.

The examples of programs provided above suggest innovative and creative ways to market potential programs and secure funding from internal sources or outside agencies. Packaging ideas into unique programs, and naming them helps to create an identity which donors visualize the concept and benefits to the community, and respond to favourably.

5.1.2 Priorities and Key Planting Locations

While a strong base of support for additional tree planting and tree care exists, and priority areas for tree planting have been suggested, no specific plans have been developed that identify priorities. The 2009 Thunder Bay Urban Forest Canopy Cover Project Final Report (UFCC) indicates the City has an overall tree and shrub canopy of 47 percent. The report identified estimates of the distribution and extent of urban forest canopy cover relative to other ground cover types within the City. Table 8 provides the percent of land area for 5 different land cover types from the UFCC study.

Table 8. Percent of Land Area by Cover Type

Ground Cover Type	Percent of Land Area
Tree and shrub canopy	47%
Grass and herbaceous cover	27%
Impervious surfaces	18%
Water	7%
Bare soil	1%
Total	**100%**

There are no precise canopy cover targets, but American Forests (a non-profit conservation organization in the United States that promotes healthy forests and urban tree planting) has developed guidelines that can be used as starting points for communities to set their own goals. Those targets are typically based on the community's unique mix of climate, geography, land-use patterns, resource structure, and community attitudes. The general guidelines proposed by American Forests are: average tree cover counting all zones, 40 percent; suburban residential zones, 50 percent; urban residential zones, 25 percent; and central business districts, 15 percent.

Thunder Bay has attained those minimum targets; however, it should be recognized that considerable stands of natural forests within the wards with rural holdings heavily skewed the estimate for average overall canopy cover in Thunder Bay. Table 9 provides the cover type percentage within 9 different land types in Thunder Bay.

Table 9. Percent of Cover Type by Land Use Category

Land Use Type	Cover Type Percentage				
	Trees and Shrubs	Bare Soil	Grass and Herbaceous	Impervious Surface	Water
Rural	71%	<1%	25%	2%	2%
Hazard lands	68%	0%	23%	4%	5%
Open spaces	64%	1%	26%	4%	6%
Residential suburban	61%	1%	30%	7%	1%
Industrial lands	40%	4%	28%	22%	6%
Residential urban	29%	2%	35%	34%	<1%
Streets	22%	0%	26%	52%	0%
Commercial lands	19%	0%	15%	66%	0%
Airport	6%	0%	63%	31%	0%

There are many areas of Thunder Bay that would benefit from additional tree planting, although finding suitable space is a challenge.

While urban canopy cover averaged 47 percent across the entire community, this figure is heavily influenced by the well-treed rural land type in McIntyre Ward (68 percent) and Neebing Ward (53 percent). In contrast, the higher density, urban core wards had lower canopy cover averages with 13 percent in McKellar Ward, 23 percent in Northwood, 25 percent in Westfort, 30 percent in Red River, and 33 percent in Current River. Table 10 provides the percent canopy cover in each ward. Map 2 provides a map of Thunder Bay's ward boundaries.

Table 10. Percent of Cover Type by Ward

Ward	Tree and Shrub Cover Percentage			Other Cover Type Percentage			
	Trees and Shrubs (City Owned)	Trees and Shrubs (Non-City Owned)	Trees and Shrubs (Total)	Bare Soil	Grass and Herbaceous	Impervious Surface	Water
McIntyre	10%	58%	68%	<1%	24%	8%	1%
Neebing	7%	46%	53%	2%	33%	10%	2%
Current River	18%	15%	33%	3%	26%	26%	12%
Red River	10%	20%	30%	0%	35%	35%	1%
Westfort	5%	20%	25%	2%	21%	21%	31%
Northwood	10%	12%	23%	0%	35%	41%	1%
McKellar	4%	9%	13%	2%	21%	54%	11%

Urban forest canopy cover is an important measure of urban forest sustainability. However, it is only one measure and does not, in itself, tell a complete picture. It does not describe species diversity, age and diameter distributions, or provide hazard tree assessments. However, it is one tool that can be used to identify priority areas for additional planting.

In addition to the canopy cover study results, the City of Thunder Bay Strategic Plan (2011-2014) identified three image routes that will need detailed design guidelines, including tree planting in appropriate locations. Tree planting along these corridors is a key element to improve the appearance of these high profile locations. The routes include Red River Road (north core); Arthur Street (south core); and Algoma, Memorial, Junot, and May Streets.

The tree planting on these specific rights-of-way, as well as others across the city, should also be considered for implementation as a core concept of the Complete Streets initiative under development for Thunder Bay. The Complete Streets concept, when enhanced with green infrastructure, is a tremendous opportunity to improve the livability of Thunder Bay, both now and for future generations.

Issues

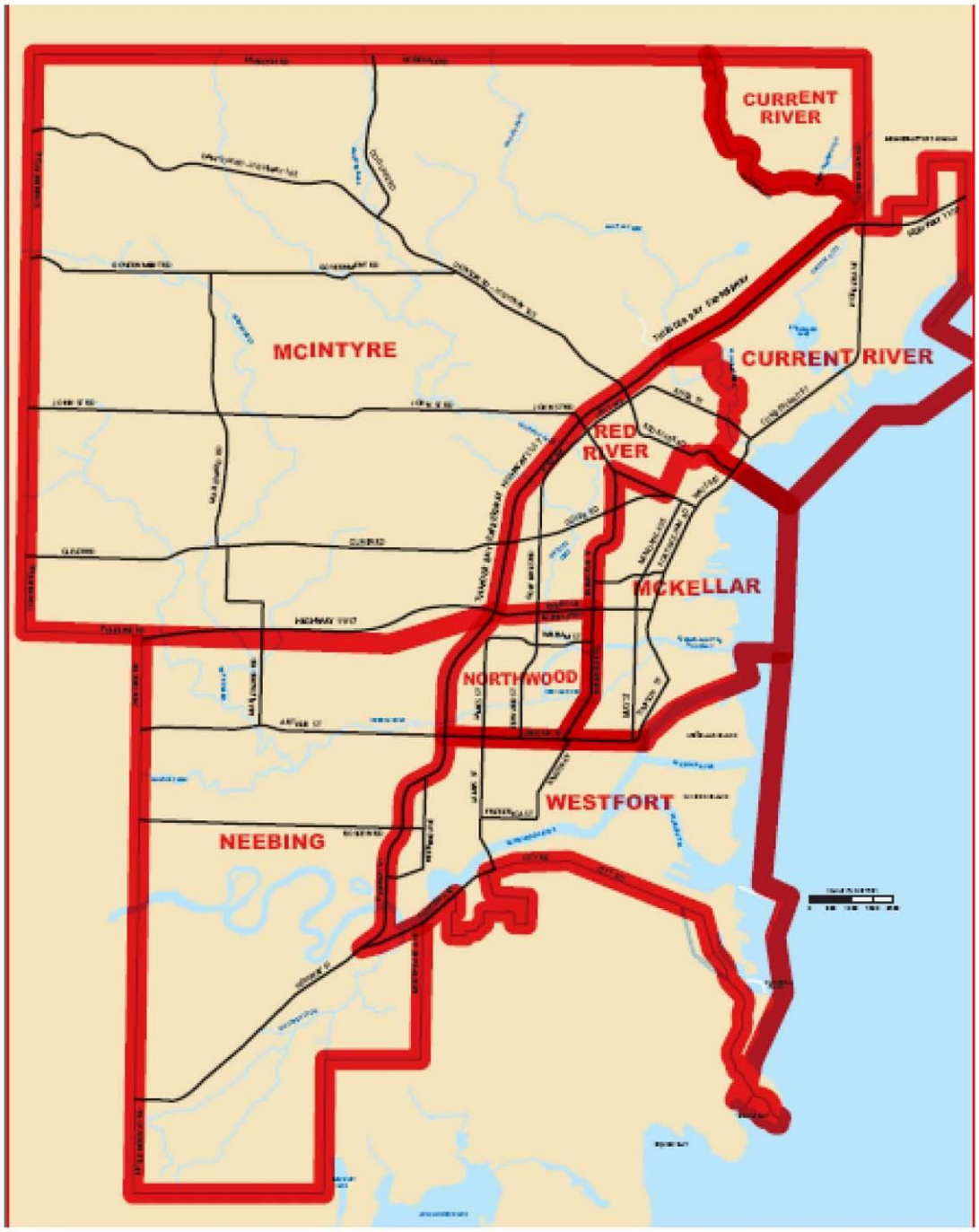
- No canopy cover goal is in place to provide a target canopy cover for which to aim.
- Wards such as McKellar (12.9 percent), Northwood (22.5 percent), and Westfort (24.7 percent) have relatively low canopy cover.
- Road reconstruction in some neighbourhoods simply restores roads, leaving potential tree planting locations unimproved.
- Public survey results (see Appendix A) indicated very strong support for enhanced tree planting initiatives, particularly on the arterial streets and urban core.

Recommendations

- 54. Establish an overall citywide goal of 50 percent tree canopy cover. Fifty-five of 59 respondents to the Public Survey felt that Thunder Bay should establish a canopy cover goal.
- 55. Begin an aggressive campaign to increase tree canopy in the urban boundary area of Thunder Bay with particular emphasis on the McKellar, Northwood, and Westfort wards. In the residential areas of these wards, canopy cover goals should be established at 25 percent for urban residential.

- 56. Develop a policy that more trees will be planted each year than will be removed. Without this simple goal, a net loss of tree cover will occur in Thunder Bay, reducing the overall benefits provided by its urban forest. Ensure that adequate funds are budgeted to maintain trees that are planted.
- 57. Comprehensive guidelines including “Complete Streets”, and Urban Design Guidelines under development for the City of Thunder Bay, should be considered for approval and implementation wherever feasible.
- 58. Develop specific plans for the inclusion of appropriate tree planting on image routes, including Red River Road (north core); Arthur Street (south core); and Algoma, Memorial, and May Streets. Arterial streets and urban core should be considered priority action areas. Fifty-one of fifty-four respondents wanted more trees to be planted on arterial streets in the urban core.

THUNDER BAY WARDS



Map 2. Thunder Bay's Ward Boundaries

5.1.3 Species Selection

Proper landscaping and tree selection are critical components to the character, livability, and ecological quality of a community's urban forest. The recommended tree species provided in the following lists have been evaluated for factors such as size, disease and pest resistance, seed or fruit set, hardiness, tolerance to urban conditions, and availability. The list is offered to assist all relevant community personnel in selecting appropriate tree species. Most of the trees have been selected because of their functional characteristics and their observed ability to exist in the majority of soil and climate conditions found throughout the Thunder Bay area. Inclusion on the list, however, is not a guarantee of excellent performance in Thunder Bay. Some species are listed for "consideration" and are shown on the list after the included tables. These species have limited occurrence in Thunder Bay, or may not currently occur, but are worthy of consideration.

This suggested species list was compiled using excellent references including Dirr's *Hardy Trees and Shrubs* (Dirr, 2003), the *Manual of Woody Landscape Plants* (5th Edition) (Dirr, 1998), *Trees in Canada* (Farrar, 2007), and the Natural Resources Canada website, as well as existing tree species lists for Thunder Bay. Cultivar selections are recommendations based on Davey Resource Group's experience and tree availability in the nursery trade, as well as species found by City Forestry staff to be hardy.

City trees require careful site selection as part of responsible planting practices. Adopting a philosophy, such as "right tree, right location", will ensure that trees are selected that will best suit the chosen site.

5.1.4 Recommended Planting Lists

Deciduous Trees

Table 11. Large Trees Capable of Growing 14m in Height at Maturity

Scientific Name	Common Name	Cultivar	Boulevard	Parks	Woodlands	Tree Pits
Acer x freemanii	Freeman maple	'Jeffersred'	x	x		
Acer rubrum	red maple	'Northwood'	x	x	x	
Acer saccharinum	silver maple		x	x	x	
Acer saccharum	sugar maple	Unity', 'Northern Select'	x	x	x	
Celtis occidentalis	common hackberry	'Prairie Pride'	x	x		
Larix decidua	European larch			x		
Larix laricina	tamarack			x	x	
Quercus alba	white oak			x	x	
Quercus macrocarpa	bur oak			x	x	
Quercus rubra	northern red oak		x	x	x	
Tilia americana	American linden	'Redmond' 'Boulevard'	x	x	x	
Tilia cordata	littleleaf linden	'Chancellor 'Greenspire' Ronald'	x	x		x
Ulmus x	hybrid elm	'New Horizon' 'Regal'	x	x		

Table 12. Medium Deciduous Trees Capable of Growing 9 to 14m in Height at Maturity

Scientific Name	Common Name	Cultivar	Boulevard	Parks	Woodlands	Tree Pits
Ostrya virginiana	ironwood, hop hornbeam			x	x	
Phellodendron amurense	amur corktree	'Macho'	x	x		
Populus tremuloides	trembling aspen			x	x	
Populus balsamifera	balsam poplar			x	x	

Table 13. Small Deciduous Trees Capable of Growing up to 9m in Height at Maturity

Scientific Name	Common Name	Cultivar	Boulevard	Parks	Woodlands	Tree Pits
Acer ginnala	amur maple		x	x		
Elaeagnus angustifolia	Russian olive			x		
Malus spp.	flowering crabapple	(disease resistant varieties)	x	x		x
Sorbus americana	American mountainash			x		x
Sorbus aucuparia	European mountainash		x	x		
Syringa reticulata	Japanese tree lilac	'Ivory Silk'	x	x		x

Coniferous and Evergreen Trees

Table 14. Large Trees Capable of Growing 14m in Height at Maturity

Scientific Name	Common Name	Cultivar	Boulevard	Parks	Woodlands	Tree Pits
Picea abies	Norway spruce			x		
Picea glauca	white spruce	'Black Hills Spruce'		x	x	
Picea mariana	black spruce			x	x	
Picea pungens	Colorado spruce			x		
Pinus bansiana	jack pine			x	x	
Pinus resinosa	red pine			x	x	
Pinus strobus	eastern white pine			x	x	
Pinus sylvestris	scotch pine			x		

Table 15. Medium Conifers Capable of Growing 9 to 14m in Height at Maturity

Scientific Name	Common Name	Cultivar	Boulevard	Parks	Woodlands	Tree Pits
Juniperus virginiana	eastern red cedar	'Burkii', 'Canaertii', 'Glauca', 'Hillii'		x	x	
Thuja occidentalis	eastern arborvitae			x	x	

Table 16. Small Conifers Capable of Growing up to 9m in Height at Maturity

Scientific Name	Common Name	Cultivar	Boulevard	Parks	Woodlands	Tree Pits
Pinus mugo	mugo pine			x		
Taxus cuspidata	Japanese yew			x		
Thuja occidentalis	eastern arborvitae	'Brandon' 'Techny' 'Nigra'		x		

While they are not yet common, and may have some limitations, consider these trees for planting on a trial basis in Thunder Bay:

Table 17. Tree Species Recommended on a Trial Basis

Scientific Name	Common Name	Cultivar	Boulevard	Parks	Woodlands	Tree Pits
Abies concolor	white fir			x		
Betula nigra	river birch	'Cully' (heritage) 'BNMTF' (dura-heat)	x	x		x
Carpinus caroliniana	Blue beech, American hornbeam			x		
Catalpa speciosa	northern catalpa			x		
Fagus grandiflora	American beech			x		
Ginkgo biloba	ginkgo		x	x		x
Gymocladus dioicus	Kentucky coffeetree		x	x		x
Ostrya virginiana	ironwood, hophornbeam			x		
Pinus nigra	Austrian pine			x		

5.2 Tree Maintenance

5.2.1 Current Status of Tree Maintenance Operations

This section outlines current practices for pruning, removals, mulching, watering, urban forest health and wood utilization. Recommendations to address significant issues are shown in pertinent sections. Guidelines for managing risk, and demonstrating due diligence,are also provided..

A Parks Operations crew removing street trees.

5.2.2 Pruning

Currently, Thunder Bay has no systematic pruning program for its street tree population. Pruning is performed "as needed" and typically is generated by a request from a resident. In various City parks, pruning occurs; however, there is no regular planned pruning in place for this work. Staff with limited experience decide where pruning is needed.

The most successful and effective urban forestry programs utilize a systematic (regularly scheduled) tree maintenance program. As evidenced by the i-Tree Streets assessment, trees are valuable assets in Thunder Bay. Similar to equipment and vehicles, long-term tree care costs are reduced and provide more predictable results if they are maintained in a systematic way. While the shift to a cyclical maintenance program will take an increased amount of effort initially, the long term benefits justify this shift. Advantages include lower long term program costs, enhanced public safety, reduced storm damage and power interruptions, and healthier, more attractive trees.

Parks staff prune trees based primarily on homeowner requests. A cyclical pruning program, while desired, does not exist. While young tree training is considered a critical maintenance need, past attempts to schedule this on a regular basis have not been successful due to staffing issues.

Maintenance activities that require elevated levels of arboricultural expertise are typically handled by a contractor. This includes crown thinning, cabling, bracing, insect control, and fertilization. Parks crews are used for crown raising and branch reduction. Any tree work that requires an approach distance of less than 3.3m from an energized line requires a utility arborist and is referred to Thunder Bay Hydro for completion. Should Thunder Bay Hydro not be able to accommodate the request, it is then referred to the services of a local utility contractor.

Tree maintenance requests are often generated as a request for a tree assessment. These requests may include insect control, cabling, or fertilization. The City Forester or Consulting Arborist will meet property owners and/or perform a field inspection to assess the street tree and determine appropriate action.

The workflow process for the service requests described above typically begins with a service request generated by a resident request (called in to Parks Clerk who records it in Hansen) These requests (except for pruning which go to Parks Operations) are then directed to the City Forester for assessment. Additional steps such as species selection, ordering a tree, or assigning work to a Parks crew or contractor is undertaken. Once a specific determination is made by the City Forester or Consulting Arborist for action, a Hansen service code is assigned. This code is used to track the volume of service request types. Each service request is also assigned a unique identification number so it can be tracked for progress and completion.

Typically, all service requests, with the exception of requests for tree pruning initiated by a citizen, are passed through the City Forester for further assessment and assignment of actions. Citizen for tree pruning are received by a Parks Clerk and then assigned to a Parks Supervisor (North or South) who then assigns a crew to perform the work. This means that assessments for pruning are made by staff with limited arboricultural training. Also, pruning is performed without any systematic tree pruning efficiencies. While citizen requests can be very useful in spotting and reporting a need for action to reduce risk, they are not an efficient method of ensuring that public trees receive periodic inspections and pruning to improve tree health and overall safety. Citizen initiated requests generally occur after situations involving potential or real damage.

A total of 1,213 trees were pruned in 2010 within parks and on City streets, including 100 trees which were pruned by Citizen Pruners. This represents a large increase over the previous four year average of 713 trees per year. An estimated total of $204,150 was spent on tree pruning in Thunder Bay in 2010 at an average cost per serviced tree of $183. A systematic tree pruning program will help to stabilize these numbers and greatly assist with predicting budget needs and reducing costs.

Thunder Bay's current tree inventory data provide no fields for specifically determining or scheduling anticipated or identified maintenance needs. An inventory that has specific fields for scheduling work, tracking accomplishments, and assessing trends is a necessity during the transition to a systematic tree pruning program.

Once appropriate and customized tree inventory data management software is in place, the City tree population can be divided into management zones or districts. These zones can be selected by ward, or other current management zones, already in use. Some cities coordinate with other divisions to use identical management zones that are already in use. The number of zones is typically a matter of the ability of current staff to accomplish work. Many cities use a seven-year cycle for tree pruning with one zone being scheduled for each year.

Developing and using a systematic (or cyclical) tree pruning program does not mean that property owner requests for service are ignored. Requests should still be taken and inspected per current practice. If any immediate needs are identified that pose significant risk to public safety, then that work would still be scheduled according to its level of urgency. If the pruning request can be deferred until the next pruning cycle, the homeowner is then educated about the benefit of the cyclical pruning program. The benefits of the cyclical pruning program and a map indicating pruning program deployment should be posted on the City Forestry website and communicated to citizens.

Issues

- Reactive pruning triggered by customer requests causes unnecessary costs to the City.
- Property owners want to prune City trees on their boulevards as regular pruning does not happen. A method of dealing with citizen requests is required since the City does not allow property owners to prune publicly owned street trees (except by permit needed for certain types of pruning).

Recommendations

- 59. Develop a policy for property owners who want to prune street trees adjacent to their homes or businesses. The current system of requiring permits for pruning small limbs may not be an effective tool that ensures good tree care. Consider having the City perform all pruning (no pruning of street trees by property owners) and advising property owners that a cyclical pruning program has been implemented.
- 60. Place a high priority on developing a systematic, regularly scheduled tree maintenance program including care for newly planted and young trees, cyclical pruning, and regular inspections that assign tree risk ratings that will prioritize tree removals. Updated and effective tree data management software will assist with this task.
- 61. Establish a cyclical tree pruning program (by neighbourhood or block) that will create efficiencies and reduce costs associated with pruning and removals. Citizen requests still receive inspections to determine if a risk to the public is involved, but non-urgent pruning needs are deferred to the next pruning cycle.

In its 1998 assessment of urban forests, the USDA Forest Service found that over 95 percent of U.S. cities identified the same five, long-term tree care strategies—proper site and species selection; proper pruning techniques; minimization of construction damage; insect management; and tree health monitoring—as being priorities and critical to preserving the health and sustainability of the urban forest. However, the assessment revealed almost 40 percent of cities in the U.S. practice crisis management—responding to accidents, impending hazards, and complaints rather than implementing a systematic and preventive tree maintenance program (Pokorny, 1998).

While Thunder Bay's current system of request-generated tree work may have strong political appeal and appears to cost less in the short term, it may not be the most cost-effective, efficient, or prudent method of providing much needed maintenance for trees in the long term. A preventive approach to tree maintenance, especially pruning, will provide savings through in-house and contractual work efficiencies, reductions in storm damage and response costs, while resulting in a healthier, long-lived, and safer urban forest.

Funding tree maintenance programs can be difficult in some communities. While tree maintenance budgets are cut, tree planting tends to be an appealing expenditure as it creates a high-profile event that captures the attention of media and citizens. Communities with healthy tree populations that maximize benefits for its citizens will find a balance between expenditures for tree planting and tree maintenance. It is difficult to sustain an urban forest without this balanced approach.

Thunder Bay staff and stakeholders have identified adequate follow-up care for newly planted trees as a priority. While understanding the importance for watering, mulching, and young tree pruning, Thunder Bay does not currently have the resources to provide these critical maintenance activities for all young trees.

5.2.3 Removals

A portion of Thunder Bay's tree population will decline and die each year as part of a natural process. Additionally, some trees will have defects that render the tree unstable and create a need for removal. Thunder Bay spent $198,978 on tree removals in 2010, removing 421 trees at an average cost of $473 per serviced tree.

There is currently no system in place for systematically assessing trees for risk in Thunder Bay. Once trees with high levels of risk are identified, either by citizen generated calls or alerts from City staff, they are removed. This method of identification and response is similar to the current tree pruning by request system and may lead to inefficient workload distribution or may result in serious failure of a tree before any notification is provided. It is important to inspect trees regularly, assign risk ratings, and then remove in order of priority, utilizing the rating system and a specified removal protocol. Typically, trees with the highest risk rating would be removed first, with the next round of removals working its way down the list.

The removal of any public tree requires a site visit and the approval of the City Forester. Once a request is approved, it is assigned to one of the Parks Operations Sections and assigned a priority rating to determine the appropriate timing for a response. When a tree is removed, the limbs are typically chipped and removed from the site. Log sections are left for residents or wood collectors to remove. Stump grinding is scheduled for the fall months when mowing responsibilities in the parks is reduced. Property owners are also provided information about tree replacement options.

Issues

- No system in place to proactively inspect trees and apply risk rating.
- City Forester spends valuable time assessing individual trees reactively.
- No system in place to cost-efficiently schedule systematic removals.
- Stump grinding by City staff diverts resources from activities that could provide higher benefits to the community, such as cyclical pruning, and is unlikely to be cost-effective.

Recommendations

- 62. A tree inventory should be done, at a minimum, every 10 years to capture information regarding tree health and potential structural issues. Reports can be generated for efficient pruning and removals which will save the City resources, and enhance due diligence. Removals can be planned as part of cyclical cycle that will promote efficiencies and lower costs.
- 63. City Forester or Lead Hand/Arborist can efficiently validate tree removal reports generated by inventory software.

- 64. Contract out all stump removals via City tender process. Contract prices for stump removal are generally much less expensive than using municipal crews who could be better utilized elsewhere.
- 65. Ensure inventory is updated as removals occur to provide ease of preparation of tender documentation for contractors regarding stump removal.

5.2.4 Mulching

When applied properly, mulch can be one of the best, and least expensive, tree health care practices. It adds organic material and nutrients to the soil, improves soil texture over time, retains soil moisture, buffers soil temperature, and provides a barrier from lawn care equipment such as mowers and string trimmers.

When applied improperly, mulching will create serious issues such as encouraging stem girdling roots and basal decay. Mulch rings should resemble doughnuts, not volcanoes. Rather than stacking mulch up around a tree, keep it pulled away so that mulch does not contact the base of the tree. In addition to girdling roots and basal decay, excessive mulching can retain too much soil moisture and promote root rot, and it can create nesting areas for small rodents that may chew away bark.

Keep mulch depths at 75mm and keep mulch away from the tree trunk. Ideally, mulch should be applied to the entire area within the dripline. This is not always practical, and judgment is needed for each site.

Organic mulches are best and readily available. Tub grinding wood residue from municipal tree pruning and tree removals is likely the most cost-effective source. Quality control is critical, including a system to ensure that harmful contaminants are not present.

Issue

- Mulching specifications required review

Recommendation

- 66, Current municipal guidelines in Thunder Bay's *Guidelines and Specifications for Planting of Municipal Trees and Shrubs* are adequate for mulching newly planted trees and should be used for all plantings.

5.2.5 Watering

Water is a critical need for tree establishment, growth, and survival. Supplemental watering is nearly always crucial for newly planted trees. Transplanted trees often lose up to 90 percent of their root system when they are dug at the nursery and re-planted on site. Without a fully developed root system, they require supplemental watering, especially during periods when natural rainfall is insufficient. Newly planted trees typically need about 5cm of rain per week. Even with watering, a tree's limited root system may not be able to absorb enough moisture. The importance of providing adequate follow-up care for newly planted trees to ensure they establish new roots quickly cannot be under-emphasized.

Purchasing and planting trees is a large investment that should be protected with an adequate program of follow-up care that includes basic care such as watering.

The recommendations for this section are the same as provided in the Tree Planting section, but are important enough to be reiterated.

Recommendation

- 67. Watering is critical for tree establishment. Ensure newly planted trees are watered regularly during the critical period of establishment of two years. Options include contracting out, or staff watering. Although communication to residents to encourage them to water street trees may provide some positive action, the City should not rely on effective watering by volunteers. Watering should be included as a requirement of contracted tree planting services.
- 68. Consider hiring a part-time summer employee and equip them with a small truck or lawn tractor, water tank, pump and hose, for watering young trees in City parks and open spaces. Though basic, it is a very successful and cost-effective method of watering to promote tree survival and growth.
- 69. Slowly applied water through 'gator' bags work well, but are sometimes targets for vandalism. Consider a test trial for use in parks. The watering truck can refill them.

5.2.6 Urban Forest Health

Thunder Bay is located in climate zone varying from 2b to 3a, which is challenging for trees. Tree growth is slower than found in more southern climates. Extended periods of drought, increased wind events, and deadly attack by insects and disease all conspire to threaten tree health. As an example, the effects of climate change have been witnessed in Thunder Bay for several years through the decline of both mature and immature white birch trees. Hundreds of trees on municipal property (and an unknown number on private) have succumbed to the stress of drought and subsequent attack by bronze birch borer, which may well cause the elimination of this species from the landscape.

Birch tree removals and subsequent canopy cover loss have impacted the McKellar and Westfort Wards heavily. Inventory statistics derived from the 2000 street tree census showed that there were 1,900 birch trees, which made up 10 percent of the boulevard tree population. All of those trees have been and will continue to be threatened. In addition, balsam poplar trees have been declining significantly over the past several years and Canadian Forestry Services cites climate change as the likely cause. The potential to impact Thunder Bay's urban forest is very real in the short term.

Another significant threat to the health and sustainability of the urban forest is the introduction of pests from other countries. Emerald ash borer (EAB) is one such example that has killed millions of ash trees in Canada and the northern U.S. While its presence has not yet been detected in Thunder Bay, the probability is very high of its arrival in the near future. EAB has the potential to kill all boulevard ash trees. In 2000, ash comprised 4,750 trees (25 percent) of the street tree inventory. The number of ash trees in parks and on private lands is unknown.

In response to this threat, the Northwestern Ontario EAB Task Force Steering Committee has been created. The group is composed of municipal, provincial, and federal government; public and private utilities; First Nations; College and University faculty; community groups and private citizens, and local tree services, It has applied for grants from OMNR to fund a coordinator position and develop an EAB strategy for the region. CFIA has increased early detection trapping in the area and the City of Thunder Bay has undertaken branch sampling (referred to as Ryall Branch Sampling Method) in 2011 to determine EAB presence and infestation levels.

While no formal City monitoring and control program is in place, the City Forester has initiated alliances with key stakeholders in the region to ensure timely communication of insect presence throughout the area.

Issue

- EAB is an imminent threat to Thunder Bay's urban forest, potentially impacting approximately 25 percent of street trees.

Recommendations

- 70. Prepare a detailed emerald ash borer strategy that will prepare Thunder Bay for the arrival of this devastating insect. The strategy should include provisions for discovery, monitoring, response, and capacity for response including human resources, equipment, and budget. City response to this insect will require extensive resources and planning.
- 71. EAB warning notices, identification guides, and warnings against movement of firewood should be posted on the City's Urban Forestry website.
- 72. Continue to monitor regional and national information about pest threats for not only exotic and invasive pests but other pests that threaten the community tree resource, and learn from what other communities are doing in terms of planning and response. London and Oakville have excellent resources to share with communities battling EAB threats.
- 73. Plant diverse species, as noted in Genus and Species Recommendations to mitigate the impact of the urban forest when invasive species arrive, or other factors such as climate change impact tree health.

5.2.7 Wood Utilization

Thunder Bay currently has a steady stream of wood residue from public trees generated by such activities as pruning, removals, and storm damage clean-up. Wood residue may eventually be generated at a more rapid rate and at a higher quantity than previous levels if a higher emphasis on risk management results in a more rapid rate of tree removal or pruning, or if exotic pests (such as EAB) threaten a large percentage of Thunder Bay's urban trees.

In the past, many challenges existed when it came to dealing with what many called urban wood waste, but is now commonly referred to as wood residue. While some challenges do still exist, many have been overcome as a result of new technologies and an ever-growing market for the use of urban wood generated through the removal of dead and high-risk trees and those that succumbed to insect and disease infestations.

The market for wood residues is growing rapidly for many reasons. Environmental awareness and a desire to operate sustainably have fueled an increase in the level of research about urban wood and its uses, and created a demand for wood products from urban trees. New technologies allow faster, more efficient, and more useful wood processing, and allow a closer look at wood as a clean fuel for plants to generate electricity. Economics and the sheer volume of this renewable and multi-use natural resource also have driven an increase in the focus on creative wood utilization.

In Thunder Bay, wood that can be chipped on site from pruning and tree removals are taken to the City's Solid Waste and Recycling Center. Larger material that will fit into the City's tub grinder is also taken there and processed. The resulting material is made available to residents as mulch and compost. Large logs are sometimes cut and left at the curb and disappear within a few days.

Building a truly sustainable system for dealing with wood residue in Thunder Bay will eventually require a commitment to treating wood residue as a commodity, or resource, that can directly benefit Thunder Bay residents and potentially create a revenue stream for the City. Treating wood residue as a resource corresponds well with the Earthwise® Community Environmental Action Plan (2008) that promotes a Zero Waste philosophy.

In order to achieve this level of sustainability, the City will need to understand the costs associated with collecting and disposing of a waste product versus the cost of collecting a resource that can create new products from recycled wood, biomass for energy, landscape mulch, and compost that can be sold. Nearly all of Thunder Bay's wood residue is currently collected and delivered to processors without any revenue in return. The value of making mulch and compost available to residents should be measured and factored into the urban forestry program benefits.

While organized programs that sustainably utilize urban wood residue are in their infancy, several models now exist in communities that have made the shift from dealing with urban wood residue as a waste product to effectively market and utilize it as a revenue generating resource (Bratkovich, 2001 and Bratkovich, *et. al.,* 2008).

Many communities such as Winnipeg, have programs in place that utilize urban wood residues as a commodity that can be sold. Some grind the wood residues and offer materials to residents free of charge, while selling the rest to nearby landscape contractors and others in the landscape or nursery trade. Markets are limited, but close by. Others are more innovative and have developed programs that set aside logs that can be sold at a much higher price than the tub ground material. These urban programs are similar to the forest management industry's chip-n-saw operations in many areas of the country where trees are utilized as logs with the remaining materials chipped for use in the pulp industry or as biofuels. Markets for these products may be geographically more challenging. Any program that seeks to increase the utilization of wood residue will require an increase in knowledge about the potential products and developing markets. Canada Green Building Council is a starting point for contacting potential purchasers of wood residue.

Issues

- Wood residue is not fully utilized as a potential source of revenue

Recommendations

- 74. Explore partnerships with local companies who purchase wood products. Refer to http://www.woodanchor.com/how-we-reclaim as an excellent example of a successful business who reclaims wood from the City of Winnipeg and sells as environmentally sustainable products used for LEED certification.
- 75. Develop a city-owned collection yard. This option provides some control over the woody materials that are generated within the City. Many municipalities store wood residue at a "collection yard" within their municipal boundaries or nearby. This reduces fuel, crew time, and equipment needs. All wood residues can be delivered to the secured site each day and stored in sections depending on the type of woody materials. The City's Solid Waste and Recycling Facility or the Parks Empire Yard should be considered for collection yards.

- 76. Consider processing wood residue and creating materials it can then market, to generate revenues. Processing can include the typical tub grinder operation for converting wood residue into mulch and compost, or using portable, band saw-type sawmills for converting higher quality logs into lumber. Collection yards with processing facilities can be developed and operated with the use of City crews, or the entire operation can be contracted and fees negotiated for its operation. Typical contracts include the payment of a base monthly fee, plus a percentage of products sold. In addition, the contract should include supplies of mulch and products for City landscaping projects.
- 77. The facility for wood residue can be managed to handle publicly generated wood only, or can be set up as a fee collection facility that handles wood residue for private contractors, or both. The market is changing rapidly and the price of finished products (*e.g.,* mulch and compost) continues to rise.

5.2.8 Managing Risk

Urban forestry programs typically highlight public safety as a priority. It is impossible to maintain trees free of risk; some level of risk must be accepted by the community to experience the benefits that trees provide. Developing and implementing a tree risk plan will increase public safety, reduce the potential woody debris loads generated by storms, and move Thunder Bay one step closer to a proactive urban forestry program. A tree risk plan will locate trees with defects, plan for the remediation of high-risk situations, and implement the recommended maintenance work before the trees fail and create crisis management situations.

Street trees need to be inspected regularly for defects and rated for tree risk and removed based on priority.

According to the USDA Forest Service, a tree is considered hazardous when structural defects in its roots, stem, or branches create an unacceptable risk of failure that may cause injury to people or damage to property (Pokorny, 2003). The word “hazard” often means that some threshold of acceptable risk has been passed and implies a sense of immediacy to some corrective action. Arborists who perform tree risk assessments are assigning tree risk ratings based on factors that include a potential for tree (or limb) failure, the size of the part that may fail, and the type of occupancy of the potential target. Tree risk managers will then use these ratings to determine which trees are “hazardous” and need corrective action.

Tree defects often derive from injury or disease that seriously weakens part the tree, predisposing the tree to failure. Defects also arise from poor tree architecture in stems and branches that lead to weak branch attachments, shallow rooting habits, and inherently brittle wood. Structurally sound and healthy trees may be considered high risk if they interfere with utilities, roadways, walkways, raise sidewalks, or obstruct motorist vision.

An effective tree risk program begins with an inventory of public trees that includes a tree risk assessment for each tree. The collected data should be placed in a software database system that will organize and analyze the tree data so that tree risk priorities can be made. A tree risk manager (the City Forester) can then review the list of trees and take steps to mitigate or completely remove the risk.

While there are several tree risk rating methodologies in use, a municipality should ensure that the rating system they use is compatible with their tree inventory system. The USDA Forest Service Community Tree Risk Rating System (Pokorny, 2003) suggests that it should provide information that permits a reasonable ranking of tree risk based on the three categories that include: 1) the potential of tree (or limb) failure; 2) the size of the part that may fail; 3) the type of occupancy of the potential target; and 4) other factors. This system assigns a numerical rating to each category and then adds the values together using the following formula:

Table 18. USDA Forest Service Community Tree Risk Rating System

Risk Rating Category	Points
Probability of failure	1-4
Size of defective part	1-3
Probability of target impact	1-3
Optional subjective risk rating	0-2
Total	**3-10**

Subjective risk categories can then be assigned:

- **None.** Used for planting and stump sites only (Risk Rating 0-2).
- **Low.** Trees designated as low (Risk Rating 3 or 4) have minor visible structural defects or wounds in areas with moderate to low public access.
- **Moderate.** Trees described as moderate (Risk Rating 5 or 6) have defects that may be cost-effectively or practically treated. The majority of trees in this category exhibit several moderate defects affecting <40 percent of a tree's trunk, crown, or critical root zone.
- **High.** Trees designated as high (Risk Rating 7 or 8) have defects that may or may not be cost-effectively or practically treated. The majority of the trees in this category have multiple or significant defects affecting >40 percent of the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely between 10-50cm in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.
- **Severe.** Trees described as severe (Risk Rating 9 or 10) have defects that cannot be cost-effectively or practically treated. The majority of the trees in this category have multiple and significant defects present in the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely larger than 50cm inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.

Public safety can be increased and potential tree debris generated from storm events can be reduced if high-risk trees are remediated. Options include moving the target, pruning the tree, or removing the tree. Cabling and bracing and creating a wildlife habitat tree are options in some cases.

Moving a potential target away from a high-risk tree will reduce risk; however, it is only recommended if removal and pruning cannot be completed immediately. Removing the target does not prevent a tree from failing, it only reduces the risk. Typically, moving a target away from a tree that is likely to fail is a short-term solution and pruning or removal may be necessary to reduce the risk to acceptable levels

Tree defects such as dead and/or broken branches can occur even when the rest of the tree is sound. In these cases, pruning the branch or branches can correct the problem and reduce the risk associated with the tree.

Pruning is recommended when:

- A branch is dead, but trunk condition is still acceptable.
- A branch of sufficient size and/or weight is cracked or decayed.
- A weak branch union exists and one of the branches can be removed.
- Branches have poor form, sharp angles, a twist, or bend.
- A branch is lopsided or unbalanced.
- A broken branch is lodged in the crown (hanger).
- A branch is improperly pruned or topped.
- A branch is obstructing the view of signs, signals, or limit visibility of traffic.

Although tree removal is a usually considered a last resort and can stir emotions from the community, there are circumstances when it is necessary. Trees should be removed when corrective pruning or installation of hardware will not adequately reduce the risk or it is cost-prohibitive to correct the problems. Additionally, trees that cause obstructions or interfere with power lines and other infrastructure should be removed when their defects cannot be removed through pruning or other maintenance. A tree can also be considered a high risk if it adversely affects public service and safety goals such as obstructing proper sight distances at intersections, compromising uninterrupted power service, and heaving sidewalks.

Cabling and bracing does not repair a high-risk tree, but when done correctly by a trained arborist, it can reduce the amount of stress on branches with poor structure, thus reducing the amount of risk associated with the tree. Done incorrectly, cabling and bracing can create a more serious risk. Cabling and/or bracing is recommended as treatment for a high-risk tree only if the tree has significant historic or landscape value. Cabling and bracing systems should be monitored on a yearly schedule, and to manufacturer's specifications. Hardware requires replacement whenever changes to the tree or the hardware occur.

Some high-risk trees are good candidates for conversion into a wildlife habitat tree. Suggestions include:

- Consider trees with defects in low use area.
- Choose a tree with characteristics such as cavities that are suitable for wildlife habitat.
- Remove or reduce the size of defective scaffold branches.
- Shorten the trunk to minimize the chance that the tree will fail.
- Leave the cavity for wildlife to inhabit.

Issue

- A tree risk assessment system including risk rating is not in place.

Recommendations

- 78. Undertake a systematic tree inventory that includes risk ratings performed by professional, certified arborists.

5.3 Tree Inventory Management

Many types of tree inventory systems have been used by cities to gather and organize information about their trees. A tree inventory system must meet the specific requirements of that city, and provide detailed and useful information that staff will utilize daily to manage workloads more efficiently. To help in this evaluation towards optimizing the City of Thunder Bay tree inventory, a standard of comparison was chosen. Thunder Bay's tree inventory was evaluated against the standards set forth in the *Best Management Practices for Tree Inventories*, published by the International Society of Arboriculture in 2006.

5.3.1 Current Inventory Evaluation

As noted in Table 11, there are three classes of information that are outlined in the *Best Management Practices for Tree Inventories*: location information, standard tree information, and supplemental tree information.

Within the location information section, the City of Thunder Bay's current inventory includes general location and detailed information on street trees. The City does not currently include a full inventory of parks and other public green spaces in its tree inventory, which among other possible spaces would be classified as randomly distributed trees.

Standard tree information captured in the City's inventory includes species, diameter, and condition. The inventory does not include information about maintenance needs, and also lacks a comments field that would capture critical information not listed in a pre-determined list of options, such as insect or disease damage.

Supplemental tree information collected in the City's inventory includes height but does not include fields that capture details such as risk assessment, memorial or heritage trees, lightning protection, and plant health care issues.

Table 19. Standard Inventory Data Fields as Compared to Thunder Bay

Inventory Field	Description	Thunder Bay Inventory
Location Information		
General Location	Collecting ward, precinct, neighbourhood, or zone information facilitates maintenance routines.	Yes
Detailed Location: Street Trees	The tree's physical location in relation to public ROW and/or public space, X and Y coordinate locations, address, block side information, site information. Planting sites are often inventoried.	Yes, GIS location for all trees, and 86 percent of trees have address information
Detailed Location: Randomly Distributed Trees	X and Y coordinate locations, distance and direction from fixed reference points. Planting sites usually not inventoried.	None, parks and cemeteries currently underway through summer students
Standard Tree Information		
Species	Trees identified by genus and species using botanical names. Common names often collected for non-professionals.	Yes
Diameter	Provides an estimate of tree age to obtain overall forest age structure.	Yes
Condition	No single system for evaluation. Two methods include: assigning a Code between 1 and 4; and the U.S. Forest Service system separates structure and health.	Yes, adapted version of the ISA rating, Dead to Perfect
Maintenance	Primary maintenance, including remove, clean, raise, structural prune, thin, reduce, stump/grind, inspect.	None
Comments	Critical observations concerning a given feature.	Haphazard entries under SPECIES
Supplemental Tree Information		
Other Site Information	Collect other field data of interest *e.g.*, hardscape damage, underground utilities.	None
Height	Expensive to measure, constantly changing, and rarely useful in urban forestry.	Yes
Crown Width/Spread	Potentially desirable for environmental assessment programs, but serves no managerial purpose.	None
Community Status	Special status such as historical, memorial.	None
Secondary Maintenance	Structural support, soil, lightning protection, pests.	None
Risk Assessment	Tree failure hazards can be noted and the level of danger posed to the public can be evaluated.	None
Plant Health Care	Recommendations such as irrigation, mulch, fertilization.	None

5.3.2 Inventory Enhancement

The *Best Management Practices for Tree Inventories* lists the following benefits of having an inventory:

- Increased efficiency
- Improved community relations
- Emergency preparedness
- Justified budgets
- Documented actions

Thunder Bay achieves these benefits with varying degrees of success. A high-quality, complete inventory helps forest managers identify work to be done and gives the City the ability to execute tasks much more efficiently. Work can be scheduled for specific areas where multiple operations can be performed in a single visit to that area.

According to a City forestry staff member, "an inventory of street trees was initially completed in the late 1990s and has only been partially updated since then." The partial update to the inventory has meant many fields in the original inventory were not updated. In order to achieve an accurate representation of the urban forest, and to be able to task, plan, and budget accordingly, it is important to commit to a full inventory update.

The existing inventory has several strengths that should be used to their full advantage. Table 18 lists strengths and weaknesses of Thunder Bay's street tree inventory.

Table 20. Strengths and Weaknesses of the Thunder Bay Tree Inventory

Strengths of Thunder Bay Inventory	Weaknesses
Inventory included geospatial information	GIS management system not optimized for urban forest management
Inventory is managed in a GIS	Inventory does not include all public spaces
Complete street tree inventory	No risk assessment information
Basic tree attributes identified, including species, DBH, condition	No hazard risk assessments/ratings captured
Each tree has a unique identifier	No primary maintenance recommendations
Block side location information for majority of trees	No secondary maintenance recommendations

Strengths

The City's current inventory is already digitized and accessible through an ESRI based GIS system, interfacing with Hansen, which blends spatial data (referenced location) and attribute data (*e.g.,* species). This allows easy data transfer and manipulation. Another strength, implicit in the inventory's existence within a GIS, is the inclusion of geospatial data, which allows a tree to be located in space.

In its current form, it can be used to model and quantify benefits that Thunder Bay receives from its urban forest. Using the i-Tree Streets software, basic City information can be used in tandem with basic tree attribute data (species, diameter, and condition rating) to output the dollar value of the environmental and economic contributions made by the tree population. Current inventory does provide complete numbers of trees, their species and locations, which has been valuable for preparing for loss of threatened species such as ash or birch. A number of Lakehead University students have also used the inventory as a resource for research projects.

Weaknesses

While GIS is considered a strength of the current inventory, it has limitations. Hansen is not optimized for tree management operations. Upgrading the inventory interface through a more specialized tree management software tool would allow the City to increase effective use of financial and staffing resources.

The inventory does not yet include all trees on public property. This means the City cannot capture the complete public urban forest within their GIS system, or within any database management system. This inhibits planning and proactive tree work. The capture of all public trees in the inventory will allow the City to obtain a full accounting of maintenance costs, risk levels, and diversity. Forestry Section staff have been working toward capturing some data with the assistance of summer students and the temporary intern.

The lack of risk rating information in the inventory makes it very difficult for Thunder Bay to prioritize, plan, and schedule tree work, and to budget accordingly. Risk rating is considered one of the most important attributes to an urban forest manager, who is tasked with efficiently managing the forest and delivering optimal public safety. Numeric risk rating systems exist which include the probability of failure, size class, and significance of potential targets. Certified arborists with experience and knowledge of tree risk should be used to perform the risk assessment.

The City of Thunder Bay tree inventory also records available planting site information. Recording available planting sites allow forest managers to track the percentage of possible tree sites having existing trees. This percentage figure is called the stocking level. According to the *Best Management Practices for Tree Inventories*, planting sites are often not suggested for park settings, but are often recorded for street trees.

Recording available planting sites will permit the City to determine its stocking level, and set planting goals. Inventoried planting sites help with budgeting for future planting by allowing forecasting and goal setting for expansion, or enhancement of the community forest. Without accurate stocking level information, it becomes more difficult to know how to prioritize planting areas. When these sites are mapped, well-considered decisions can easily be made on where the most effective planting area will be.

When available planting sites are identified during the inventory data collection, additional information can be collected that will assist with planning for future tree planting efforts. The additional information should include location site information, such as type of planting area, dimensions, presence of utilities, and adjacent land use.

The absence of maintenance recommendation data in the inventory means the inventory is not being utilized to its full potential. Without primary maintenance information, the City has limited information with which to budget for coming years. When primary maintenance data are collected, budgeting becomes more accurate and longer-term budgeting becomes feasible.

Secondary maintenance recommendations are another useful element in a city tree inventory. These details allow the City to make specific recommendations for each individual tree. Such recommendations may include structural support, soil modifications, lightning protection, pest controls, and plant health care (including irrigation, mulching, and fertilization). Secondary maintenance with an emphasis on pest detection may deserve consideration under the assumption of the eventual arrival of the emerald ash borer.

5.3.3 Quality of Data

The usefulness of an inventory depends directly on accuracy and quality of its data. According to City staff, the personnel used to keep the inventory up-to-date are temporary employees including a one year intern and summer students. The *Best Management Practices for Tree Inventories* suggests temporary staff have fair to good accuracy. To maximize data quality, the City should consider either full-time ISA certified arborist staff or employing professional, qualified, experienced ISA certified arborists on contract to increase the accuracy of data collection. This will also eliminate the amount of training and supervision required for the project, and speed up completion time.

Data collection equipment is an important component to ensure accurate and consistent data are captured. Personal Digital Assistants (PDAs) or tablet personal computers are capable of running GIS directly, and allow the user to input data directly into the GIS. This method minimizes error from human data entry, since the data only have to be entered once. With high-quality input software, field value verification checks are a built into the system, further reducing human error. Ruggedized equipment should be used for any outdoor application to reduce the chance for damage.

5.3.4 Tree Management Software

During the tree inventory data collection process, functional data collection software is needed. Once data collection is completed, the task then shifts to data management, including data analysis, preparation of work orders, and tracking performed work. A data management software upgrade will optimize and co-ordinate tree-related tasks. There are distinct differences between software tailored specifically to tree management which offer efficiencies and general purpose software adapted to provide some functionality.

Ideal tree management software is tree-centric and developed by urban foresters to optimize efficiencies. It has specific functionality that is directly related to managing the needs of a constantly changing tree inventory database. These functions should include a flexible species lookup list that is configurable by common name or botanical name, and capable of being customized to manage general information about a particular species such as shade tolerance, wind resistance, and pest susceptibility.

Tree inventory software is built with specific functions related to the operational management of trees, including processes to handle tree-related tasks such as tree removals, stump removals, and tree plantings. Quality tree management software should include a GIS interface that complements the database and allows urban foresters to set up tree work projects. The fact that the software is tree-centric rather than address-centric makes it easy for the user to relate data to specific trees rather than general information in a comments field tied to an overall address record, as is typical with public works systems.

An additional consideration when examining tree management software is making the inventory accessible to the public in some capacity, such as viewing species information. Limited access to other City departments for cross-referencing with other infrastructure projects and requirements is another useful option. Such accessibilities should be accompanied by varying permissions for manipulating and viewing the data.

Issues

- Existing tree condition data in the inventory has been found to be inaccurate.
- No hazard risk rating information was captured during inventory, so City Forester unable to assess priorities effectively
- Some inventory data capture was performed by individuals with limited expertise in inventories

Recommendations

- 79. Update the current tree inventory to provide complete, more accurate and useful data upon which to base planning decisions. Current inventory did not take into account tree risk assessments, which is a fundamental industry standard tool for cost-efficient planning of cyclical pruning programs, and of critical importance to Forestry staff who are tasked with managing public safety. A numerical risk rating system will provide clear direction for assigning work priority. A dynamic inventory system that can be updated periodically as trees are re-inspected is a very strong and important tool for recording pest incidence and referencing past threats, as well as planning for future pest threats such as EAB.
- 80. Complete the inventory to include all public trees and available planting sites.
- 81. Commit to full updates of the inventory at least every 10 years, and subsequently update continuously to capture changes in tree structure, health, and potential issues.
- 82. Employ full-time, ISA certified staff or Certified Arborist contractors to increase the accuracy of data collection and provide risk assessment.
- 83. Include primary and secondary maintenance information when collecting tree data.
- 84. Prior to any future inventory, evaluate potential data quality against the ISA Best Management Practices for Tree Inventories.
- 85. Update the current tree inventory in advance of establishing a cyclical, or grid pruning program. Tree inventories could be phased to align with City budget process, *e.g.* street tree inventory of approximately 20,000 trees could be phased over 2 or 3 years.
- 86. Invest in tree management software developed specifically for urban forestry management. Consider software that allows public calls to be tracked, and work order generated automatically, as well as report capability to assist with prioritization of work.
- 87. Utilize tree data collection and tree management software to collect, store, and utilize tree data.
- 88. Compare tree management software by various suppliers to ensure functionality, ease of use, and reporting capabilities to maximize efficiencies and effectiveness of the software.
- 89. Invest in hand held PDA's or tablet personal computers to allow field updates by City staff.

Section 6: Budgets

6.1 Capital and Operational Budgets

Municipal governments are constantly challenged to allocate funds in an equitable way that provides for public safety and services for the greatest public good. Some decisions and allocations are easy. Others may require a periodic assessment of public values to determine appropriate budget amounts. In the past, trees were thought to be strictly an aesthetic benefit and were largely ignored as infrastructure that provides tremendous public health and safety benefits.

In recent years, much has been learned about the economic benefits that trees provide in community settings. While public tree management competes with other community services, a full understanding of tree benefits will permit a more appropriate allocation of funds to maintain those benefits. Municipalities with active community forestry programs consider these expenditures as investments for the current and future well-being of the community. In 2010, Thunder Bay's investment of $705,003 in its urban forestry program yielded benefits with a value of $1,555,888. This calculation of benefits, provided by utilizing the i-Tree Streets model, yields a benefit-cost ratio of 2.21, meaning that for every dollar invested in the urban forestry program, a total of $2.21 was provided in return.

The City's current urban forestry budget of $705,003 represents less than 1 percent of the City's total budget. Cost categories are provided in Table 5 and indicate that tree pruning (29 percent) and tree removal (28 percent) account for the majority of budget expenditures. Tree planting accounts for 11 percent and program administration 18 percent of the total budget. All other categories account for less than 6 percent of the total.

The Urban Forestry Section's allocation of funds is very typical and is in line with average municipal figures of 30 percent for pruning, 28 percent for removal, 14 percent for planting, and 8 percent for management and administration (Kielbaso, 1989). Priority is given to public safety categories such as removal of high-risk trees and pruning to maintain structural integrity.

The following Table 21 and Figure 6 illustrate comparative costs of various urban forestry programs across Canada. It is important to note the very wide spread of funding across municipalities, from almost $23 per capita to under $5 per capita. Within that range, Thunder Bay is positioned near the bottom end, at $6.47 per capita. There is room for Thunder Bay's urban forestry budget to be increased, and still remain in the low-mid municipal urban forest comparative budgets.

Table 21. Comparisons of Municipal Urban Forestry Budgets 2010

	Oakville	Toronto	Winnipeg	Thunder Bay	Edmonton	Ajax
Gross Forestry Budget	$3,785,900	$42,864,600	$10,830,000	$705,003	$5,695,000	$473,600
Forestry % of total budget	1.22%	0.47%	1.28%	0.38%	0.68%	0.70%
Population	165,000	2,503,281	693,200	109,000	1,150,000	100,000
Per Capita Cost of Forestry	$22.94	$17.12	$15.62	$6.47	$4.95	$4.74

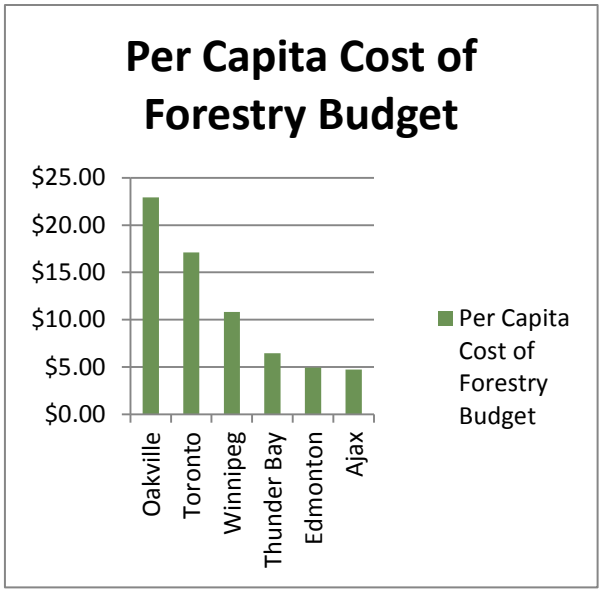


Figure 6. Comparison of 2010 Per Capita Budgets for Urban Forestry

In addition to the operational budget of $705,003, the Forestry Division should consider the following capital projects that are relatively short-term in nature, but will yield very long term benefits and result in operational efficiencies.

An updated city-wide inventory of trees on public lands is needed that will include information about tree locations, species, size, maintenance needs, and risk assessment information. The inventory should be supported by software that allows maintenance needs to be categorized and assigned in an efficient way. The total cost of completing an updated inventory is estimated to be $96,000 and could be completed in three one-year increments at an annual cost of $32,000. Inventory should be done in advance of pruning, to move the City toward a systematic pruning cycle.

Additionally, a cyclical pruning program should be implemented that will prune trees on a seven-year rotation. Developing a cyclical pruning program that prunes trees on a block-by-block basis creates tremendous efficiencies that result in significant long-term savings and a healthier urban forest with fewer high risk trees. In 2010, the city pruned 1213 trees. Contractors pruned 147 of that total. The 1213 trees was an increase over the totals from previous years that ranged from 631 pruned trees in 2008 to a total of 808 trees pruned in 2009. Even at the 2010 pruning level, the city pruned only 6.64% of its trees. At this rate, a cyclical program would take 15-16 years before all trees were pruned. It is recommended that this program be considered for capital funding, as a separate initiative to accelerate pruning to the point where operational budgets can include cyclical pruning costs. A program to achieve a 7-year cycle necessitates using contracted crews for up to seven years and utilize capital funds to complete. The 2012 pruning costs are expected to be $60,815 and are expected to increase at approximately 2% per year.

Once the capital pruning project is completed, the city crews will be phased in to a cyclical program and adjust to the block-by-block pruning system. While the potential number of trees to prune will increase above current figures, the efficiencies of block-by-block pruning and the increased attention that trees have received will reduce the amount of time required for each tree.

Issues

- Thunder Bay's current level of funding for urban forestry activities is relatively low compared to other cities.
- Efficiencies are needed to help the city maintain or enhance the level of service provided to its citizens.

Recommendations

- 90. Create a more accurate system of tracking costs for urban forestry related activities. Difficulty in tracking actual expenses for operational work such as tree planting, pruning, and removals seriously impedes the City's ability to plan and track program efficiencies.
- 91. Create efficiencies by developing short term capital projects such as an updated tree inventory and increasing the current rate of tree pruning using contracted tree services to perform block-by-block pruning.
- 92. Create a specific capital budget line item for planned replacement of existing equipment and purchase of new equipment.
- 93. Consider increasing the annual operating budget for urban forestry activities to levels consistent with other cities in amounts that reflect values described in other city long term planning documents.

6.2 Funding Opportunities

Urban forest management is a valued function in Thunder Bay and receives dedicated funding. With greater funding levels, the City could move from a reactive to a proactive management approach, provide greater services, and increase tree canopy coverage.

6.2.1 Tree Stewardship Program

The City currently has highly successful Tree Stewardship Program (TSP) which was created in 2006 to help promote the long-term sustainability of the urban forest by providing an accelerated, cost-shared tree planting program for Thunder Bay citizens. The Tree Stewardship Program is The TSP increases the number of urban trees in the city, enhances community stewardship, beautifies neighbourhoods and raises the profile of urban tree values. As noted in Tree Planting Section 5.1.1, property owners may also participate in the Tree Stewardship Program (TSP) by paying for a portion of the cost (currently $125) and have a tree planted the following season. This program provides a cost-shared option for accelerated tree planting, and includes a public outreach component that encourages stewardship of the new trees and other boulevard trees. Tax receipts are issued for this popular program.

There are other funding mechanisms and sources the City can also consider to provide additional revenues in support of a truly progressive, comprehensive urban forest management program.

6.2.2 Establish a Thunder Bay Tree Bank

Create a separate internal municipal account to deposit funds from various sources, which are restricted for use by the urban forestry program. The funds in this account should be managed by the Urban Forestry Section, subject to the annual budget process, and expenditures need to follow normal purchasing policies and procedures. The Forestry Section currently has a budget line for Miscellaneous Revenue, which is a good start, and includes revenues, donations and sponsorships. By attaching a name to the pool of revenues, it provides a marketable name for potential donors to contribute to, as well as including monies from various additional sources listed below.

6.2.2.1 Damage Compensation

This is a legitimate and often under-pursued source of funds. When an automobile damages a public tree or when construction equipment destroys a group of public trees, the City should seek compensation for the landscape value of that tree(s). The City can rightly seek compensation for the total damages, including: the value of the tree(s); the cost of repair or clean-up; and the cost of the administrative time used during the resolution of the situation. The receipt of $500 from a minor car accident to $5,000 for a major damage claim can add up over time. Generally, the compensation is collected from the insurance company of the person responsible for the damage or directly from the business that caused the damage to public trees. The compensation funds can be used to remedy the specific damage, or be used for other legitimate urban forestry functions throughout the City. The Forestry section does pursue damage compensation on larger claims, although currently limited staff resources make it difficult to find time to follow up.

6.2.2.2 Permit and Plan Review and Inspection Fees

Most municipalities require private developers and businesses to support the administrative and staff time needed for proper and professional plan review and site inspection tasks. Thunder Bay currently does this per authorization of Article 297 Planning Application Fee and further by Schedule ‘A’ - Planning Act - Tariff of Fees. In light of the City’s goal to protect and enhance the urban forest, additionally and specifically charging for the time and arboricultural expertise needed to approve permit applications, review plans, and make site inspections might be a viable option to support the salary and benefits of additional full or part-time urban forestry positions. The City may need to perform a job analysis to determine the time spent performing review and inspection tasks, and could investigate what other cities in the region, or of a similar size, are charging for such a task.

6.2.2.3 Developers’ Fees

In lieu of or in addition to new tree-related plan and inspection fees, and previously mentioned currently required expenses for tree preservation compliance, landscape installation, and other zoning/subdivision regulation activities, developers could be required to pay a set amount to support Thunder Bay’s overall urban forestry program. In effect, it would be a cost of doing business within the City limits. The fee could be a percentage of the total project cost, based on the number of housing units built, or based on the area of land being developed. The City’s Planning and Engineering Division may have better information upon which to base this fee. It is suggested that this fee would be paid and deposited in the Tree Bank before the project is approved.

6.2.2.4 Utility Company Fees

Utility companies perform new construction, maintenance, and repair work on an annual basis in the City. This work may affect the aboveground and belowground portions of public trees. It is prudent and reasonable to assess a fee to such utility companies when their work affects municipal trees. Utility companies with aerial facilities might be required to provide the City with an anticipated annual work plan and maps with an appropriate fee attached to a blanket, city-wide annual permit to provide for inspection and monitoring. Additionally, any compensation for documented damage to public trees during utility work would be collected separately on a case-by-case basis, and the utility company should be responsible for the costs for any remediation necessary (*e.g.,* pruning, fertilization, or temporary irrigation) above and beyond the fees and compensatory payment. The same conditions would apply for companies installing or maintaining underground utilities. The City of Cincinnati's urban forestry program has successfully used funds both an annual permit fee and damage compensation collection from utility companies to support staff time and remediation of utility projects for over 30 years (Refer to the Cincinnati Municipal Code - Chapter 743, Sections 11 and 17).

6.2.2.5 Private Donations and Corporate Sponsorships

Thunder Bay is fortunate to have generous citizens who care about the quality of life in the City. Advocacy groups in Thunder Bay should solicit citizens for private donations to support tree planting, tree care, and public education activities. Again, attaching a name to the program would help market the "Tree Bank". A major source of donations could be from businesses and corporations who wish to sponsor non-profit, environmental activities. All potential contributors should be reminded that any donations may be tax-deductible when they file their federal income tax return, similar to the Tree Stewardship Program.

6.2.2.6 Memorial and Honor Trees

Thunder Bay's Tree Planting Program includes a Commemorative Tree and Bench Program. Citizens at times of loss and at times of celebration often choose to plant a tree to remember special people or mark a special achievement or event such as a birth. This type of program can generate good public relations for the urban forestry program.

A prudent approach to implementing such a program is to set a level of funding that will not only purchase and plant a tree of a certain size, but that will also collect funds to pay for maintenance for three years. Although the Forestry Section website notes that this program is a full cost recovery program, the revenues fall short of the costs involved. Currently, the program revenue is $450 for purchase, planting, and maintenance of the tree for a 10-year period. A replacement guarantee is given for 3 years post planting.

6.2.2.7 Firewood, Mulch, and Wood Sales

The wood waste from tree maintenance and removals can be a source of funds for the 'Tree Bank'. Other cities such as Winnipeg have been successful in selling split and un-split firewood, hardwood timber, and rough wood chips to the general public and commercial businesses.

Rather than pay for removal and disposal, cities sell these excess wood products. A new trend is when a significant or historic public tree must be removed; the logs and useable wood are given to local craftsmen who then create furniture, sculpture, and other collectibles from the wood. These are sold and all or portions of the proceeds are returned to the City.

6.2.2.8 Grants

The City has previously received grants for urban forestry projects, but with the investment in time and a person skilled in grant writing, there are likely multitudes of grant opportunities for Thunder Bay. These opportunities can be found with the Provincial and Federal governments, non-profit organizations, large corporate and private business foundations, and private charitable foundations. If Thunder Bay establishes a Tree Bank, there will be a ready source of matching funds to leverage even more grant dollars.

Issues

- Memorial tree program costs do not recoup full costs.
- Funding opportunities need further exploration.
- Wood waste is not fully utilized as a potential source of funds.

Recommendations

- 94. Establish a Thunder Bay Tree Bank to support tree planting programs.
- 95. Increase the memorial tree purchase cost to cover all associated costs. Examples of other City programs are provided below for comparison.
    - Oakville: $2,100 includes plaque and maintenance for 5 years (http://www.oakville.ca/memorialtree.htm)
    - (http://www.edmonton.ca/environmental/conservation_landscaping/commemorative-planting.
      aspx). $1,000 donation includes tree and plaque
    - Mississauga: $750 for a tree, $250 for the plaque, maintained as other parks trees (www.mississauga.ca/portal/residents/preserveourparks?paf_gear_id=10200022&itemId=200022&returnUrl=%2Fportal%2Fresidents%2Fpreserveourparks)
- 96. Establish a gift donation option on the Forestry web page to allow donations of any amount. The City of Toronto has a gift donation program that may be referenced: http://www.torontoparksandtrees.org/catalog/index.
- 97. Explore partnerships with local companies who purchase wood products. Refer to http://www/woodanchor.com/how-we-reclaim as an excellent example of a successful business who reclaims wood from the City of Winnipeg and sells as environmentally sustainable products used for LEED certification.
- 98. The City may consider developing a list of interested parties to be contacted when wood of significance becomes available.
- 99. The Urban Forestry Program Specialist should continue to explore opportunities for environmental grants and prepare at least 3 proposals per year to secure funds. Suggested organizations to explore are:

Trees Ontario Forest Restoration Program
www.treesontario.ca/programs

- The Trees Ontario Forest Restoration Program provides financial support to partners wishing to organize tree planting projects who make a significant contribution to ecological sustainability at the local level. Recipients include Trees Ontario planting agencies that have identified a specific geographic area having an ecological requirement that may in part be addressed through tree planting. The subsidy will help to reduce the tree planting costs. In turn, the planting agency provides all services required to plant the trees, including site inspection, preparation of site plan, ordering stock, site preparation, overseeing the tree planting, tending and follow-up survival assessments.

  *Note: Trees Ontario Forest Restoration Program availability is dependent on donor contributions.

OMNR Grant Program
www.evergreen.ca/en/funding/grants/

- The Ontario Ministry of Natural Resources (OMNR) and Evergreen have launched a grant program designed to support the planting of 100,000 native trees on publicly accessible lands in cities and towns across the province.
- Grants awarded will range from $5,000 to $15,000.

Walmart – Evergreen Green Grants
www.evergreen.ca/en/funding/grants/

- For community-based restoration and stewardship initiatives in urban and urbanizing areas, including naturalization, restoration and stewardship, and community food gardens.
- Amount: Up to $10,000

The Rebuilding Nature Grant Program
www.evergreen.ca/en/funding/grants/

- Supported by The Home Depot Canada Foundation and led by Evergreen
- For community groups to cover the costs of tools and building projects, native plants and trees, and other expenses in support of environmental stewardship projects.
- Amount: $1,000, $3,000 or $12,000 plus $2,000 in The Home Depot gift cards
- The deadline for applications for 2011 has now passed.

Toyota Evergreen Learning Grounds School Ground Greening Grants
www.evergreen.ca/en/funding/grants/

- For schools wishing to create outdoor classrooms and food gardens to provide students with a healthy place to play, learn, and develop a genuine respect for nature.
- Amount: $500 to $3,500 for publicly funded Canadian schools (JK–Grade 12); $500 to $2,000 for not-for-profit daycares
- For 2011–12 - Application intake dates: September 16, 2011; December 2, 2011; March 16, 2012; June 1, 2012

Fido – Evergreen Quick Start Grants **www.evergreen.ca/en/funding/grants/**

Association of Municipalities of Ontario (AMO)
www.amo.on.ca

- Grants and Awards are available. The website is still under development; check back frequently.

Section 7: By-laws, Standards, and Policies

A review of current by-laws, standards, and policies that are part of urban tree management in Thunder Bay was performed and the following comments are made to amend or improve them.

7.1 Tree By-law

Thunder Bay's current Tree By-law (#008-2005 and the 2006 amendment #144-2006) is referred to as "A By-law to authorize and regulate the planting, care, maintenance, protection, preservation, and removal of public trees on municipal property, and to ensure the sustainability of the urban forest at various sites in the City of Thunder Bay, in the District of Thunder Bay". This By-law can be referenced in Appendix E.

The By-law was created in 2005 to raise the profile and value of urban trees on municipal land. It also was designed to educate the community on the value of tree protection and alternatives to removal. The By-law has given the City the leverage needed to regulate the planting, care and maintenance, protection, preservation, and removal of public trees on municipal property, and to ensure the sustainability of the urban forest in the city of Thunder Bay.

Thunder Bay's current Tree By-law was reviewed and was compared to those of other Canadian cities. Overall, Thunder Bay's Tree By-law is comprehensive. If properly and adequately enforced, the By-law is a good foundation for the continuation and advancement of proper urban forest management and protection in the City. As the program evolves and improves, and as other issues arise in the municipality, the By-law should be amended as necessary. At this time, the following recommendations are made to strengthen Thunder Bay's Tree By-law:

Issues

- Tree By-law does not reflect current state of Thunder Bay's urban forest.
- Tree By-law does not optimize protection of the urban forest.

Recommendations

- 100. Article 2: Philosophy, should be enhanced with content that addresses not only tree preservation but also increased tree establishment and gaining more tree canopy cover.
- 101. Consider renaming Tree By-law to Tree Preservation By-law to recognize the intent and reinforce the "Clean, Green and Beautiful" strategy.
- 102. Create a list of species not permitted for planting on public property. Examples of species to prohibit may include those with prominent thorns, large fruits, and those known to be invasive, including those which have potential to be invasive in the future if introduced to the area. Examples are: *Crataegus* (thorny hawthorns), *Gleditsia* (thorny honeylocust), *Maclura* (osage-orange), *Robinia* (black locust), *Ailanthus altissi*ma (tree of heaven), *Rhamnus cathartica* (European or common buckthorn), *Rhamnus frenula* (glossy buckthorn). This amendment would require changes in Article 3, Section 3.08, 3.11, and Article 4, Section 4.01.
- 103. Remove provisions for owners of property adjacent to city trees to prune trees of any size, or cut limbs of any size. Educate property owners about the reasons for such provisions. Will require changes in Article 3, Section 3.09.

- 104. Section 3.04 Removal of Objects is difficult to enforce. Consider renaming to “Prohibition of Posting to or Injury of Public Trees”. Include language that protects trees from injury due to posting of signs or other objects including wires, fasteners, or fixtures, or injuring trees in any way. City of Toronto’s By-law is a good example, stating: “Remove or cause to be removed without notice or compensation to any person any object or thing that adversely affects a tree or part of a tree on a City street. No person shall attach in any manner any object or thing to a tree or part of a tree located on a City street except with the prior written approval of the General Manager. The City of Ottawa Municipal Trees and Natural Areas Protection By-law is another good reference.
- 105. Develop and include fines and amounts per Section 391 of the Municipal Act 2011. This requires amending Article 7: Enforcement and Penalties.
- 106. Include statement prohibiting planting of trees on public property without the written consent of the City Forester.
- 107. Change the title of Article 9 from ‘Public Nuisance’ to ‘Public Hazard.’
- 108. In the definitions, include a definition of “tree crown,” and in Section 1.01s, revise the sentence to be”…the trunk *or root flare* is totally or partially located….”
- 109. Aspects of regulations and enforcement of tree protection measures/guidelines should be made part of the By-law in the future.
- 110. Add language to the By-law that addresses concerns about protection of woodland buffers and other natural areas. Appendix E contains a section of Ottawa’s tree By-law that addresses the protection of natural areas.
- 111. Add language that clarifies issue related to “nuisance trees”. Sample language is provided in Appendix E that should be considered.
- 112. Generally speaking, the Tree By-law articles, sections, and language should be reviewed every 5 to 10 years, unless a dramatic change in the resource or other related By-laws occurs prior to the scheduled review.
- 113. A public education effort should be made to acquaint the citizens and businesses in Thunder Bay with the provisions and restrictions of the By-law, and the public consultation should be included in the process prior to any major revisions.

7.2 Standards and Policies

Thunder Bay has developed a number of standards and specifications that guide the processes involved with carrying out municipal tasks. They provide useful guidelines for performing urban forestry related activities and create consistency in operations as staff turnover occurs.

City of Thunder Bay guidelines and specifications that were reviewed include the *Guidelines and Specification for the Planting of Municipal Trees and Shrubs,* and the *Tree Protection Standards*. Creating such documents involves a range of tasks that includes gathering current accepted standards within the industry and applying those standards to current and local conditions. As new research and information becomes available, many standards need to be updated to reflect new arboricultural and horticultural knowledge and accepted techniques. For example, new studies have identified important information about tree planting depth. Final planting depth should allow for the root flare and top lateral root to be visible. Such specifics need to be incorporated into the city’s standards and polices.

Additionally, recommended soil volumes have been established for planting trees. Survival of newly planted trees in Thunder Bay would increase if recommended soil volume specifications were adopted and utilized. Street trees rely heavily on the moisture and nutrients provided by limited rooting space. Usable soil volumes can be calculated using several different models (appendix G), but most provide the following guidelines:

- Between 5 and 15 cubic metres for a small tree
- Between 20 and 40 cubic metres for a medium sized tree
- Between 50 and 80 cubic metres for a large tree.

The issues of tree protection during development, woodland buffers, and "nuisance" trees, appear to be priorities at this time and deserve specific standards and polices be developed for proper management and protecting the integrity of the City's urban forest.

7.2.1 Woodland Buffers

Woodland buffers are natural, forested areas that exist on both public and private properties. These areas provide valuable canopy coverage and air quality benefits for the entire City as well as provide site-specific benefits such as privacy, wildlife habitat, stormwater moderation, and energy reduction. Woodlands are an especially valuable municipal asset in that they provide many benefits but require very little investment in management, maintenance, or planting costs. To manage these properly, however, standards and policies must be in place, which do not currently exist in Thunder Bay. Ottawa and Toronto have good natural area protection standards that appear in their By-laws (included in Appendix E), which are good references on which Thunder Bay can base their policy development.

7.2.2 Nuisance Trees

The other important current issue is the management of what are termed "nuisance trees". Nuisance is largely an undefined term as it depends on individual interpretation. The closest definition would include "unnecessary hardship". As an example, one person may find an oak tree to be a nuisance because it drops acorns, while another person may like the acorns and use them to make wreaths. Others may consider apple trees as nuisance because of the apple drop and subsequent arrival of wasps. In any event, Thunder Bay Forestry staff should assess each situation and determine the severity of the nuisance on the homeowner. Where it is determined to be severe, options can be presented. However, these must be related to Article 2: Philosophy, in By-Law 008-2005 as it states: "The Corporation adopts a philosophy which seeks to preserve rather than remove Public Trees wherever possible and expedient".

Home ownership changes frequently while trees live for decades. This is reflected in the philosophy in that one owner's view of nuisance should not impact on a future owner's desire to have a tree. Therefore, a policy should be developed on the premise that since the property owner is requesting the action on the "nuisance", and if the action is deemed appropriate by the City, the property owner should responsible for all associated costs. These include, but are not limited to, costs of inspection, removal, stumping, and replanting. Replanting with alternate species is a necessity to preserve the tree cover in the City so this provision must be included in the policy. A recommendation of specifics, *e.g.,* the replacement tree should be planted as close to the original tree as possible—preferably the same lot frontage should be included. Once this policy has been developed, it should be adopted into the Tree By-law.

Issues

- Standards and specifications do not reflect current best practices for tree care.
- Planning and policies to better protect and enhance the urban forest should be developed and implemented.

Recommendations

- 114. Update species list in the *Guidelines and Specification for the Planting of Municipal Trees and Shrubs* (Appendix G).
- 115. .Update tree planting standards to include information about identifying and exposing the root flare at the time of planting. ANSI A300 Standards are a good reference for this language. The City of Thunder Bay *Engineering and Development Standards* also include references to tree planting and tree planting diagrams that need to be updated.
- 116. Tree protection standards referenced in the *Engineering and Development Standards* need to include language that provides additional protection for root systems of trees in construction zones. The current language and diagrams do little to require protection of critical root zones. Appendix E provides an excellent example from the City of Toronto policy.
- 117. Add language in the *Engineering and Development Standards* that provides tree protection requirements as part of the site plan review process. This may also require coordination with existing site plan review language in the By-Law. Appendix E provides a sample tree protection policy from Toronto that could be referenced in Thunder Bay By-law.
- 118. Utilize GIS to map the location of woodland tracts and identify those that create buffers between incompatible land uses. Plan naturalized buffers where appropriate, *e.g.,* between highways and residential housing.
- 119. Create policies that will guide land use decisions for publicly owned woodland buffers and incorporate as appropriate by-law provisions that would regulate the loss of woodlands on private property.
- 120. Make tree preservation a more significant part of the plan/site review process and ensure that the Urban Forester has an official role in all phases of site development—from application review to final approval. Currently, the Coordinator of Park Planning has this responsibility but is limited by the lack of a municipal Private tree By-Law.
- 121. Require a comprehensive tree preservation and/or landscape plan be developed for all public projects where trees are present. This plan would show how trees are being protected and restored, and would preferably be completed by a Certified Arborist.
- 122. Adopt a “nuisance tree” policy that can be equitably applied and enforced city-wide.
- 123. The City’s policies and standards should be reviewed every 5 to 10 years, unless a dramatic change in the resource, technology, and/or industry standards occur prior to the scheduled review.
- 124. A public education effort should be made to educate property owners in Thunder Bay with the existence and value of the current standards and policies; and the public should be included in consultation concerning major revisions.
- 125. Soil volume specifications should be adopted (see Appendix G)

Section 8: Public Relations and Education

8.1 Communicating the Program and Urban Forest Benefits

Residents take part in the Citizen Tree Pruner program and receive training to prune small trees in Thunder Bay.

The public, including city residents, property owners, and business owners, has the greatest influence on the preservation of Thunder Bay's urban forest and canopy cover. This influence can be seen on both public and private lands. As the vast majority of the canopy cover is privately owned, residential and commercial property owners influence most of the City's canopy cover through the proper (or improper) actions (or inactions) they take to care for trees on their properties. The public further influences the urban forest through its ability to participate in public processes regarding land development.

The citizens effectively own both the public and private urban forests. Without greater political support and increased citizen understanding and commitment, urban forest management in Thunder Bay may not reach its full potential. Therefore, it is important for staff to communicate with and educate the public about the benefits of trees, the Urban Forestry Section's program, and what can be done to improve both their own trees and public trees.

The City of Thunder Bay would benefit from creating a comprehensive communications plan including corporate policies on the environment and sustainability, volunteer involvement, and community development. Such a plan will enable the City to get timely information to the citizens, create more synergies between stakeholder groups, and provide information to encourage and facilitate integrating the urban forest into interdepartmental infrastructure improvement, economic development, and planning projects.

8.2 Accomplishments

8.2.1 Urban Forestry Web Page

Using the internet is an effective means of keeping residents informed or urban forestry projects, policies, and opportunities. It can also create a sense of understanding and awareness about the state of their community forest. Thunder Bay has established an attractive, user-friendly Forestry webpage (http://www.thunderbay.ca/Living/Environment/Urban_Forestry.htm) which contains a wealth of information including:

- How to make service requests and contact staff
- Tree care and planting advice
- Threats to the Urban Forest (*e.g.* EAB)
- Sponsorship opportunities
- News and new project announcements
- Links to other organizations and resources

8.2.2 Partnerships

Thunder Bay has an extensive, broad-based system of partnerships established. Thunder Bay's Forestry staff should be recognized as leaders in forming valuable alliances with effective, engaged volunteer groups and partners. These partnerships contribute directly and indirectly to the promotion of the urban forestry program, implementation of a variety of projects, and the dissemination of best management practices and other public outreach efforts.

Examples of current partnerships for advocacy, general support, and fundraising include:

- Garden of Eden Tree Services
- Boreal Tree Services
- Rutter Urban Forestry
- Trim-It Landscapers
- Landale Gardens
- Thunder Bay Hydro
- Hydro One
- Union Gas
- Lakehead University Faculty of Natural Resources Management
- Confederation College Natural Resources Centre
- Lakehead Region Conservation Authority
- Thunder Bay District Stewardship Council
- Ecosuperior
- EarthWise® Thunder Bay
- Clean, Green, and Beautiful Committee
- Evergreen/Wal-Mart
- Provincial Stewardship Council
- School of Natural Resources
- Trees Thunder Bay
- Ontario Power Generation
- Evergreen / Walmart

The following existing partnerships and programs contribute significantly and directly to the sustainability of the City's urban forestry program and the community forest itself:

- The Citizen Pruner Program was initiated in 2010 and is Canada's first all-volunteer tree maintenance support program. Citizens are trained on proper small tree maintenance techniques and commit to provide care for public trees.
- The Tree Stewardship Program was started in 2006 and promotes the long-term sustainability of the urban forest by providing an accelerated, cost-shared tree planting program for Thunder Bay citizens. Uniquely, this program funds trees planting through a three-way partnership between the City, the property owner, and private donors.

- EarthWise® Thunder Bay is a partnership between the City of Thunder Bay and the community that works collaboratively on issues of climate change and community sustainability. The main priority of EarthWise® Thunder Bay is to implement the EarthWise® Community Environmental Action Plan. The Parks Division currently plays a leading role in the Community Greening program.
- Trees Thunder Bay is the City's community tree advocacy group which was formed by concerned local citizens whose interest lay in beautifying the City by ensuring that the urban forest is protected, enhanced, and maintained. Its mandate includes increasing awareness of the value of the urban forest, educating about trees and their place in urban and rural life, and compelling City Council to invest in the urban forest. This very active advocacy group also is involved with the Tree Stewardship Program and the Notable Tree Program.

8.2.3 General Outreach Efforts

Thunder Bay promotes urban forestry through both tried-and-true methods and innovative communication outlets. Some examples include:

- Arbor Day celebrations
- Becoming involved with the Firesmart initiative
- Creating and distributing pamphlets and factsheets
- Placing booths at industry and green event tradeshows
- Planning a city calendar with an urban forestry theme
- Submitting articles to print and electronic media outlets
- Supporting a Tree Blog
- Using Facebook

Thunder Bay's urban forestry program has an excellent and diverse communications foundation and resources. Through the efforts of the City and its partners, it has the ability to reach the community with messages for educational, fund-raising, and political engagement purposes.

Creating a comprehensive communication plan will help deliver key messages. This plan would highlight the existing efforts and resources; identify opportunities, and integrate City and stakeholder efforts and resources to maximize the effectiveness of all communication efforts.

Marketing campaigns for urban forest programs can capture the attention and support of a community. Some campaigns have been very effective, such as Trees Pay Us Back and the Fit Forest campaigns (see Appendix F for examples of these campaigns). Both were developed by C.E.L., a professional marketing and public relations firm in the United States. The most memorable highlight of the Trees Pay Us Back campaign used in Minneapolis, Minnesota was the giant price tags placed on the trees around the city capital that presented the dollar value of each tree's environmental contributions. The Fit Forest campaign used in Elgin, Illinois, had the goal of encouraging residents to invest in improving the health of trees throughout their community. A visually appealing, coordinated set of marketing and outreach materials was developed using the central theme of growing a healthy community forest in Elgin today, tomorrow, and for generations to come.

Key messaging for the communications plan should come from information gathered at the previous public meetings, and from future stakeholder input efforts. From the public engagement efforts used during the Management Plan's development, the highest ranked reason for having a sustainable urban forest was that "Trees improve the quality of life by creating a pleasing City character." This is supported by many comments, such as "I think having trees, especially mature trees, in the City is important because it makes the City look more attractive and makes it more comfortable to be in." The public ranked these tree benefits as the highest: increasing property values, protecting water quality, filtering air pollutants, making Thunder Bay a better place to work and live, and decreasing energy use and consumption (see Appendix A).

Thunder Bay's urban forest management program transcends the daily operational maintenance routines. It demonstrates the City's leadership and commitment to improving the environmental quality of life for its citizens. It also recognizes that managing land not only grants privileges but also entails obligations.

Professional, appropriate, and frequent communication is vital to the sustainability of both the City's urban forest and its management program. Public outreach, education, and marketing should be ongoing with staff actively looking for daily opportunities to communicate their program.

Issues

- Communications program needs to reach wider range of target audience.
- Elected officials do not receive orientation to provide education regarding the urban forestry program.
- Thunder Bay's Trees not well linked with Tourism.

Recommendations

- 126. Create a professional, comprehensive communications plan.
- 127. Develop a central, unifying theme or message for the urban forestry program that the City and all stakeholders can use.
- 128. Continue public and citizen urban forestry outreach efforts through a wide variety of media outlets, special events, and publications to instill a sense of civic pride and gain financial and political support for the program. York Region Forestry Department has some excellent programs such as Guided Forest Hikes, and Nature's Classroom which Thunder Bay should explore. City of Richmond Hill has a popular Interpretive Program Kits "Walks on the Wild Side", which is sold for educational programs.
- 129. Create an educational program for orienting newly elected public officials to the City's urban forestry program, efforts, and goals.
- 130. Promote internal educational opportunities by increasing professional interaction, coordination, and communication between departments and staff regarding tree planting, maintenance, and tree preservation principles and practices.
- 131. Market the urban forestry successes outside to other municipalities, the Province, and across the country. A widespread and heightened awareness of the quality of the urban forest and of life in Thunder Bay promotes economic development and tourism. Partner with Tourism Thunder Bay to promote your urban forest as a key component of quality of life and "Superior by Nature".
- 132. Update Urban Forestry web page to include photos of recommended trees for planting.

- 133. Update the Urban Forestry web page to include information about cyclical pruning, maps of zones, and schedules
- 134. Widely disseminate the i-Tree benefits results to demonstrate the environmental impact and value of trees to internal and external customers of the urban forest management program.
- 135. Encourage public participation and input in forest management in Thunder Bay after the Plan is adopted through workshops, feedback surveys, and forming special project/issue committees.
- 136. Encourage Trees Thunder Bay for hands-on demonstration tree planting and maintenance activities on streets around schools. School properties in Thunder Bay may be one of the City's greatest untapped public resources for planting trees and adding to City's tree canopy cover. A cooperative program could be developed and implemented to address the maintenance of existing trees, and to identify opportunities to plant additional trees on both existing and new school grounds. Assist the schools to develop landscape plans for school properties.
- 137. Partner with ISA Ontario Chapter and the Ontario Commercial Arborist Association to enlist their help to disseminate information on City projects/programs and tree benefits; host the annual Tree Climbing Championship or collaborate on an Arbor Day event.
- 138. Engage more local and regional tree care, landscape, and nursery companies in communication efforts; ask them to display and distribute City program information to their customers; offer discounts to Thunder Bay property owners at special times; and host training workshops.

Section 9: Implementation of the Municipal Forestry Action Plan

The City of Thunder Bay has undertaken a comprehensive review of its current urban forestry program. An independent consultant, Davey Resource Group, a Division of The Davey Tree Expert Company of Canada Limited, was hired to assess the status of the City's urban forest, estimate the costs and benefits of the urban forest to the community, analyze the current urban forest management system, and make recommendations to the City. The following tasks were performed by Davey Resource Group in formulation of the Municipal Forestry Action Plan:

- The City's current tree inventory was analyzed to better understand the state of Thunder Bay's urban forest and its needs.
- i-Tree Streets was utilized to estimate the benefits trees provide to the community and calculate the value of the investment the City makes in its trees.
- The organizational structure of and methods employed to carry out the City's urban forestry program were reviewed.
- Opinions and observations about the City's urban forestry program were sought from both internal and external stakeholders.
- City documents relating to urban forestry were assessed.

The *Municipal Forestry Action Plan* is a compilation of objectives and action items (strategies) that include recommendations made throughout the *Urban Forest Management Plan* document. Addressing the action items will significantly move Thunder Bay's urban forestry program forward, to become more efficient and effective at delivering community and environmental benefits.

9.1 Vision Statement

The recommended vision for Thunder Bay's urban forestry program is:

The City of Thunder Bay will have a sustainable, safe, healthy, and diverse urban forest that optimizes public benefits.

This vision statement aligns well with Thunder Bay's strategic plan goals of:

- Be cleaner, greener, more beautiful and proud
- Have a high quality of life
- Promote a more sustainable community by promoting the greening and protection of the City's environment including natural areas.

9.2 Urban Forest Land Types Management

The City of Thunder Bay Parks Division manages trees on three distinct land types: streets, parks, and woodlands/natural areas. Each of these land uses presents unique challenges and opportunities for tree management that should be acknowledged and considered as the City moves toward a more sustainable urban forestry program.

Trees growing in boulevard situations must be managed primarily for public safety, but also must be selected and maintained to adapt and thrive in the restricted, non-native growing conditions of this highly developed environment. Park trees may require less intensive management since the growing conditions are more favorable and there is less competition for space from buildings and utilities; but public safety is still a primary consideration. Woodlands and natural areas intend the undisturbed growth of any tree species where the desired effect is that of natural growth. Trees growing in woodland and natural areas will require the least active management, but those in buffer areas near people and structures should still be periodically evaluated for potential risk. The environmental benefits provided by these forested ecosystems provide great collective benefits to the City; therefore, these trees still require a degree of professional management.

Street Tree Management Objectives

- Street trees will be managed primarily to minimize risk to the persons and property on public right-of-way and abutting private property.
- Mature street trees will be routinely maintained through a preventive cyclical maintenance program. In addition, response to and assessment of citizen requests for maintenance, and storm damage response will continue.
- Young street trees will be maintained to assure their quick establishment, improve their vigour, and pruned to ensure their structure and form are compatible with the site, so they grow into sustainable mature trees.
- Street trees will be monitored on a regular basis to detect safety risk and/or insect and disease issues before reaching levels that are unmanageable.
- Street trees will be planted with species that are diverse, adaptable to urban conditions and site constraints, and are attractive and compliment the area. A primary driver of planting selections and decisions will be maximizing future benefits of the trees.

Park Tree Management Objectives

- Park trees will be maintained to minimize risk to persons or property in developed areas with public access, and where park property abuts privately-owned land.
- Park trees will be monitored on a regular basis to detect safety risk and/or insect and disease issues before reaching levels that are unmanageable.
- Each park will be planted utilizing master plans that containspecies that are diverse and are attractive and compliment the area.
- Preference will be to plant primarily large-canopied and native tree species in park and open space properties to more quickly and efficiently contribute to increasing citywide canopy coverage and to maximum the potential benefits to the City.

Woodland/Natural Area Tree Management Objectives

- The key philosophy for managing woodland and natural area trees is to allow nature to take its course. Passive management is typically all that will be required for these native, balanced ecosystems. It is important to note that management of woodlands and natural areas is minimal, and the public should not expect the same degree of due diligence paid to parks and boulevard trees. The public should access woodlands and natural areas at their own risk.

- Woodland trees will be protected from development or any other activity that may be harmful to the natural habitat.
- Woodland trees should be monitored for severe insect and disease threats and invasive plant species, and will be inspected for catastrophic loss after severe weather events.
- Woodland trees in defined perimeter or buffer areas that are immediately adjacent to private properties should be inspected regularly for potential risks to persons or property.
- Woodland trees in defined perimeter areas adjacent to marked public trails through woodlands should be inspected regularly for potential risks to persons or property
- Woodland areas will not generally be planted with new trees; natural regeneration of native species will be the primary means of perpetuating these forested areas. If reforestation is needed or desired, native, large growing species should be planted.

Issue

- Woodlands and Natural Areas do not have assigned budgets hence are low priority

Recommendation

- 139. Create a specific budget line for inspection and management of woodland buffers, perimeters and trails.
- 140. Management plans should be created for the various buffer areas.

9.3 Urban Forest Management Five-Year Work Plan

Six major objectives have been developed to guide management planning principles for Thunder Bay's future urban forestry program. Associated strategies are supported by the budget recommendations provided in Table 11. The budget recommendations include five, one-year plans that will be required to carry out the strategies described in the following long-term objectives:

- Establish a canopy cover goal citywide of 50 percent.
- Increase health and survival rates of newly planted trees through their establishment years.
- Increase health and survival of established trees through plant health care practices such as regular inspections, cyclical pruning, and tree protection.
- Protect public safety by developing a tree risk management program and working closely with utilities.
- Increase overall urban forest canopy and health through advocacy groups, public education, and public relation campaigns.
- Create a more efficient, and functional operating system for handling the urban forestry program in Thunder Bay.

Specific strategies to accomplish the primary management objectives of the *Municipal Forestry Action Plan* during the first five years of implementation are:

2012-2016

Objective 1. Establish a canopy cover goal citywide of 50 percent.

- **Strategy 1.1.** Increase annual municipal tree planting numbers in order to exceed the number of removals each year. This needs to occur if canopy cover levels are to be maintained or increased.
- **Strategy 1.2.** Increase the visibility of successful programs such as Tree Stewardship Program to increase citizen interest in public tree planting.
- **Strategy 1.3.** Increase private tree planting efforts through educational and public awareness campaigns utilizing advocacy groups such as Trees Thunder Bay and municipal groups such as Earthwise® Thunder Bay.
- **Strategy 1.4.** Focus tree planting efforts in wards with lowest canopy coverage (McKeller, 12.9 percent; Northwood, 22.5 percent; and Westfort, 24.7 percent) and on land types that have lower canopy percentages (Commercial Lands, 19.1 percent; Streets, 21.8 percent; and Residential Urban, 29.4 percent). Tree canopy coverage goals in the residential areas of these wards should be established at 50 percent for the suburban residential, and 25 percent for urban residential land types.
- **Strategy 1.5.** Develop specific plans for the inclusion of appropriate tree planting on image routes including Red River Road (north core); Arthur Street (south core); and Algoma, Memorial, Junot and May Streets. Streetscape guidelines, once completed should be adopted and followed for planning and construction projects.

- **Strategy 1.6.** Develop procedures and policies between the Urban Forestry Section and other municipal departments, divisions, and sections that plan public improvement projects such as road improvements, new roads, sidewalk repair and replacement, utility repairs and installations, etc. These policies must include professional arboricultural expertise at the planning table as projects are planned, tendered, or permitted that would benefit from a tree planting component. In addition, this expertise needs to be part of the construction inspection process to ensure adherence to the existing *City of Thunder Bay Guidelines and Specifications for the Planting of Municipal Trees and Shrubs*.

Objective 2. Increase health and survival rates of newly planted trees through their establishment years.

- **Strategy 2.1.** Select a diverse mix of species and planting stock of excellent quality to increase survival chances. Adhere to existing standards for quality planting stock and reject stock that does not meet specifications.
- **Strategy 2.2.** Pre-inspect all tree stock. Tag trees in the field prior to delivery by nurseries to ensure the delivery of quality stock.
- **Strategy 2.3.** Plant trees properly taking care to plant at proper depths to reduce girdling roots and increase tree survival. Include proper mulching at planting time.
- **Strategy 2.4.** Aggressively inspect the work of tree planting contractors to ensure compliance with contract specifications including the City's *Guidelines and Specifications for the Planting of Municipal Trees and Shrubs*.
- **Strategy 2.5.** Provide staff and equipment to water newly planted trees. Include watering for a period of two years in contract specifications for planting.
- **Strategy 2.6.** Provide young tree training at Year 3 and again at Year 7 to provide quality structural form for establishing trees. Trees that develop proper structure will require less pruning in future years.
- **Strategy 2.7.** Maintain a separate inventory of trees on private developments that were planted per requirements of the City's site plan control process. Use the inventory to maintain planting dates and to trigger periodic inspections to verify survivability of trees. The City should consider the option of requiring developers to fund tree planting and watering, and include these trees in the annual tendered tree planting contract.
- **Strategy 2.8.** Update tree planting standards contained in the City's *Engineering and Development Standards* and in the *Guidelines and Specifications for Planting Municipal Trees*. The specifications and diagrams should information about identifying and exposing the root flare at the time of planting. ANSI A300 standards are a good reference.

Objective 3. Increase health and survival of established trees through plant health care practices such as regular inspections, cyclical pruning, and tree protection.

- **Strategy 3.1.** Adhere to inspection intervals that provide for at least annual inspections of trees during their first three years, and inspections at least every seven years (during cyclical pruning) after trees are established.

- **Strategy 3.2.** Update the current tree inventory utilizing data fields that contain, at a minimum, information about tree species, location (GIS), diameter, condition, maintenance needs, and tree risk rating. Use tree management data software that will provide flexibility with adding additional fields (planting date, contractor name, service dates) and will allow sorting of data by numerous fields. Data sorting provides a strong tool for the development of a systematic pruning program and responsiveness to threats such as invasive insects or diseased. Enhance recordkeeping and responsiveness is critical for due diligence.
- **Strategy 3.3.** Develop and adhere to a systematic pruning cycle so that every public tree has received a detailed inspection and required pruning (or other maintenance need) at least once every seven years. Prune trees by block (or zone) to provide dramatic increase in efficiency and overall tree health. Service requests from citizens can be addressed based on a priority basis to protect public safety.
- **Strategy 3.4.** Develop procedures and policies that co-ordinate projects between the Urban Forestry Section and other municipal departments, divisions, and sections that plan public improvement projects such as road improvements, new roads, sidewalk repair and replacement, utility repairs and installations, etc. These policies must place professional arboricultural expertise at the planning table for projects are planned, tendered, or permitted that may impact public trees. In addition, this expertise needs to be part of the construction inspection process to ensure adherence to the existing tree protection standards and policies that protect trees and critical root zones.
- **Strategy 3.**5. Update tree protection standards contained in the City's Engineering and Development Standards. Tree Protection Standards should emphasize the protection of critical root zones and restrict the use of trunk protection planking to only the most extreme sites where other root protection measures are utilized and equipment may actually be operating close to a tree's trunk. Protecting only the trunk will leave roots vulnerable to soil compaction and contamination.
- **Strategy 3.6.** Develop clear policy that addresses the loss of trees from snowplow operations and fire hydrant cleaning activities. While both are considered critical municipal operations, there should be a clear policy about replacement of trees that are damaged or lost.
- **Strategy 3.7.** Create a Municipal Arborist position that will provide additional arboricultural expertise to assist with the planning of municipal construction projects (sewer, water, roads, and sidewalks), permitting, inspection of publicly owned trees, and maintaining a city-wide inventory of public trees. The City should consider realignment of forestry crews to be supervised by this position.
- **Strategy 3.8.** Continue to maintain a strong working relationship and open communication with Thunder Bay Hydro. Their impact on the public and private tree resource is significant and they have proven to be good partners in managing the urban forest resource.
- **Strategy 3.9.** Prepare an emerald ash borer (EAB) strategy to deal with EAB issues such as trapping, monitoring, treatment options, removal options, wood residue, replanting, and public education.

Objective 4. Protect public safety by developing a tree risk management program and working closely with utilities.

- **Strategy 4.1.** Assign tree risk ratings to each public tree as inventories are updated.
- **Strategy 4.2.** Utilize updated tree data management software to store data collected about tree risk and assign priorities to direct work activities and track workload.
- **Strategy 4.3.** Remove high-risk trees or prune high-risk limbs based on their rating. Utilizing tree risk ratings reduces risk and creates an efficient use of tree care dollars to deal with the highest risk first.
- **Strategy 4.4.** Document work performed in inventory database for operational records and due diligence

Objective 5. Increase overall urban forest canopy and health through advocacy groups, public education, and public relation campaigns.

- **Strategy 5.1.** Support viability of current efforts to involve advocacy groups such as Trees Thunder Bay and programs that promote urban tree care.
- **Strategy 5.2.** Increase the visibility of successful programs such as the Tree Stewardship Program to increase citizen interest in public tree planting, and the Citizen Pruner Program to educate citizens about proper tree care.
- **Strategy 5.3.** Create an education and awareness campaign to inform and educate citizens about the general benefits of trees, the importance of the City's urban forest management program, and on specific issues such as EAB and other exotic pests.

Objective 6. Create a more efficient and functional operating system for handling the urban forestry program in Thunder Bay.

- **Strategy 6.1.** Create a solid identity for the Urban Forestry Section. This begins with increased visibility of the name of the group that performs urban forestry activities. In order to facilitate effective organization of existing staff, utilize the name Urban Forestry Section in all correspondence and planning documents.
- **Strategy 6.2.** Re-organize staff and tasks to create a more efficient and effective system of identifying urban forestry needs and delivering services. There should be clear channels of authority and accountability for tasks assigned by the City Forester to operational staff.
- **Strategy 6.3.** Create a Municipal Arborist position that will provide additional arboricultural expertise to assist with the planning of municipal construction projects (*e.g.,* sewer, water, roads, and sidewalks), permitting, inspection of publicly owned trees, and maintaining a city-wide inventory of public trees. Consider realignment of crews performing operational work, to be supervised by the Municipal arborist.
- **Strategy 6.4.** Provide a planned and documented safety program related to operation of arboriculture equipment, including aerial lift inspections, aerial lift safety, aerial rescue, first aid, working near energized lines, and other topics. Regular safety training sessions should be provided to all staff who work regularly with, or near, any arboriculture equipment, or on arboriculture work sites.
- **Strategy 6.5.** Create a specific budget line item that provides dedicated funds for training and professional development.
- **Strategy 6.6.** Explore partnering with Thunder Bay Hydro on a variety of training topics.

- **Strategy 6.7.** Individuals who perform tree related activities (either planning or performing arboriculture activities) should become Certified Arborists, Certified Tree Worker (Climber Specialist or Aerial Lift Specialist), through the International Society of Arboriculture (ISA) or Ministry of Training, Colleges and Universities (MTCU). Future training should be geared towards topics that will allow staff to achieve the ISA certification.
- **Strategy 6.8.** Consider training at least 1, three-person crew in tree climbing skills and keep them trained as skilled climbers. This can reduce the need for contracted services and adds a level of safety in the event of the need for aerial rescue situations.
- **Strategy 6.9.** Staff involved with municipal construction projects should be provided training about tree protection during construction activities.
- **Strategy 6.10.** The City Forester should achieve and maintain the ISA Municipal Specialist designation.
- **Strategy 6.11.** Maintain equipment and perform required safety inspections that comply with all safety standards and requirements, particularly for aerial lifts.
- **Strategy 6.12.** Create a specific budget line item for planned replacement of existing equipment and purchase of new equipment as workload demands increase.
- **Strategy 6.13.** Keep a supply of climbing materials to properly equip any municipal climbing crews who perform tree work.
- **Strategy 6.14.** Develop a policy for property owners who want to prune street trees adjacent to their homes or businesses. The current system of requiring permits for pruning small limbs may not be an effective tool that ensures good tree care. Consider options that include the City performs all pruning (no pruning of street trees by property owners).
- **Strategy 6.15.** Develop a system for entering newly planted tree locations in the City's current inventory system. Homeowner requests are typically entered into the Hansen recordkeeping system. Make sure that a system is in place to enter other newly planted trees, such as those in new subdivisions, into the system as well and can keep track of maintenance needs and work performed. Newly planted trees should be inspected by Parks immediately after planting and again at the end of the guarantee period. After that, new trees should be placed on a young tree maintenance program starting in the third year after planting.
- **Strategy 6.16.** Select and use tree inventory software that will better track work orders and work performed on public trees. Software applications designed specifically for managing tree population data and workflow will create a more efficient urban forest program.
- **Strategy 6.17.** Create a specific budget line for inspection and management of woodland buffers and natural woodland areas perimeters and trails.

The suggested five year urban forestry budget includes components of operations, administration, staffing, and all other related costs.

Suggested 7-Year Budgets

A 7-year budget has been developed in consultation with City staff. The 7-year period accommodates the transition to a systematic and cyclical pruning program. Budget items that are considered part of the operational budget are shown in Table 22, while proposed capital items are shown in Table 23. Programs included in the capital budget are short term projects which result in efficiencies, and are intended to move the City toward a systematic, cyclical pruning program. Capital items include the use of contractors to perform pruning for a period of seven years to assist with transitioning to a cyclical pruning program that prunes trees on a block by block basis and greatly improves efficiencies, lowers long-term costs, and creates a healthier and safer urban forest. Additional capital funds are anticipated for special tree planting projects along major boulevards and image routes.

Definitions of key terms used follows:

Pruning

Unit costs were assigned to eight diameter size classes. Larger trees are typically more expensive to prune. Smaller trees may be pruned with hand pruners or hand saws, medium-sized trees may require pole saws, while larger trees will require an aerial lift or climbing.

The pruning plan is set up to gradually move the urban forestry program to a more systematic (or cyclical) pruning schedule. It takes a firm resolve to move towards this type of system as it means placing an emphasis on an orderly and systematic method to pruning trees instead of responding to citizen requests.

A cycle of seven years has been suggested initially, but the City can consider other cycle lengths after a trial period of a couple years. This means that seven management zones will need to be developed that include a balanced number of trees. Some consideration should be given to making adjustments for tree sizes in each zone as well. Trees along entire blocks will be assessed for pruning needs and the work performed along each block. This greatly minimizes set-up times and improves overall tree health as each tree is visited, assessed, and possibly pruned once every seven years.

A systematic pruning approach will still involve a response to every citizen request. The initial response will be to inspect the tree to determine if an unacceptable level of risk is involved. If so, then the tree is placed on a list to be addressed as soon as practical. If not, then the tree service is deferred until the next pruning cycle. While this may mean a slower response time for some citizen requests, it will also deliver lower overall pruning costs from efficiencies.

Some cities make the transition to cyclical pruning very quickly, while others take some time to fully achieve a systematic approach. During the transition, there will always be a number of trees outside of the current working zone that need immediate, high priority attention. Eventually, these emergency needs are reduced and a stronger emphasis is placed on systematic pruning. Emergency pruning needs (whether generated by citizen request or inspections by staff) will never disappear completely. A systematic program must still have staff and equipment, or contractors, available to address high-risk situations.

The proposed 7-year budget shown in Table 22 includes the operational costs for city crews to prune approximately 2000 trees per year during the 7-year budget period. This exceeds the city's current capacity to prune trees and represents approximately 75% of the total number of trees. In order to achieve a seven year cycle of tree pruning, the city would need to prune 2,610 trees per year (14.29% of inventoried tree population.)

In order to make the transition to a cyclical pruning program that prunes trees on a seven year cycle in a block by block program, the City will need to utilize capital funds for contracted pruning. Table 23 provides the additional number of trees that a contractor will need to prune (and the associated costs) as part of a suggested 7-year capital program. Eventually, the city should be able to utilize its own forces with minor assistance from contractors to prune 1/7th of the city's trees each year utilizing existing operational funds. If no current increases in operational budgets are expected, the reliance on contracted pruning with capital funds may be the best course to get to a fully implemented cyclical pruning program.

Training Pruning

Sometimes referred to as structural pruning, it addresses the tree at a young age (typically in Years 3 and 7 after planting and tree diameters less than 15cm.) Training pruning involves hand tools to prune away branches that create bad form such as weak branch attachments or closely spaced branches. The result should be a tree with good structure that will have fewer pruning needs in the future. The low cost of this pruning results from the work being performed by ground crews with hand tools. The savings that result are from healthier, mature tree that need less pruning, provide greater benefits, and have less probability of failure.

Removals

Eight diameter classes have been identified since the cost of removal is largely dependent on the size of the tree. Removal costs include the tree take down, stump removal, hauling wood residue, and site restoration (soil and turf) if a new tree is not planned for some time.

Tree Planting

Operational budgets are planned to remain the same at 250 trees per year. It is anticipated that capital funds will be used to plant an additional 214 trees per year. The total annual planting of 464 trees per year will keep the City on course to maintain the existing canopy cover (no net loss) by keeping the number of tree removals and tree planting balanced.

Program Administration

This includes budgeted amounts for current staff.

Municipal Arborist

This includes projected salary for a new staff position.

Inspections

This is the cost to perform inspections and the salary of staff that spend time processing inspection requests and handling citizen calls

Other Expenses

Includes watering, irrigation, insect and disease control, storm clean-up, and litigation.

Table 22. A Suggested Seven-Year Operational Budget for Thunder Bay

Activity	Diameter Class	2012			2013			2014			2015			2016			2017			2018			Seven Year Cost
		Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	
Pruning (unit cost increase at 2% per year)	0-15 cm	$55	0	$0	$56	0	$0	$57	0	$0	$58	0	$0	$60	0	$0	$61	0	$0	$62	0	$0	$0
	16-30 cm	$75	541	$40,575	$77	541	$41,387	$78	541	$42,214	$80	541	$43,059	$81	541	$43,920	$83	541	$44,798	$84	541	$45,694	$211,154
	31-45 cm	$115	448	$51,520	$117	448	$52,550	$120	448	$53,601	$122	448	$54,673	$124	448	$55,767	$127	448	$56,882	$130	448	$58,020	$268,112
	46-60 cm	$160	209	$33,440	$163	209	$34,109	$166	209	$34,791	$170	209	$35,487	$173	209	$36,197	$177	209	$36,920	$180	209	$37,659	$174,023
	61-75cm	$235	86	$20,210	$240	86	$20,614	$244	86	$21,026	$249	86	$21,447	$254	86	$21,876	$259	86	$22,313	$265	86	$22,760	$105,174
	76-90 cm	$310	36	$11,160	$316	36	$11,383	$323	36	$11,611	$329	36	$11,843	$336	36	$12,080	$342	36	$12,322	$349	36	$12,568	$58,077
	91-105 cm	$410	15	$6,150	$418	15	$6,273	$427	15	$6,398	$435	15	$6,526	$444	15	$6,657	$453	15	$6,790	$462	15	$6,926	$32,005
	105 cm +	$550	7	$3,850	$561	7	$3,927	$572	7	$4,006	$584	7	$4,086	$595	7	$4,167	$607	7	$4,251	$619	7	$4,336	$20,036
Activity Total(s)			**1342**	**$166,905**		**1342**	**$170,243**		**1342**	**$173,648**		**1342**	**$177,121**		**1342**	**$180,663**		**1342**	**$184,277**		**1342**	**$187,962**	**$868,580**
Training Pruning (unit cost increase at 2% per year)	0-15 cm	$55	675	$37,125	$56	675	$37,868	$57	675	$38,625	$58	675	$39,397	$60	675	$40,185	$61	675	$40,989	$62	675	$41,809	$193,200
Activity Total(s)			**675**	**$37,125**		**675**	**$37,868**		**675**	**$38,625**		**675**	**$39,397**		**675**	**$40,185**		**675**	**$40,989**		**675**	**$41,809**	**$193,200**
Total Pruning Figures			**2017**	**$204,030**		**2017**	**$208,111**		**2017**	**$212,273**		**2017**	**$216,518**		**2017**	**$220,849**							**$1,061,780**
Removal includes stump removal and site restoration (unit cost increase at 2% per year)	0-15 cm	$95	20	$1,900	$97	20	$1,938	$99	20	$1,977	$101	20	$2,016	$103	20	$2,057	$105	20	$2,098	$107	20	$2,140	$9,888
	16-30 cm	$125	45	$5,625	$128	45	$5,738	$130	45	$5,852	$133	45	$5,969	$135	45	$6,089	$138	45	$6,210	$141	45	$6,335	$29,273
	31-45 cm	$280	105	$29,400	$286	105	$29,988	$291	105	$30,588	$297	105	$31,200	$303	105	$31,824	$309	105	$32,460	$315	105	$33,109	$152,999
	46-60 cm	$475	100	$47,500	$485	100	$48,450	$494	100	$49,419	$504	100	$50,407	$514	100	$51,416	$524	100	$52,444	$535	100	$53,493	$247,192
	61-75cm	$650	65	$42,250	$663	65	$43,095	$676	65	$43,957	$690	65	$44,836	$704	65	$45,733	$718	65	$46,647	$732	65	$47,580	$219,871
	76-90 cm	$800	45	$36,000	$816	45	$36,720	$832	45	$37,454	$849	45	$38,203	$866	45	$38,968	$883	45	$39,747	$901	45	$40,542	$187,345
	91-105 cm	$900	20	$18,000	$918	20	$18,360	$936	20	$18,727	$955	20	$19,102	$974	20	$19,484	$994	20	$19,873	$1,014	20	$20,271	$93,673
	105 cm +	$1,000	20	$20,000	$1,020	20	$20,400	$1,040	20	$20,808	$1,061	20	$21,224	$1,082	20	$21,649	$1,104	20	$22,082	$1,126	20	$22,523	$104,081
Activity Total(s)			**420**	**$200,675**		**420**	**$204,689**		**420**	**$208,782**		**420**	**$212,958**		**420**	**$217,217**		**420**	**$221,561**		**420**	**$225,993**	**$1,044,321**
Tree Planting (unit cost increase of 5% per year)	Tree Purchase & Plant (60mm)	$350	250	$87,500	$368	250	$91,875	$386	250	$96,469	$405	250	$101,292	$425	250	$106,357	$447	250	$111,675	$469	250	$117,258	$483,493
Activity Total(s)			**250**	**$87,500**		**250**	**$91,875**		**250**	**$96,469**		**250**	**$101,292**		**250**	**$106,357**		**250**	**$111,675**		**250**	**$117,258**	**$483,493**
Current Program Administration				**$125,499**			**$128,009**			**$130,569**			**$133,181**			**$135,844**			**$138,561**			**$141,332**	**$653,102**
Municipal Arborist				**$40,000**			**$40,800**			**$41,616**			**$42,448**			**$43,297**			**$44,163**			**$45,046**	**$208,162**
Inspections				**$43,482**			**$44,352**			**$45,239**			**$46,143**			**$47,066**			**$48,008**			**$48,968**	**$226,282**
Other Expenses				**$58,894**			**$60,072**			**$61,273**			**$62,499**			**$63,749**			**$65,024**			**$66,324**	**$306,487**
Activity Grand Total			**2,687**			**2,687**			**2,687**			**2,687**			**2,687**								**13,435**
Annual Cost Grand Total				**$760,080**			**$777,907**			**$796,221**			**$815,039**			**$834,379**			**$854,257**			**$874,693**	**$3,983,626**

Table 23. A Suggested Seven-Year Capital Budget for Thunder Bay

Activity	Diameter Class	2012			2013			2014			2015			2016			2017			2018			Seven Year Cost
		Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	Cost/Tree	# of Trees	Total Cost	
Contractor Pruning (unit cost increase at 2% per year)	0-15 cm	$55	0	$0	$56	0	$0	$57	0	$0	$58	0	$0	$60	0	$0	$61	0	$0	$62	0	$0	$0
	16-30 cm	$75	162	$12,150	$77	162	$12,393	$78	162	$12,641	$80	162	$12,894	$81	162	$13,152	$83	162	$13,415	$84	162	$13,683	$63,229
	31-45 cm	$115	134	$15,410	$117	134	$15,718	$120	134	$16,033	$122	134	$16,353	$124	134	$16,680	$127	134	$17,014	$130	134	$17,354	$80,194
	46-60 cm	$160	63	$10,080	$163	63	$10,282	$166	63	$10,487	$170	63	$10,697	$173	63	$10,911	$177	63	$11,129	$180	63	$11,352	$52,457
	61-75cm	$235	26	$6,110	$240	26	$6,232	$244	26	$6,357	$249	26	$6,484	$254	26	$6,614	$259	26	$6,746	$265	26	$6,881	$31,797
	76-90 cm	$310	11	$3,410	$316	11	$3,478	$323	11	$3,548	$329	11	$3,619	$336	11	$3,691	$342	11	$3,765	$349	11	$3,840	$17,746
	91-105 cm	$410	5	$2,050	$418	5	$2,091	$427	5	$2,133	$435	5	$2,175	$444	5	$2,219	$453	5	$2,263	$462	5	$2,309	$10,668
	105 cm +	$550	2	$1,100	$561	2	$1,122	$572	2	$1,144	$584	2	$1,167	$595	2	$1,191	$607	2	$1,214	$619	2	$1,239	$5,724
Activity Total(s)			**403**	**$50,310**		**403**	**$51,316**		**403**	**$52,343**		**403**	**$53,389**		**403**	**$54,457**		**403**	**$55,546**		**403**	**$56,657**	**$261,815**
Contractor Training Pruning (unit cost increase at 2% per year)	0-15 cm	$55	191	$10,505	$56	191	$10,715	$57	191	$10,929	$58	191	$11,148	$60	191	$11,371	$61	191	$11,598	$62	191	$11,830	$54,668
Activity Total(s)			**191**	**$10,505**		**191**	**$10,715**		**191**	**$10,929**		**191**	**$11,148**		**191**	**$11,371**		**191**	**$11,598**		**191**	**$11,830**	**$54,668**
Total Pruning Figures			**594**	**$60,815**		**594**	**$62,031**		**594**	**$63,272**		**594**	**$64,537**		**594**	**$65,828**		**594**	**$67,145**		**594**	**$68,488**	**$316,484**
Special Project Tree Planting (unit cost increase of 5% per year)	Tree Purchase & Plant (60mm)	$350	214	$74,900	$368	214	$78,645	$386	214	$82,577	$405	214	$86,706	$425	214	$91,041	$447	214	$95,593	$469	214	$100,373	$413,870
Total Planting Figures			**214**	**$74,900**		**214**	**$78,645**		**214**	**$82,577**		**214**	**$86,706**		**214**	**$91,041**		**214**	**$95,593**		**214**	**$100,373**	**$413,870**
Updated Tree Inventory and Software	3 year project		6090	$32,000		6090	$32,000		6090	$32,000													$96,000
Total Inventory Figures				**$32,000**			**$32,000**			**$32,000**													**$96,000**
Annual Cost Grand Total				**$167,715**			**$172,676**			**$177,849**			**$151,243**			**$156,870**			**$162,738**			**$168,861**	**$826,353**

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9.4 Urban Forest Management 10-Year Work Plan

While the objectives and strategies outlined previously should be considered as work elements for the initial 5-year period, most of these same elements will occur for a period longer than 5 years. However, in particular, Thunder Bay should have the following elements as part of the 10-Year Work Plan (specific strategies will need to be developed based on the accomplishments, lessons learned, and resources available beginning in Year 5):

2017-2021

- In Year 5, revise and update the first five-year work plan to create a new short-term plan that guides the program through Year 10. The revisions will be based on accomplishments of the first plan, staffing and funding resources now available, and in response to any changes in management priorities or environmental threats/issues such as insect and disease problems.
- Continuously update the tree inventory data and productivity data to assess the progress of achieving a seven-year pruning cycle and adjust cycle length if needed.
- In Year 10, consider conducting another Urban Tree Canopy study to assess progress with respect to achieving canopy coverage goals,
- In Year 10, consider performing an update, comprehensive inventory of existing public trees and planting sites.
- In Year 10, perform an operational review and a staffing, equipment and funding analysis of the urban forestry program to track progress and create a needs assessment since the 2011 Urban Forestry Management Plan.
- Recalculate the City's urban forestry program benefit-cost ratio using updated benefit and cost calculations in i-Tree Streets software (or a compatible program)
- Continue to investigate any new technologies available for data management, communication equipment, or operating equipment.

9.5 Urban Forest Management 20-Year Work Plan

The objectives and strategies outlined previously collectively define the City's 20-Year Work Plan. In particular, these objective should be met and tasks completed to determine the success of the urban forest management program in becoming a sustainable and valuable public service.

2022-2031

- Revise and update detailed operational and administrative work plan every five years.
- Establishment of a systematic program should be complete by Year 20. Determine if the maintenance cycle is appropriate or needs to be adjusted.
- Recalculate the City's urban forestry program benefit-cost ratio using updated benefit and cost calculations in i-Tree Streets software (or a compatible program) every 5 to 10 years, or after significant changes have occurred to the forest resource or within the urban forest management program.
- Assess progress with achieving canopy coverage goals, especially along primary boulevards and in wards and land use types with low canopy coverage. Perform a tree canopy study every 10 years.

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- Perform an operational review and a staffing, equipment, and funding analysis of the urban forestry program every 10 years to track progress.
- Adapt public outreach and education materials and delivery methods to current issues and technologies.
- In 2022, update the 2011 Urban Forestry Master Plan.

Justifying the Work Plan

Benefit-Cost Analysis of Urban Forest Management in Thunder Bay

City trees provide Thunder Bay with a multitude of environmental benefit including mitigating stormwater runoff; conserving energy; improving air quality; and reducing carbon dioxide levels. Trees also provide other intangible benefits such as economic, social, psychological, and wildlife enhancements.

These benefits are maximized when the City has a sustainable program to manage its publicly owned trees, and supports that program with adequate funding. Benefits should exceed the costs associated with managing public trees in order for a program to be truly sustainable and deliver best value to the taxpayers.

Table 5 provided a review of the analysis of benefits and costs associated with Thunder Bay's public trees that are included in the current inventory. It is important to note that the City of Thunder Bay receives $2.21 in benefits for every $1.00 that is spent in its forestry program.

This analysis suggests that there is justification for increased funding for urban forestry planning, design, management, and maintenance at the City of Thunder Bay. As the City's public tree population ages, it will require more care, but the benefits will increase. The Work Plan includes action steps and projects that will make both the City's urban forest and the management program more sustainable and will ensure that benefits produced by the City's trees surpass the cost of managing them and that tree benefits will continue to flow steadily to the community.

Street trees add value to residential and commercial districts.

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Planning to enhance City of Thunder Bay's trees will require careful consideration of budget and time. Short and long-term goals must be kept in mind and routine maintenance must be performed on a cyclical basis to ensure good health and condition of trees as they mature.

The City should ensure that their relatively young population of trees is cared for in order that it yields maximum benefits over a lengthened lifespan. Larger-growing, mature trees are the lead benefit producers; therefore, some emphasis should be placed on planting and maintaining larger species within the population.

Planning for a greener and healthier city can begin by including urban forestry in all City improvement project discussions and considering innovative ways to ensure that Thunder Bay's urban forest is kept healthy, safe and ever-increasing for the community.

Community and Staff Support for Enhanced Urban Forestry Services

The City of Thunder Bay staff sought public consultation and feedback as part of preparation of the Urban Forest Management Plan. The community of Thunder Bay responded with large turnout and overwhelming support for preservation and expansion of their urban forest, and investment in their trees. Environmental, health, psychosocial, beautification, economic development, and noise reduction were often noted benefits. City staff, stakeholders, and citizens share a high degree of knowledge, volunteerism, and support for Thunder Bay's urban forest.

The financial benefit-cost analysis clearly supports further investment in Thunder Bay's trees. Above and beyond the financial benefits to taxpayers, the Thunder Bay community strongly wants more trees, particularly on arterial streets, better tree protection, and trees included in the planning process.

One citizen provided a comment that synthesizes the thoughts of so many:

> *"'Superior by Nature' should be reflected within the City itself…benefits include increased tourism, beautification, neighbourhood high property value, and habitat for animals that supports urban ecology."*

The balancing of municipal budgets and many competing priorities is a very difficult role for elected officials and staff. Investments must be made with greatest benefits for the community, and wisely planned to capture efficiencies in the delivery of public services. The community of Thunder Bay very strongly supports increased investment in Thunder Bay's urban forest.

EarthWise® Thunder Bay's mission is to "Focus the energy, involvement and collective wisdom of the community to secure the environmental health of our region, and thereby improve the social and economic well-being of future generations". The collective wisdom strongly supports enhanced stewardship and greening of Thunder Bay.

One community member summed up the common sense support for investing in Thunder Bay's urban forest with, "As long as it's done wisely." The *Urban Forest Management Plan* cost-effectively improves the quality of life, health, and environment for citizens while enhancing City image and helping to attract and promote business development. A plan that generates benefits that reach every citizen, while improving operational efficiencies, is indeed a wise plan for the future of Thunder Bay's urban forest.

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Issue

- Ongoing support, implementation and tracking of progress of the Urban Forest Management Plan is necessary.

Recommendations

- 141. Create an annual State of the Urban Forest Report and present it to Council, the City Manager, and citizens of Thunder Bay. Incorporate the Plan's accomplishments and status into Trees Thunder Bay's annual *Urban Forest Report Card* process.
- 142. Annually evaluate the Plan's implementation progress and need for adjustments by:
    - Assessing progress towards meeting the Plan's short-term goals and objectives
    - Assessing how effectively routine operations and special projects are contributing to meeting the Plan's goals
    - Identifying and documenting gaps and issues as they arise ensuring the Plan's recommendations
- 143. Create a committee of stakeholder representatives to advise on the Urban Forest Management Plan's implementation and urban forest, open space and other environmental priorities in the City.
- 144. Every five years and not less than 10 years, evaluate the UFMP as a whole. This more intense evaluation will reveal if there are new issues and priorities that should be addressed, and demonstrate whether the Plan has achieved its long-term goals and objectives.

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Table 24. Summary of Recommendations

	Recommendations	Priority
1	Increase diversity of Thunder Bay's urban forest. Best management principles recommend that no more than 20 percent of urban forest should be of a single genera; with not more than 10 percent of a single species.	High
2	Trees to be planted under overhead utility lines must be of species whose ultimate height at maturity does not exceed 6m.	High
3	Maples should be planted only when historic character warrants it, until the genus and species distribution adjusts.	Medium
4	City staff should regularly check the status of tree trials conducted by the Western Nursery Growers Group for new introductions that show good hardiness.	Medium
5	Update the current tree inventory to provide more accurate and useful data upon which to base planning decisions. Current inventory did not take into account tree risk assessments, which is an industry standard primary tool for cost-efficient planning of cyclical pruning programs, and of critical importance to Forestry staff who are tasked with managing public safety.	High
6	Update the current tree inventory in advance of establishing a cyclical, or grid pruning program.	High
7	Invest in tree management software developed specifically for urban forestry management.	High
8	Structural pruning of young trees pays off well in the long run, with less costly pruning required, and less damage due to public property resulting from weak unions. Continue to promote the Citizen Pruner Program; it is an excellent community program which provides excellent returns.	High
9	Tree inventories should be updated at intervals of not more than 10 years, to capture changes in tree structure, health and potential issues.	Medium
10	Ensure inventory is updated as removals occur to provide ease of preparation of tender documentation for contractors for stump removals.	Medium
11	The small percentage of trees found in poor or dead condition indicates that Thunder Bay has done a good job addressing trees when considered hazardous and in need of immediate pruning or removal. The City should continue to improve its population's tree condition by correcting all trees with serious structural deficiencies that pose risk, and those trees showing very poor health, through appropriate tree maintenance activities and by removing and replacing all poor and dead trees.	High
12	Continue to invest in extending the health of Thunder Bay's larger trees by routine pruning and inspections. Larger trees provide the most benefits to the community, and are the most significant contributors to the urban canopy cover.	High
13	The size class distribution of the inventoried tree population illustrates that Thunder Bay has done a good job planting young trees. However, with only 7 percent mature trees, investment in larger trees needs to be a priority. The planting of large-stature trees should continue.	Medium
14	Continue to update tree species selection lists. As new cultivars are developed or existing species are identified as tolerant of Thunder Bay's harsh climate, they should be added to the list. Alternatively, factors may develop that create the need to remove species that are currently on the list, such as insect or disease threats. While the list should be used as guidance for what is acceptable in certain planting situations, there may be good cases made to consider additional species for use.	Medium
15	Select species for future plantings that are tolerant of the Thunder Bay growing environment, including those that exhibit stronger tolerance for extended dry periods.	Medium
16	Begin tracking all annual urban forest management costs more accurately.	High
17	Complete the inventory of all public trees including parks, and update attributes of existing trees in the inventory to reflect growth differences from the 2000-2001.	High

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Table 24. Summary of Recommendations (Continued)

	Recommendations	Priority
Section 3 - Costs of Managing the City of Thunder Bay's Urban Forest		
18	Re-run the i-Tree Streets benefit-cost analysis with the more accurate and complete information incorporating updated inventory records.	Medium
19	Begin a focused effort to plant and maintain large-canopied trees. Larger species sustain the environmental benefits.	Medium
20	In the transition period between planting new large canopied trees and encouraging the growth of existing shade trees currently in the small- to medium-diameter ranges, preserve as many mature silver maple and green ash trees as practical and as risk tolerance allows.	High
Section 4 - Municipal Forestry Management and Administration		
21	Staff performing forestry work should report to the proposed Leadhand/Arborist position, and there should be clear channels of authority and responsibility for tasks assigned by the City Forester.	High
22	Create a solid identity for the Urban Forestry Section.	High
23	The recently created Forestry Supervisor position and the proposed Leadhand/Arborist positions may also create the need to reallocate job duties of the City Forester and the Urban Forestry Program Specialist.	High
24	All individuals who perform tree related activities should become Certified Arborists or Tree Workers.	High
25	Continue a regularly scheduled and documented safety program.	High
26	Train a minimum of one, three person crew in advanced tree climbing skills in case of aerial rescue situations.	Medium
27	Explore partnering with Thunder Bay Hydro on mutually valuable training topics.	Medium
28	The City Forester should achieve and maintain the ISA Municipal Specialist designation.	Medium
29	The City Forester should attend an annual urban forestry conference to learn from speakers, peers, and colleagues. Information learned should then be presented to Forestry staff.	Medium
30	Increase networking and opportunities to interact.	Medium
31	Create a specific budget line item that provides dedicated funds for training and professional staff development.	Medium
32	Explore government funding assistance to employers available through arborist apprenticeship programs.	Medium
33	Continue planned regular inspections and documentation of all forestry equipment.	High
34	Designate Lead Harnd/Arborist as responsible for equipment maintenance and records.	Medium
35	Maintain a supply of climbing materials to properly equip tree climbing crews.	High
36	Develop protocol that includes City Forester during construction planning for all City property projects.	High
37	Update tree protection standards and enforce compliance.	High
38	Recognize trees as a vital component of "Green Infrastructure" to be included on all municipal projects.	High
39	Forestry staff should be recognized as a professional service who provides input and is consulted on all tree related issues in the City.	High
40	Develop a policy to address the loss of trees from municipal operations.	Medium
41	Staff and contractors involved with municipal construction projects, should be provided training about tree protection during construction activities.	High
42	Project managers should receive additional training regarding tree protection measures. Project managers need to be held accountable for enforcing tree protection on construction projects.	High
43	City Forester should present an educational session regarding tree protection to the Engineering and Development and Construction staff.	High

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Table 24. Summary of Recommendations (Continued)

	Recommendations	Priority
Section 5 – Municipal Forestry Operations Evaluation		
44	Reduce the number of potential options for tree planting request types from property owners.	Medium
45	Update City Forestry website to include cut-off date for placing request for tree to be planted on boulevards.	Medium
46	Street tree planting should be contracted out via City tender process and include a two-year guarantee period.	High
47	City Forester/Urban Forestry Program Specialist should inspect the work of tree planting contractors to ensure compliance with contract specifications.	High
48	Ensure newly planted trees are watered regularly during the critical period of establishment of two years.	High
49	Develop a system for entering newly planted tree locations in the City's current inventory system.	High
50	Update tree planting standards to include exposing root flare.	High
51	Develop a protocol to maintain a separate inventory of trees on private developments that were planted per requirements of the City's site plan control process and inspect them for survival.	High
52	Develop options to improve viability of trees planted as part of new development, including requiring contractors to provide watering of newly planted trees.	Medium
53	Urban Forestry Specialist prepare innovative program proposals for consideration for internal funding such as "Clean, Green & Beautiful" initiatives.	Medium
54	Establish an overall citywide goal of 50 percent tree canopy cover.	High
55	Increase tree canopy in the urban boundary area of Thunder Bay with particular emphasis on the McKellar, Northwood, and Westfort wards.	High
56	Develop a policy that more trees will be planted each year than will be removed.	High
57	Comprehensive urban design guidelines which include tree planting as part of streetscaping should be considered.	Medium
58	Develop specific plans for the inclusion of appropriate tree planting on image routes, including Red River Road (north core); Arthur Street (south core); and Algoma, Memorial, and May Streets. Arterial streets and urban core should be considered priority action areas.	High
59	Develop a policy for property owners who want to prune street trees adjacent to their homes or businesses. Consider having the City perform all pruning (no pruning of street trees by property owners).	Medium
60	Develop a systematic, regularly scheduled tree maintenance program including cyclical pruning, young tree train and regular inspections.	High
61	Establish a cyclical tree pruning program that will create efficiencies and reduce costs associated with pruning and removals.	High
62	A tree inventory should be done, at a minimum, every 10 years to capture information regarding tree health and potential structural issues.	High
63	City Forester or Lead Hand/Arborist can efficiently validate tree removal reports generated by inventory software.	Medium
64	Contract out all stump removals via City tender process.	Medium
65	Ensure inventory is updated as removals occur to provide ease of preparation of tender documentation for contractors regarding stump removal.	High
66	Current municipal guidelines in Thunder Bay's *Guidelines and Specifications for Planting of Municipal Trees and Shrubs* are adequate for mulching newly planted trees and should be adhered to for all plantings.	High
67	Ensure newly planted trees are watered regularly during the critical period of establishment of two years. Watering should be included as a requirement of contracted tree planting services.	High
68	Consider hiring a part-time summer employee and equip them with a small truck or lawn tractor, water tank, pump and hose, for watering young trees in City parks and open spaces.	Medium

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Table 24. Summary of Recommendations (Continued)

	Recommendations	Priority
Section 5 – Municipal Forestry Operations Evaluation (Continued)		
69	Consider a test trial of "gator" watering bags for use in parks.	Low
70	Prepare a detailed emerald ash borer (EAB) strategy that will prepare Thunder Bay for the arrival of this devastating insect.	High
71	EAB warning notices, identification guides, and warnings against movement of firewood should be posted on the City's Urban Forestry website.	High
72	Continue to monitor regional and national information about pest threats and what other communities are doing in terms of planning and response.	High
73	Plant diverse species, as noted in Genus and Species Recommendations to mitigate the impact of the urban forest when invasive species arrive, or other factors such as climate change impact tree health.	High
74	Explore partnerships with local companies who purchase wood products.	Medium
75	Develop a city-owned collection yard.	Medium
76	Consider processing wood residue and creating materials it can then market, to generate revenues. Processing can include the typical tub grinder operation for converting wood residue into mulch and compost, or using portable, band saw-type sawmills for converting higher quality logs into lumber.	Medium
77	The facility for wood residue can be managed to handle publicly generated wood only, or can be set up as a fee collection facility that handles wood residue for private contractors, or both.	Medium
78	Undertake a systematic tree inventory that includes risk ratings performed by professional, certified arborists.	High
79	Update the current tree inventory to provide more accurate and useful data upon which to base planning decisions. Current inventory did not take into account tree risk assessments.	High
80	Complete the inventory to include all public trees and available planting sites.	High
81	Commit to full updates of the inventory at least every 10 years, and subsequently update continuously to capture changes in tree structure, health, and potential issues.	Medium
82	Employ full-time, ISA certified staff or Certified Arborist contractors to increase the accuracy of data collection and provide risk assessments.	High
83	Include primary and secondary maintenance information when collecting tree data.	High
84	Prior to any future inventory, evaluate potential data quality against the ISA Best Management Practices for Tree Inventories.	High
85	Update the current tree inventory in advance of establishing a cyclical, or grid pruning program.	High
86	Invest in tree management software developed specifically for urban forestry management.	High
87	Utilize tree data collection and tree management software to collect, store, and utilize tree data.	High
88	Compare tree management software by various suppliers to ensure functionality, ease of use, and reporting capabilities to maximize efficiencies and effectiveness of the software.	High
89	Invest in hand held PDA's or tablet personal computers to allow field updates by City staff.	Medium
Section 6 - Budgets		
90	Create a more accurate system of tracking costs for urban forestry related activities.	High
91	Develop short term capital projects to create operational efficiencies.	High
92	Create a specific capital budget line item for planned replacement of existing equipment and purchase of new equipment.	High
93	Increase budgets for urban forestry to reflect values cited in planning documents.	High
94	Establish a Thunder Bay Tree Bank support tree planting programs.	Medium
95	Increase the memorial tree purchase cost to cover all associated costs.	Medium
96	Establish a gift donation option on the Forestry web pate.	Low

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Table 24. Summary of Recommendations (Continued)

	Recommendations	Priority
Section 6 – Budgets (Continued)		
97	Explore partnerships with local companies who purchase wood products.	Medium
98	Develop a list of interested parties to be contacted when wood of significance becomes available.	Low
99	The Urban Forestry Program Specialist should continue to explore opportunities for environmental grants and prepare at least 3 proposals per year to secure funds.	Medium
Section 7 – By-laws, Standards, and Policies		
100	Article 2: Philosophy, should be enhanced with content that addresses not only tree preservation but also increased tree establishment and gaining more tree canopy cover.	Medium
101	Consider renaming Tree By-law to Tree Preservation By-law to recognize the intent and reinforce the "Clean, Green and Beautiful" strategy.	Medium
102	Create a list of species not permitted for planting on public property.	Medium
103	Remove provisions for owners of property adjacent to city trees to prune trees of any size, or cut limbs of any size.	Medium
104	Protect trees from injury due to posting of signs or other objects including wires, fasteners, or fixtures, or injuring trees in any way.	Medium
105	Develop and include fines and amounts per Section 391 of the Municipal Act 2011.	Medium
106	Prohibit planting of trees on public property without the written consent of the City Forester.	Medium
107	Change the title of Article 9 of Tree By-law from 'Public Nuisance' to 'Public Hazard.'	Medium
108	In the Tree By-law, include a definition of "tree crown," and in Section 1.01s, revise the sentence to be"…the trunk *or root flare* is totally or partially located…."	Medium
109	Aspects of regulations and enforcement of tree protection measures/guidelines should be made part of the By-law.	Medium
110	Add language to the By-law that addresses concerns about protection of woodland buffers and other natural areas.	Medium
111	Add language that clarifies issue related to "nuisance trees".	Medium
112	Tree By-law articles, sections, and language should be reviewed every 5 to 10 years.	Low
113	A public education effort should be made to acquaint the citizens and businesses in Thunder Bay with the provisions and restrictions of the By-law, and the public consultation should be included in the process prior to any major revisions.	Medium
114	Update species list in the *Guidelines and Specification for the Planting of Municipal Trees and Shrubs.*	Medium
115	Update tree planting standards to include information about identifying and exposing the root flare at the time of planting.	Medium
116	Tree protection standards referenced in the *Engineering and Development Standards* need to include language that provides additional protection for root systems of trees in construction zones.	Medium
117	Add language in the *Engineering and Development Standards* that provides tree protection requirements as part of the site plan review process.	Medium
118	Utilize GIS to map the location of woodland tracts and identify those that create buffers between incompatible land uses. Plan naturalized buffers where appropriate.	Medium
119	Create policies that will guide land use decisions for publicly owned woodland buffers.	Medium
120	Make tree preservation a more significant part of the plan/site review process and ensure that the Urban Forester has an official role in all phases of site development.	Medium
121	Require a comprehensive tree preservation and/or landscape plan be developed for all public projects where trees are present.	Medium
122	Adopt a "nuisance tree" policy that can be equitably applied and enforced city-wide.	Medium

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Table 24. Summary of Recommendations (Continued)

Recommendations		Priority
Section 7 – By-laws, Standards, and Policies (Continued)		
123	City policies and standards should be reviewed every 5 to 10 years, unless a dramatic change in the resource, technology, and/or industry standards occur prior to the scheduled review.	Low
124	A public education effort should be made to educate property owners in Thunder Bay with the existence and value of the current standards and policies.	Medium
125	Adopt soil volume specifications for tree planting.	Medium
Section 8 – Public Relations and Education		
126	Create a professional, comprehensive communications plan.	Medium
127	Develop a central, unifying theme or message for the urban forestry program that the City and all stakeholders can use.	Medium
128	Continue public and citizen urban forestry outreach efforts through a wide variety of media outlets, special events, and publications to instill a sense of civic pride and gain financial and political support for the program.	Medium
129	Create an educational program for orienting newly elected public officials to the City's urban forestry program, efforts, and goals.	Medium
130	Promote internal educational opportunities by increasing professional interaction, coordination, and communication between departments and staff.	High
131	Market the urban forestry successes outside to other municipalities, the Province, and across the country. A widespread and heightened awareness of the quality of the urban forest and of life in Thunder Bay promotes economic development and tourism. Partner with Tourism Thunder Bay.	High
132	Update Urban Forestry web page to include photos of recommended trees for planting.	Low
133	Update the Urban Forestry web page to include information about cyclical pruning, maps of zones, and schedules.	Medium
134	Widely disseminate the i-Tree benefits results to demonstrate the environmental impact and value of trees to internal and external customers.	High
135	Encourage public participation and input in forest management in Thunder Bay after the Plan is adopted through workshops, feedback surveys, and forming special project/issue committees.	Medium
136	Encourage Trees Thunder Bay for hands-on demonstration tree planting and maintenance activities on streets around schools.	Medium
137	Partner with ISA Ontario Chapter and the Ontario Commercial Arborist Association to enlist their help to disseminate information on City projects/programs and tree benefits; host the annual Tree Climbing Championship or collaborate on an Arbor Day event.	Medium
138	Engage more local and regional tree care, landscape, and nursery companies in communication efforts; ask them to display and distribute City program information to their customers; offer discounts to Thunder Bay property owners at special times; and host training workshops.	Medium
Section 9 – Implementation of Municipal Forestry Action Plan		
140	Management plans should be created for the various buffer areas.	Medium
141	Create an annual State of the Urban Forest Report and present it to Council, the City Manager and the citizens of Thunder Bay.	High
142	Annually evaluate the Plan's implementation progress and adjust accordingly.	High
143	Create a committee of stakeholder representatives to advise on the Urban Forest Management Plan's implementation.	High
144	Every five years, and no less than every ten years, evaluate the Plan as a whole.	Medium

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Appendix A
Public Consultation
Public Survey Results

Survey results and highlights of comments provided by citizens responding to the web-based survey (22 respondents) in addition to the 35 surveys provided at the public meeting, and 2 surveys returned by Councillors, are shown below. Note: numbers may not be exact totals as some surveys were partially filled in.

The Value of the Urban Forest to the Community

Question: "Do you think the citizens of Thunder Bay value the City's urban forest?"

Yes: 40 No: 17 Uncertain: 2

Very strong support indicated by participants. Comments indicated that the choice "No" indicated that people did not value the urban forest enough, or that City management did not value the urban forest.

Question: "What do you think the annual dollar value of the benefits provided by Thunder Bay's urban forest is to the citizens of the City?"

$0.5-1.0M: 7 respondents $1.5-2.5M: 39 respondents Uncertain: 8

The majority of respondents valued the benefits provided by Thunder Bay's urban forest at over $1.5 million annually.

Comments:

- City politicians need to be better educated about the importance of trees.
- Council needs to understand this is good for business.
- City support; much of it is lip service. They think trees are "nice" but dispensible…evidenced by hundreds of trees cut down in Marina Park to make way for a developer to build condos and a hotel, or the forest along McIntyre floodway being cut for buildings.
- "Superior by Nature" should be reflected within the City itself…benefits include increased tourism, beautification, neighbourhood high property value, habitat for animals that supports urban ecology.
- Link urban forestry to tourism.
- Due to abundance of forests just outside of the city's borders, I feel that citizens of Thunder Bay do not value the urban forest as much…however, I feel that it is still important to have access to green space and areas within the city which enriches the lives of citizens.
- Need ad campaign to show actual cost/benefits of trees.
- Look forward to recommendations regarding education.
- Educate citizens about the health benefits of the urban forest…the psychosocial benefits…link to health organizations.

The Planning Process

Question: Do you think the City's planning process should involve input from the City Forester when trees may be impacted?

No: 0 Yes: 57 Uncertain: 1

Virtually unanimous support for the City Forester being consulted and having a degree of authority during the planning process. This section received more feedback than any other, indicating strong support for updating bylaws, proactive planning, increased tree planting by developers, and the need for more trees along arterial streets.

Comments:

- We have lost large portions of our urban forest recently to huge projects like hospital, federal building on Balmoral…with Golf-Links/Junot corridor development project, we have an opportunity to ensure the urban forest is an integral part.
- The Complete Street concept is non-negotiable for Junot corridor and image routes.
- City must plant trees along arterial streets where there are no citizens to request.
- The removal of trees along Memorial by the City has always bothered me…their replacement was assured but never happened…"Memorial" comes from the trees planted in honour of people that died in the war. As a young man in the City, I am always bothered by this.
- Need subdivision and business planning standards.
- Update public bylaws.
- Room for trees needs to be made in all City planning and not an afterthought.
- Need to get Engineering onside in revising City Engineering standards. Also coordinate Urban Design guidelines and Streetscaping Guidelines.
- City Planning department should have a forester on staff.
- Get rid of cash-in-lieu of parkspace for subdivisions.
- All future projects should include input regarding how trees will be incorporated into plan…industrial parks, big box parking lots, parks, residential streets.
- Develop strategy that trees planted by developers get adequate support.
- Ensure City staff have power to uphold site plan requirements re: landscaping.
- I support a bylaw requiring new firms to landscape properties and existing firms to improve theirs over time.
- Plant trees in cooperation with business.
- Plant more trees but not near City sewers regarding roots plugging sewers.
- Put in budget for 10- to 20-year plan.

Current Level of Service

Question: Do you think the City Forestry crews' responsiveness to citizens' requests for pruning or tree maintenance is adequate?

No: 29 Yes: 26 Uncertain: 13

This question received the highest number of uncertain responses, indicating that many people could not comment as they had not requested services personally. Some comments that indicated "yes" also noted that the "they are doing the best they can within limited budget". Several people indicated room for improvement but noted the good work provided by staff.

Comments:

- I know that our City Forester is understaffed because she is always busy when I call.
- We need more resources there; they do a good job with the number of staff they have.
- New hire seems to have limited value… Urban Forestry Specialist …whose main role is media involvement.
- City would benefit by having ISA arborists on staff.
- No ongoing health assessments, pruning for aesthetics or proactive measures being taken.
- Tax dollars spent on contracting out to local arborists who have no real accountability to tax payers.
- Lack of biodiversity in tree species.
- City Forester is very reactive due to lack of supporting staff (arborists).
- Forester and her team work hard but do not receive enough support from the City.
- No provision for watering! If we can flood dozens of rinks, can we not water our urban trees?
- Citizen pruning excellent.
- City Parks Division does an amazing job.
- Thunder Bay Fire Rescue has partnered with the MNR Firesmart program where we go into areas and clean up deadfall and undergrowth that would create a fireload to fuel fire damage

Costs

Do you recognize that operational costs such as watering, pruning, etc should be funded to support enhanced tree planting initiatives?

No: 1 Yes: 56 Uncertain: 1

Are you willing to consider investing in sustainable urban forest management practices that help make Thunder Bay clean, green, and beautiful?

No: 1 Yes: 55 Uncertain: 0

Overwhelming public support for enhanced tree planting initiatives and funding to provide those services.

Comments:

- Budget should be $2-$4M.
- I would support initiatives to increase funding to the City urban forestry programs.
- More funding and more staff needed to improve the urban forest through pro-active management.
- I am willing to invest if publicized as part of the strategic plan.
- As long as done wisely.
- Via city taxes.

"Yes" to pruning, but "no" to watering…I have not watered my yard or washed a vehicle at home for 5 years.

Enhanced Tree Planting Initiatives and Beautification

Question: Should more trees be planted on arterial streets in the urban core?

No: 2 Yes: 51 Uncertain: 1

Question: Should more trees be planted on subdivision streets?

No: 4 Yes: 44 Uncertain: 1

Question: Do you feel Thunder Bay should move toward establishing a canopy cover goal, as several Canadian cities have done?

No: 2 Yes: 55 Uncertain: 2

Overwhelming support for enhanced tree planting initiatives, particularly on the arterial streets and urban core. Some respondents indicated subdivision streets to be of secondary importance compared to urban core and arterial streets.

Comments:

- Primary arteries (Arthur, Memorial, Red River) lacking boulevard trees and have surplus paved surfaces.
- More trees should be planted along arterial streets and carefully maintained.
- If we want to be known as "Gateway to the North", we really need to clean up our appearance…Arthur St, Red River Rd, and Memorial Ave is depressing. All you see is concrete…we look cheap…There is a reason everyone from Thunder Bay goes and weekends in Duluth and not the other way around,,,
- Lots of trees should be planted on corner of John and Junot.
- Please don't take trees down on Junot across from new EMS – people need the noise barrier.
- Canadian and international tour groups…some suggest more mature trees, particularly in commercial areas would make them more appealing…
- Puzzlement on why national and multinational firms that have appealing landscapes elsewhere are anything but appealing here…we should demand that businesses improve their properties and plant and care for more trees.
- Yes, but the right kind of trees which do not grow into power lines or whose roots damage underground utilities such as natural gas, water, sewer telecommunications and hydro.
- Trees need to be planted along streets where trees are absent.
- There is value in keeping bush within the City.
- We do need more trees.
- Some street trees would be a detriment to downtown core (respondent supported enhanced planting on urban streets, but with caution regarding species selection).

Stakeholder and City Staff Input and Survey Results

Survey results and highlights of comments provided by stakeholders and City staff interviewed are noted below. 12 Surveys were returned.

The Value of the Urban Forest to the Community

Question: "How important is the urban forest to you? What is your opinion of the value of public trees?"

Consistently expressed, by both internal and external stakeholders, is the high value of the urban forest to the community. This value is supported by the extensive participation of volunteer groups and stakeholders such as Lakehead University Forestry professors, Earthwise® Thunder Bay, Citizen Pruners, Firesmart and the Stewardship Council.

Comments:

- Very important. Public trees help to beautify City landscapes and help to provide a sense of community for its inhabitants. A healthy urban forest reflects citizens' commitments to that community. Cities with a poor urban forest and /or few trees are quite ugly presenting a poor image to any visitor.
- I think having trees (especially mature trees) in the City is important because it makes the City look more attractive and makes it more comfortable to be in.
- Public trees are extremely important to quality of life and environmental sustainability.

The Planning Process

Question: "What are the most important issues related to trees and land development/economic growth in Thunder Bay?"

This section received more feedback than any other, indicating strong support for updating bylaws, proactive planning, increased tree planting by developers, and the need for more trees along arterial streets. City staff, stakeholder groups including Thunder Bay Hydro, contractors expressed concern that the City's tree canopy will shrink unless more tree protection by-laws are implemented. Much concern also expressed regarding more stringent rules to require, and to subsequently enforce increased tree planting and aftercare by developers. Very strong support for trees to be included in all new street designs during the planning process, and improved tree protection during construction and development. Co-operation between Engineering and the City Forester is improving, however many people interviewed noted lack of enforcement of tree protection post development and construction.

Comments:

- There is little to no protection (from) developers to prevent development on greenfield vs. brownfield. Developers are also only required to plant a very minimum number of trees and (those) are often substandard. Road construction and reconstruction does not include green infrastructure (trees). City property is not required to include the minimum (number) of trees and is behind even (the) expectations of developers.

- See that guidelines are in place to ensure planting of trees is included in major road construction. Most of the main arteries in Thunder Bay are completely devoid of trees. This does not have to be.
- Far too many trees are removed to accommodate land development within the urban landscape and development is at the …expense of existing trees. Replacement trees that are mandated by City Planning department are generally smaller in caliper and are sparsely located within commercial developments. No replacements seem to be done when one or more of these trees are damaged after the final inspection.
- Perceived cost and being content with low standards and requirements. Lack of preservation culture. Lack of teeth to site plan control and tree preservation.

Question: "Are the City's existing regulations and guidelines (e.g. Article 12 of the Zoning Ordinance, Subdivision and Land Development Regulations, etc…)sufficient to maintain and protect the City's urban forest? If not, what improvements are needed?"

Comments:

- Little effort is made by developers to protect trees on private property when reconstruction is undertaken. Also when development occurs there seems to be only a minimal effort made to "green" up the property.
- On public land it is getting better – higher consequences would be nice. Private tree by-law would be helpful. Things like performance guarantees and development charges would be helpful. As they are not in place of the site plan control yet. Strong urban design guidelines (hopefully will happen late 2011, early 2012).
- No, should require the city forester to inspect and approve trees before subdivision is accepted by city. There is no development protection on greenfields.
- Tree protection bylaw, zoning ordinance, etc. are all fine tools to protect the urban forest if they are applied and followed up.
- More rules with respect to private developers and site plans for residential, commercial and industrial.
- Yes, but more follow up with developers' agreement to plant and maintain trees.
- I think Engineering standards re: roadways and parking lots need to be updated.
- Need to be more efficient, proactive and better technically with the resources we have. Using the hammer with the development community to incorporate and then maintain green infrastructure.

Current Level of Service

Question: "Do you believe the current status of Thunder Bay's urban forestry program (funding, staffing, equipment, regulations) is adequate? If no, what needs more support?

Although participants expressed high regard for the work performed by Parks crews and the office of the City Forester, it is apparent that significant gaps exist in providing services to the community. This is a department lacking expertise and facing challenges as a result. There is a strong need for a structured job hierarchy, with accountability of staff performing tree work to a supervisor with strong technical expertise and field experience. Currently there is a disconnect between the City Forester and Parks crews, with crews regularly dispatched without input from the Forester. Professional staff training is needed, as the skill level of some current staff is low. There is a need for an emergency storm plan, lighting for night work, and equipment such as structural pruning hand tools.

Concern was expressed regarding the value of natural lands to the community and the environment, however current funding prohibits maintenance of natural woodlands.

There is a good working relationship between Hydro and the City that results in savings to citizens, as planning is as proactive as limited staff resources will allow.

Comments:

- Urban forestry needs to be its own department.
- We need permanent staff to maintain and improve the tree inventory…staff requirements for maintenance worker, a full time arborist, and a full time permanent admin assistant.
- Switching from reactive to proactive would be more economical in the long run. Need qualified people to do the work and want to do the work. Staff dedicated to tree work only, not other park duties. The north/south side divide gets in the way sometimes.
- No, (the current status) is not adequate. There needs to be more funding for hiring staff, the purchase of trees for planting, pruning trees and a pruning cycle.
- No. I think we need more staff to effectively coordinate and roll out the forest program into the other departments of the City and with the citizens.
- Restructuring parks to have urban forestry a supervisory/management role, otherwise we just maintain what we have and do not move forward.
- Parks needs more staff to play a more lead role in coordination between departments. Someone needs to define all the interrelated work flows and continually educate and communicate between the departments. The department should be asked to cooperate not to coordinate.

Question: "What are the immediate needs of your community's tree management program?"

Stakeholder feedback included strong support for enhanced planting on City streets, indicating approximately one third of potential planting sites are currently empty. The need to plant buffers along major roads and highways is a recurring theme, as well as planting the right tree in the right place – establishing standards for maximum height and root zone grow space under hydro and around buried utilities. The lack of documentation of routine inspections of trail inspections and pruning was also raised as a concern.

Comments:

- Funds for more trees and maintenance.
- Immediate needs include: 1. A pruning cycle rather than pruning trees as a response to storm damage or citizen complaints (well pruned trees live longer and are less hazardous to the public at large); 2. Plant trees in all available planting spots (too many streets are completely barren in Thunder Bay).
- A right tree, right place program should be examined with input from the utilities that share the same space as the urban forest. Past practices of planting tall growing species under power lines still continues in some locations.
- Assess not just city streets but parks, heritage areas and brown spaces.
- Prepare for EAB, manage loss of birch. Move from reactive to proactive; a watering schedule and increased tree planting.

Public Education and Outreach

Question: "What is your attitude towards the role of municipal government in having a community tree program?"

The work done by the City Forester and staff in Thunder Bay to develop partnerships and volunteer participation is impressive. Work has been done to partner with Earthwise® Thunder Bay and the Stewardship Council. The City has developed an Urban Forestry webpage, and Facebookpages to reach the community, and have initiated Notable Tree Nomination, Tree Stewardship and Community Tree and Bench programs.

Comments:

- The municipal government should lead and co-ordinate the tree program to make sure it is as efficient and effective as possible, with respect to the citizen and municipal workforce.
- Definitely should be most involved with most public trees.
- I strongly support this.
- Think it is vital. We need public buy-in to the idea of an urban forest.

Community/Stakeholder Inclusion in the Planning Process

Public education is one of the keys to reaching the goals of a municipal urban forestry program to create a sustainable urban forest. Public education must target citizens, elected officials, city staff, business owners, developers, contractors, and other stakeholders, Through education, Thunder Bay will be able to achieve community-wide acceptance and support for the expansion, and care of the urban forest.

This education process is dependent upon an effective, engaging, and multi-faceted communications program. The program should be designed to appeal to a broad cross-section of stakeholders, using various communication media. Strategies should also encourage the participation of non-profit groups, schools, citizens and businesses in community forest projects. Simple, concise key messages are key.

The City of Thunder Bay strongly encourages public inclusion in planning processes. To this end, Davey Resource Group conducted a series of meetings with various stakeholder groups, City staff and elected officials. Surveys were provided should participants wish to provide further feedback.

A public meeting provided a forum for education, questions and feedback from citizens. Surveys were provided for further comments, as well as being posted on the City website. Elected officials were provided with the survey and given another opportunity to record commentary and input to the Plan. Highlights of the community and stakeholder inclusion process are outlined as follows:

Meetings and Public Engagement

- Interdepartmental Meetings (May, 2011) – Held with senior management from the Parks, Roads, Engineering, and Planning Divisions, Realty Services, Transportation and Works staff, and the City Manager.
- Elected Officials Communication (September, 2011).
- Community Groups Meeting (May, 2011) – Met with Lakehead Region Conservation Authority, Trees Thunder Bay, Rutter Urban Forestry, Boreal Tree Services, Garden of Eden Tree Services, Confederation College Natural Resources Centre, Lakehead University, School of Natural Resources, Landale Gardens, Ecosuperior, Earthwise® Thunder Bay and Clean, Green, and Beautiful Committee.
- Utilities (May, 2011) – Met with Thunder Bay Hydro, Thunder Bay Telephone, Hydro One, and Union Gas.
- Citizens Engagement (September, 2011) – Conducted an Open House Public Consultation meeting, with Powerpoint presentation.
- Public survey posted on City website (September, 2011).
- Radio interviews conducted with Magic 99.9 and CBC Thunder Bay.

The following recommendations are aimed at continuing the active participation of these groups in the Plan's implementation and future updating.

Recommendations

- Create a committee of stakeholder representatives to advise on the *Urban Forest Management Plan's* implementation and urban forest, open space, and other environmental priorities in the City.
- Create an annual "State of the Urban Forest Report" and presenting it to the Council, the City Manager, and the citizens of Thunder Bay. Incorporate the Plan's accomplishments and status into Trees Thunder Bay's annual Urban Forest Report Card process.
- Annually evaluate the Plan's implementation progress and need for adjustments by:
    - Assessing progress towards meeting the Plan's short-term goals and objectives.
    - Assessing how effectively routine operations and special projects are contributing to meeting the Plan's goals.
    - Identifying and documenting gaps and issues as they arise ensuring the Plan's recommendations
- Every five years, and no less than every ten years, evaluate the Plan as a whole. This more intense evaluation will reveal if there are new issues and priorities that should be addressed, and demonstrate whether the Plan has achieved its long-term goals and objectives.

Appendix B
Inventory Frequency Reports

SPECIES TOTALS

Species	Total	Percentage of Population
green ash	4,667	25.54%
silver maple	3,202	17.53%
american basswood	1,477	8.08%
paper birch	1,406	7.70%
norlin linden	1,151	6.30%
white spruce	772	4.23%
crabapple	731	4.00%
black ash	528	2.89%
manitoba maple	501	2.74%
amur elm	387	2.12%
japanese tree lilac	336	1.84%
chokeberry	303	1.66%
amur chokecherry	247	1.35%
red maple	238	1.30%
amur maple	165	0.90%
norway maple	158	0.86%
bur oak	155	0.85%
red pine	153	0.84%
eastern white cedar	131	0.72%
colorado blue spruce	129	0.71%
dropmore linden	111	0.61%
mountain ash	109	0.60%
scot's pine	105	0.57%
hackberry	86	0.47%
balsam poplar	84	0.46%
sugar maple	83	0.45%
red oak	77	0.42%
jack pine	68	0.37%
n/a	57	0.31%
hawthorn	56	0.31%
siberian elm	54	0.30%
trembling aspen	54	0.30%
apple	53	0.29%
white ash	45	0.25%
willow species	44	0.24%
balsam fir	41	0.22%
white pine	36	0.20%
cherry - wild	34	0.19%
larch	30	0.16%
linden species	27	0.15%
poplar species	22	0.12%

Species	Total	Percentage of Population
eastern cottonwood	22	0.12%
black poplar	15	0.08%
white poplar	13	0.07%
maple species	13	0.07%
butternut	12	0.07%
discovery elm	11	0.06%
mugo pine	11	0.06%
plum - wild	8	0.04%
black spruce	8	0.04%
norway spruce	7	0.04%
serviceberry species	4	0.02%
pear	4	0.02%
amur corktree	4	0.02%
honeylocust	4	0.02%
pin cherry	3	0.02%
poplar	3	0.02%
russian olive	3	0.02%
unkown	2	0.01%
white oak	2	0.01%
speckled alder	2	0.01%
ohio buckeye	2	0.01%
russian mountain ash	1	0.01%
sumac	1	0.01%
western cottonwood	1	0.01%
juniper species	1	0.01%
	18,270	**100.00%**

DAVEY

ThunderBay, ON

Quantity Report: CONDITION_Convert

CONDITION_Convert	*Total*	*Percentage of Entire Population*
Good	15515	84.92%
Fair	1359	7.44%
N/A	1181	6.46%
Poor	169	0.93%
Perfect	39	0.21%
Dead	7	0.04%
Grand Total	*18270*	*100%*

Friday, August 26, 2011

Page 1 of 1

Total Number	Diameter (cm)	Percentage of Entire Population
11	0	0.06%
118	1	0.65%
181	2	0.99%
404	3	2.21%
800	4	4.38%
888	5	4.86%
561	6	3.07%
429	7	2.35%
381	8	2.09%
336	9	1.84%
345	10	1.89%
309	11	1.69%
330	12	1.81%
287	13	1.57%
304	14	1.66%
376	15	2.06%
296	16	1.62%
270	17	1.48%
314	18	1.72%
315	19	1.72%
488	20	2.67%
323	21	1.77%
302	22	1.65%
320	23	1.75%
312	24	1.71%
386	25	2.11%
307	26	1.68%
317	27	1.74%
316	28	1.73%
332	29	1.82%
323	30	1.77%
291	31	1.59%
338	32	1.85%
288	33	1.58%
311	34	1.70%
301	35	1.65%
280	36	1.53%
294	37	1.61%
295	38	1.61%
267	39	1.46%
296	40	1.62%
218	41	1.19%
226	42	1.24%
228	43	1.25%
217	44	1.19%
223	45	1.22%
166	46	0.91%
181	47	0.99%
135	48	0.74%
151	49	0.83%
139	50	0.76%
139	51	0.76%
136	52	0.74%
Total Number	**Diameter (cm)**	**Percentage of Entire Population**

133	53	0.73%
122	54	0.67%
101	55	0.55%
106	56	0.58%
95	57	0.52%
107	58	0.59%
97	59	0.53%
97	60	0.53%
81	61	0.44%
64	62	0.35%
64	63	0.35%
71	64	0.39%
63	65	0.34%
54	66	0.30%
61	67	0.33%
45	68	0.25%
34	69	0.19%
44	70	0.24%
45	71	0.25%
44	72	0.24%
41	73	0.22%
32	74	0.18%
39	75	0.21%
31	76	0.17%
23	77	0.13%
22	78	0.12%
30	79	0.16%
20	80	0.11%
40	81	0.22%
28	82	0.15%
21	83	0.11%
18	84	0.10%
18	85	0.10%
13	86	0.07%
21	87	0.11%
12	88	0.07%
23	89	0.13%
11	90	0.06%
16	91	0.09%
12	92	0.07%
8	93	0.04%
17	94	0.09%
10	95	0.05%
4	96	0.02%
15	97	0.08%
10	98	0.05%
16	99	0.09%
4	100	0.02%
4	101	0.02%
11	102	0.06%
2	103	0.01%
1	104	0.01%
7	105	0.04%
Total Number	**Diameter (cm)**	**Percentage of Entire Population**
6	106	0.03%

6	107	0.03%
3	110	0.02%
5	111	0.03%
4	112	0.02%
3	113	0.02%
2	114	0.01%
3	115	0.02%
1	117	0.01%
1	118	0.01%
1	119	0.01%
3	120	0.02%
1	122	0.01%
1	124	0.01%
1	125	0.01%
2	129	0.01%
1	132	0.01%
1	135	0.01%
1	136	0.01%
1	137	0.01%
2	140	0.01%
1	143	0.01%
1	146	0.01%
1	152	0.01%
1	155	0.01%
1	157	0.01%
2	159	0.01%
1	165	0.01%
1	167	0.01%
1	177	0.01%
1	194	0.01%
1	200	0.01%

Appendix C
i-Tree Methodology

i-Tree Streets

The method used to determine environmental and economic benefit values is the United States Department of Agriculture (USDA) Forest Service's i-Tree Streets software. Streets is a component of i-Tree, a suite of free software tools recently released by the U.S. Forest Service that can be used to assess and manage community forests. With these tools, communities and urban forest managers can accurately quantify the benefits of urban forests to better understand and balance the costs of urban forest management.

Specifically, i-Tree Streets is a tool that quantifies the benefits of street trees and compares them directly with the costs of urban forestry programs to produce accurate net annual benefit values. It is a statistically valid, financially sound, and defensible cost-benefit analysis tool for urban forest managers that may be used with complete or sample inventories.

i-Tree Streets was originally designed to quantify the environmental and economic functional benefit and corresponding value of street trees. The model uses climate data from a reference city in the United States, and hence may not fully account for the specific climate of Thunder Bay. Additionally, data for such things as Air Quality were not known for Thunder Bay and so the default values for the city of Minneapolis were used. However, this program is still relevant to assessing the environmental and economic benefits and values of Thunder Bay's current tree inventory.

i-Tree Streets assesses tree population structure and the function of those trees, such as their role in building energy use, air pollution removal, stormwater interception, carbon dioxide removal, and property value increases. In order to analyze the economic benefits of the City of Thunder Bay's inventoried trees, i-Tree Streets assigns a dollar value to the annual resource functionality and compares that to annual program expenditures. This analysis combines the results of the City's tree inventory with benefit-cost modeling data to produce information regarding resource structure, resource function, and resource value to make informed resource management decisions. For a detailed accounting of how i-Tree Streets handles tree sampling, tree growth modeling, replacement value, and the calculations of annual benefits, refer to the *City of Minneapolis, Minnesota Municipal Tree Resource Analysis*.

i-Tree Streets regionalizes the calculations of its output by incorporating detailed reference city project information for 16 climate zones across the United States. The City of Thunder Bay was compared to the Midwest zone (see map). Sample inventory data from Minneapolis, Minnesota, represent the basis for the Midwest Reference City Project for the Midwest Community Tree Guidelines. The basis for the benefit modeling in this study compares the inventory data from the City of Thunder Bay to the results of the Midwest Reference City Project to obtain an estimation of the annual benefits provided by the City's managed resource.

Growth rate modeling information was used to perform computer-simulated growth of the existing tree population for one year and account for the associated annual benefits. This "snapshot" analysis assumed that no trees were added to, or removed from, the existing population during the year. Calculations of carbon dioxide (CO_2) released due to decompositions of wood from removed trees did consider average annual mortality. This approach directly connects benefits with tree-size variables such as diameter at breast height (DBH) and leaf-surface area. Many benefits of trees are related to processes that involve interactions between leaves and the atmosphere (*e.g.*, interception, transpiration, and photosynthesis); therefore, benefits increase as tree canopy cover and leaf surface area increase.

For each of the modeled benefits, an annual resource unit was determined on a per-tree basis. Resource units are measured as Megawatt-hours (MWh) of electricity saved per tree; one hundred thousand British thermal units (Therm) of natural gas conserved per tree; kilograms of atmospheric CO_2 reduced per tree; kilograms of nitrogen dioxide (NO_2), particulate matter (PM_{10}), and volatile organic compounds (VOCs) reduced per tree; cubic meters of stormwater runoff reduced per tree; and square meters of leaf area added per tree to increase property values.

Prices were assigned to each resource unit using economic indicators of society's willingness to pay for the environmental benefits trees provide. Estimates of benefits are initial approximations as some benefits are difficult to quantify (*e.g.*, impacts on psychological health, crime, and violence). In addition, limited knowledge about the physical processes at work and their interactions makes estimates imprecise (*e.g.*, fate of air pollutants trapped by trees and then washed to the ground by rainfall). Therefore, this method of quantification provides first-order approximations. It is meant to be a general accounting of the benefits produced by urban trees—an accounting with an accepted degree of uncertainty that can, nonetheless, provide science-based platform for decision-making.

For a detailed description of how the default benefit prices are derived, refer to the *City of Minneapolis, Minnesota Municipal Tree Resource Analysis* (McPherson, E. Gregory, et al., 2005) and the *Midwest Community Tree Guide* (McPherson, Gregory E., et al., 2005). In order to further refine the estimation of benefits to the City of Thunder Bay, certain benefit prices were provided by the City of Thunder Bay (see table).

City of Thunder Bay's Benefit Prices Used in this Analysis (CDN $)

Benefits	Price	Unit	Source
Electricity	$0.0735	$/ Kilowatt-hour	City of Thunder Bay
Natural Gas	$0.8778	$/Therm	City of Thunder Bay
CO_2	$0.0073	$/pound	i-Tree Streets default- Northeast
PM_{10}	$2.7917	$/ pound	i-Tree Streets default- Northeast
NO_2	$3.2832	$/ pound	i-Tree Streets default- Northeast
SO_2	$2.0249	$/ pound	i-Tree Streets default- Northeast
VOC	$3.6863	$/ pound	i-Tree Streets default- Northeast
Stormwater Interception	$0.0266	$/ gallon	i-Tree Streets default- Northeast
Average Home Resale Value	$155,060	$	City of Thunder Bay

i-Tree requires these inputs in imperial units. The outputs are automatically converted to metric units.
The local benefit prices for Electricity, Natural Gas, and Average Home Resale Value were provided by the City of Thunder Bay. i-Tree Street's default values from the Midwest Climate Zone were used for all additional benefit values (carbon stored, air quality and stormwater). These values were converted from US dollars to Canadian dollars (exchange rate on Aug 26, 2011). Using these prices, the magnitude of the benefits provided by the street tree resource was calculated using i-Tree Streets. For a detailed description of how the magnitudes of benefit prices are calculated, refer to the *City of Minneapolis, Minnesota Municipal Tree Resource Analysis.*

Appendix D
i-Tree Benefit Analysis

Ontario

Annual Aesthetic/Other Benefits of Public Trees by Species

8/30/2011

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
ash, green	103,139	(N/A)	25.5	25.6	22.13
maple, silver	160,477	(N/A)	17.8	39.8	49.45
basswood, American	14,025	(N/A)	7.9	3.5	9.74
birch, paper	32,375	(N/A)	7.7	8.0	23.03
linden, harvest gold	23,560	(N/A)	6.6	5.9	19.68
spruce, white	10,505	(N/A)	4.2	2.6	13.61
crababpple, pink spire	2,381	(N/A)	4.0	0.6	3.25
ash, black	4,933	(N/A)	2.9	1.2	9.19
boxelder, baron	13,284	(N/A)	2.8	3.3	26.46
elm, American	10,755	(N/A)	2.1	2.7	28.08
Japanese tree lilac	1,717	(N/A)	1.8	0.4	5.14
chokecherry, common	653	(N/A)	1.6	0.2	2.28
chokecherry, amur	198	(N/A)	1.4	0.1	0.80
OTHER STREET TREES	25,053	(N/A)	13.8	6.2	9.91
Citywide total	403,056	(N/A)	100.0	100.0	22.06

Ontario

Annual Air Quality Benefits of Public Trees by Species

8/30/2011

Species	Deposition (kg)				Total Depos. ($)	Avoided (kg)				Total Avoided ($)	BVOC Emissions (kg)	BVOC Emissions ($)	Total Emissions	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2								
ash, green	133.6	21.3	82.5	6.0	1,656	1,274.0	187.0	178.6	1,228.8	17,310	0.0	0	3,111.8	18,965	(N/A)	25.5	4.07
maple, silver	565.4	95.9	291.9	25.1	6,695	1,592.2	233.3	222.8	1,530.9	21,606	-321.2	-2,610	4,236.3	25,690	(N/A)	17.8	7.92
basswood, American	25.0	4.3	16.9	1.1	321	286.8	41.7	39.7	271.4	3,867	-28.7	-233	658.2	3,955	(N/A)	7.9	2.75
birch, paper	147.9	25.5	76.5	6.6	1,755	569.7	82.8	78.9	538.6	7,679	-37.1	-302	1,489.3	9,132	(N/A)	7.7	6.50
linden, harvest gold	63.2	10.8	36.1	2.8	770	427.7	62.2	59.2	404.6	5,766	-62.1	-505	1,004.6	6,032	(N/A)	6.6	5.04
spruce, white	43.7	8.7	38.0	5.4	637	133.7	19.5	18.5	126.8	1,805	-125.9	-1,024	268.3	1,418	(N/A)	4.2	1.84
crababpple, pink spire	12.7	2.1	6.9	0.6	152	89.5	12.7	12.1	81.1	1,186	-0.1	-1	217.5	1,337	(N/A)	4.0	1.83
ash, black	1.5	0.2	1.5	0.1	22	34.2	5.0	4.7	32.5	462	0.0	0	79.6	483	(N/A)	2.9	0.90
boxelder, baron	35.3	5.6	17.5	1.6	411	160.3	23.4	22.3	152.9	2,168	-15.0	-122	403.9	2,457	(N/A)	2.7	4.89
elm, American	28.2	4.8	16.8	1.2	348	191.5	28.0	26.8	183.9	2,597	0.0	0	481.3	2,945	(N/A)	2.1	7.69
Japanese tree lilac	1.0	0.2	1.4	0.1	17	10.4	1.5	1.4	9.2	137	-4.6	-37	20.5	117	(N/A)	1.8	0.35
chokecherry, common	2.5	0.4	1.5	0.1	31	24.3	3.4	3.3	21.8	321	0.0	0	57.3	351	(N/A)	1.6	1.22
chokecherry, amur	0.5	0.1	0.4	0.0	6	8.1	1.1	1.1	7.2	106	0.0	0	18.4	113	(N/A)	1.4	0.46
OTHER STREET TREES	76.9	14.1	54.0	6.1	1,018	329.8	47.7	45.5	309.4	4,432	-130.7	-1,063	752.8	4,387	(N/A)	13.8	1.74
Citywide total	1,137.2	193.9	641.8	56.8	13,838	5,132.3	749.4	714.9	4,899.0	69,441	-725.5	-5,896	12,799.7	77,383	(N/A)	100.0	4.24

Ontario

Annual CO Benefits of Public Trees by Species

8/30/2011

Species	Sequestered (kg)	Sequestered ($)	Decomposition Release(kg)	Maintenance Release(kg)	Total Released ($)	Avoided (kg)	Avoided ($)	Net Total (kg)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
ash, green	570,006	9,174	-22,158	-2,795	-402	454,730	7,318	999,784	16,090 (N/A)	25.5	24.0	3.45
maple, silver	1,138,353	18,320	-59,563	-3,470	-1,014	567,343	9,131	1,642,662	26,437 (N/A)	17.8	39.4	8.15
basswood, American	90,848	1,462	-4,684	-699	-87	100,251	1,613	185,716	2,989 (N/A)	7.9	4.5	2.08
birch, paper	203,271	3,271	-11,827	-1,136	-209	199,063	3,204	389,371	6,266 (N/A)	7.7	9.3	4.46
linden, harvest gold	176,002	2,833	-11,110	-967	-194	149,520	2,406	313,445	5,045 (N/A)	6.6	7.5	4.21
spruce, white	20,687	333	-1,289	-491	-29	46,977	756	65,883	1,060 (N/A)	4.2	1.6	1.37
crababpple, pink spire	27,458	442	-1,119	-291	-23	30,014	483	56,062	902 (N/A)	4.0	1.3	1.23
ash, black	16,280	262	-336	-125	-7	12,022	193	27,841	448 (N/A)	2.9	0.7	0.83
boxelder, baron	94,356	1,519	-5,151	-402	-89	56,631	911	145,434	2,341 (N/A)	2.8	3.5	4.66
elm, American	44,185	711	-3,878	-372	-68	68,022	1,095	107,958	1,737 (N/A)	2.1	2.6	4.54
Japanese tree lilac	843	14	-19	-48	-1	3,409	55	4,185	67 (N/A)	1.8	0.1	0.20
chokecherry, common	7,689	124	-260	-92	-6	8,056	130	15,393	248 (N/A)	1.6	0.4	0.86
chokecherry, amur	2,829	46	-70	-44	-2	2,664	43	5,379	87 (N/A)	1.4	0.1	0.35
OTHER STREET TREES	107,733	1,734	-6,127	-1,016	-115	114,491	1,843	215,081	3,461 (N/A)	13.8	5.2	1.37
Citywide total	2,500,540	40,243	-127,590	-11,948	-2,246	1,813,193	29,181	4,174,195	67,178 (N/A)	100.0	100.0	3.68

Ontario

Stored CO2 Benefits of Public Trees by Species

8/30/2011

Species	Total Stored CO2 (kg)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
ash, green	4,614,181	74,259	(N/A)	25.5	17.4	15.93
maple, silver	12,391,133	199,420	(N/A)	17.8	46.7	61.45
basswood, American	974,478	15,683	(N/A)	7.9	3.7	10.89
birch, paper	2,456,249	39,530	(N/A)	7.7	9.3	28.12
linden, harvest gold	2,314,213	37,244	(N/A)	6.6	8.7	31.11
spruce, white	268,442	4,320	(N/A)	4.2	1.0	5.60
crababpple, pink spire	232,589	3,743	(N/A)	4.0	0.9	5.11
ash, black	69,053	1,111	(N/A)	2.9	0.3	2.07
boxelder, baron	1,068,701	17,199	(N/A)	2.8	4.0	34.26
elm, American	807,454	12,995	(N/A)	2.1	3.0	33.93
Japanese tree lilac	3,687	59	(N/A)	1.8	0.0	0.18
chokecherry, commor	53,832	866	(N/A)	1.6	0.2	3.02
chokecherry, amur	13,885	223	(N/A)	1.4	0.1	0.90
OTHER STREET TR	572,348	20,307	(N/A)	13.8	4.8	8.04
Citywide total	26,529,705	426,962	(N/A)	100.0	100.0	23.37

Ontario

Annual Energy Benefits of Public Trees By Species

8/31/2011

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
ash, green	597.7	43,929	76,988.0	67,580	111,509	(N/A)	25.5	24.5	23.92
maple, silver	745.7	54,807	97,408.4	85,505	140,312	(N/A)	17.8	30.8	43.24
basswood, American	131.8	9,685	18,234.3	16,006	25,691	(N/A)	7.9	5.6	17.84
birch, paper	261.6	19,230	36,293.1	31,858	51,088	(N/A)	7.7	11.2	36.34
linden, harvest gold	196.5	14,444	27,199.8	23,876	38,320	(N/A)	6.6	8.4	32.01
spruce, white	61.7	4,538	8,556.3	7,511	12,049	(N/A)	4.2	2.6	15.61
crababpple, pink spire	39.4	2,900	6,417.6	5,633	8,533	(N/A)	4.0	1.9	11.66
ash, black	15.8	1,161	2,193.1	1,925	3,086	(N/A)	2.9	0.7	5.75
boxelder, baron	74.4	5,471	10,034.2	8,808	14,279	(N/A)	2.8	3.1	28.44
elm, American	89.4	6,571	11,704.9	10,275	16,846	(N/A)	2.1	3.7	43.98
Japanese tree lilac	4.5	329	785.3	689	1,019	(N/A)	1.8	0.2	3.05
chokecherry, common	10.6	778	1,802.9	1,583	2,361	(N/A)	1.6	0.5	8.23
chokecherry, amur	3.5	257	609.2	535	792	(N/A)	1.4	0.2	3.21
OTHER STREET TREES	150.5	11,060	21,603.1	18,963	30,023	(N/A)	13.8	6.6	11.88
Citywide total	2,383.1	175,161	319,830.1	280,747	455,908	(N/A)	100.0	100.0	24.95

Ontario

Annual Stormwater Benefits of Public Trees by Species

8/30/2011

Species	Total rainfall interception (cu.m.)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
ash, green	15,646	109,941	(N/A)	25.5	19.9	23.59
maple, silver	32,819	230,620	(N/A)	17.8	41.8	71.07
basswood, American	2,859	20,090	(N/A)	7.9	3.6	13.95
birch, paper	7,174	50,409	(N/A)	7.7	9.1	35.85
linden, harvest gold	5,362	37,675	(N/A)	6.6	6.8	31.47
spruce, white	3,006	21,122	(N/A)	4.2	3.8	27.36
crababpple, pink spire	528	3,711	(N/A)	4.0	0.7	5.07
ash, black	377	2,653	(N/A)	2.9	0.5	4.94
boxelder, baron	2,572	18,075	(N/A)	2.8	3.3	36.01
elm, American	2,754	19,351	(N/A)	2.1	3.5	50.53
Japanese tree lilac	147	1,032	(N/A)	1.8	0.2	3.09
chokecherry, common	137	962	(N/A)	1.6	0.2	3.35
chokecherry, amur	41	290	(N/A)	1.4	0.1	1.18
OTHER STREET TREES	5,184	36,430	(N/A)	13.8	6.6	14.42
Citywide total	78,606	552,362	(N/A)	100.0	100.0	30.23

Ontario

Total Annual Benefits, Net Benefits, and Costs for Public Trees

10/28/11

Benefits	Total ($)	Standard Error Total	$/tree	Standard Error Per Tree	$/capita	Standard Error Per Capita
CO_2	67,178	(N/A)	3.68	(N/A)	.55	(N/A)
Air Quality	77,383	(N/A)	4.24	(N/A)	0.63	(N/A)
Aesthetic/Other	403,056	(N/A)	22.06	(N/A)	3.28	(N/A)
Energy	455,908	(N/A)	24.95	(N/A)	3.71	(N/A)
Stormwater	552,362	(N/A)	30.23	(N/A)	4.49	(N/A)
Total Benefits	1,555,887	(N/A)	85.16	(N/A)	12.66	(N/A
Cost						
Planting	74,000		4.05		0.60	
Contract Pruning	204,150		11.17		1.66	
Pest Management	1,387		0.08		0.01	
Irrigation	10,000		0.55		0.08	
Removal	198,978		10.89		1.62	
Administration	125,499		6.87		1.02	
Inspection/Service	43,482		2.38		0.35	
Infrastructure Repairs	0		0.00		0.00	
Litter Clean-up	8,564		0.47		0.07	
Liability/Claims	5,637		0.31		0.05	
Other Costs	33,306		1.82		0.27	
Total Costs	705,003		38.59		5.74	
Net Benefits	850,884	(N/A)	46.57	(N/A)	6.92	(N/A)
Benefit-cost ratio	2,2069225	(N/A)				

Ontario

Annual Benefits of Public Trees by Species ($/tree)

8/30/2011

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error
ash, green	23.92	3.45	4.07	23.59	22.13	77.16	(N/A)
maple, silver	43.24	8.15	7.92	71.07	49.45	179.83	(N/A)
basswood, American	17.84	2.08	2.75	13.95	9.74	46.35	(N/A)
birch, paper	36.34	4.46	6.50	35.85	23.03	106.17	(N/A)
linden, harvest gold	32.01	4.21	5.04	31.47	19.68	92.42	(N/A)
spruce, white	15.61	1.37	1.84	27.36	13.61	59.78	(N/A)
crababpple, pink spire	11.66	1.23	1.83	5.07	3.25	23.04	(N/A)
ash, black	5.75	0.83	0.90	4.94	9.19	21.61	(N/A)
boxelder, baron	28.44	4.66	4.89	36.01	26.46	100.47	(N/A)
elm, American	43.98	4.54	7.69	50.53	28.08	134.82	(N/A)
Japanese tree lilac	3.05	0.20	0.35	3.09	5.14	11.83	(N/A)
chokecherry, common	8.23	0.86	1.22	3.35	2.28	15.94	(N/A)
chokecherry, amur	3.21	0.35	0.46	1.18	0.80	5.99	(N/A)
OTHER STREET TRI	11.88	1.37	1.74	14.42	9.91	39.32	(N/A)

Ontario

Total Annual Benefits of Public Trees by Species ($)

8/30/2011

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
ash, green	111,509	16,090	18,965	109,941	103,139	359,644	(±0)	23.1
maple, silver	140,312	26,437	25,690	230,620	160,477	583,536	(±0)	37.5
basswood, American	25,691	2,989	3,955	20,090	14,025	66,750	(±0)	4.3
birch, paper	51,088	6,266	9,132	50,409	32,375	149,271	(±0)	9.6
linden, harvest gold	38,320	5,045	6,032	37,675	23,560	110,632	(±0)	7.1
spruce, white	12,049	1,060	1,418	21,122	10,505	46,154	(±0)	3.0
crababpple, pink spire	8,533	902	1,337	3,711	2,381	16,864	(±0)	1.1
ash, black	3,086	448	483	2,653	4,933	11,604	(±0)	0.7
boxelder, baron	14,279	2,341	2,457	18,075	13,284	50,436	(±0)	3.2
elm, American	16,846	1,737	2,945	19,351	10,755	51,634	(±0)	3.3
Japanese tree lilac	1,019	67	117	1,032	1,717	3,952	(±0)	0.3
chokecherry, common	2,361	248	351	962	653	4,576	(±0)	0.3
chokecherry, amur	792	87	113	290	198	1,480	(±0)	0.1
OTHER STREET TREI	30,023	3,461	4,387	36,430	25,053	99,355	(±0)	6.4
Citywide Total	455,908	67,178	77,383	552,362	403,056	1,555,888	(±0)	100.0

Appendix E
By-laws and Policy References

Corporate By-law

By-law Number 008-2005

AUTHOR: Shelley Vescio, City Forester

SUBJECT: **Tree By-law**

MEETING DATE: **City Council** - **February 14, 2005**

Authorization: Committee of the Whole - January 31, 2005 - Report No. 2005.018 (Parks)

THE CORPORATION OF THE CITY OF THUNDER BAY

BY-LAW NUMBER 008-2005

A By-law to authorize and regulate the planting, care, maintenance, protection, preservation and removal of public trees on municipal property, and to ensure the sustainability of the urban forest at various sites in the City of Thunder Bay, in the District of Thunder Bay.

Recitals:

1. Subsection 11(5) of the *Municipal Act, 2001* provides authority to municipalities for the control and regulation of parks, including trees within parks.

2. Section 44 of the *Municipal Act, 2001* provides that municipalities are responsible to maintain highways in a reasonably safe condition.

3. Sections 135 through 141 of the *Municipal Act, 2001* provide authority to municipalities to regulate the cutting of, planting of, and general maintenance of trees.

4. Sections 62 and 137 of the *Municipal Act, 2001*, authorize municipal officers to enter onto private property, in prescribed circumstances, for the purposes of enforcement of tree by-laws.

5. Section 138 of the *Municipal Act, 2001* authorizes the imposition of penalties for the commission of an offence under a tree regulatory by-law.

THE COUNCIL OF THE CORPORATION OF THE CITY OF THUNDER BAY ENACTS AS FOLLOWS:

ARTICLE ONE: DEFINITIONS, INTERPRETATION

1.01 Definitions: Wherever a word is used in this By-law with its first letter capitalized, the term is being used as it is defined in this Section 1.01. Where any word appears in ordinary case, its regularly applied meaning in the English language is intended.

(a) "Accepted Arboricultural Standards and Practices" are recommended methods and techniques based on scientific research or experience that have proven to be effective and/or defined by the relevant and current American National Standard Institute for Tree Care Operations.
(b) "Affect" means fertilize, prune, plant, disturb or alter.
(c) "Applicant" means any person **applying** for permission to take any action authorized by this By-law to be taken with the Corporation's permission.
(d) "By-law" means this by-law, as it may be amended from time to time. The Recitals and Schedules to this By-law are considered integral parts of it.
(e) "Corporation" means The Corporation of the City of Thunder Bay.
(f) "Construction" includes reconstruction.
(g) "Council" means the elected municipal council for the Corporation.
(h) "Damage" means mark, cut, break, debark, deface, damage or in any manner injure (short of destruction).
(i) "Drip Line" means the outer boundary of an area on the surface of the ground that corresponds to the outer edge of the crown of a tree.
(j) "Emergency Personnel" means any or all of: a police officer, a member of a fire protection or fire suppression service, a medical doctor, a nurse, a paramedic, or the staff or administration of any Public Utility.
(k) "Highway" means every road and every road allowance under the Corporation's authority, whether open or unopened, within Thunder Bay. The road allowance includes all of the property that makes up the road, including the traveled roadway, the shoulders, curbs, boulevards and sidewalks within the road allowance.
(l) "Manager" means the General Manager of the Department of Community Services of the Corporation, or his or her designate.**(m) "*Municipal Act, 2001*"** means the provincial legislation cited as S.O. 2001, c. 25, as amended from time to time, including successor legislation.
(n) "Municipal Law Enforcement Officer" means a member of any Police Service with jurisdiction in Thunder Bay or any person appointed by the Corporation for the enforcement of municipal by-laws.
(o) "Municipal Property" means any and all land owned by the Corporation, including: Highways, parks, trails, planned properties, any of the Corporation's facilities, and open space lands.
(p) "Private Property" means any and all land in Thunder Bay which is not Municipal Property.

(q) "Public Utility" means a board, commission or corporation, including a municipal corporation that owns or operates a Public Service.

(r) "Public Service" means works supplying utilities and similar services and includes: works for the production, supply and transmission of gas, oil, sewer, water and electric power or energy, street signs and street lighting, and all telephone, cable television and other telecommunications lines.

(s) "Public Tree" means any Tree or Woody Shrub, for which the trunk is totally or partially located on Municipal Property.

(t) "Qualified Arborist" means a person in possession of one of the following:

(i) a valid International Society of Arboriculture Certification as an Arborist;

(ii) a Journeyman Arborist Trades Certification from the Ontario Ministry of Education and Training with both a Certificate of Apprenticeship and a Certificate of Qualification; or

(iii) a diploma signifying successful graduation from a Community College level program specializing in Arboriculture and/or Ornamental Tree Care; or

(iv) qualifications considered by the Manager to be the equivalent to those set out in a, b and c.

(u) "Thunder Bay" means the geographic area within the jurisdiction of the Corporation.

(v) "Tree" means any woody plant of a species which at maturity is usually five (5) or more metres in height, having one or more self-supporting trunks, and the term includes the whole and/or all parts of: the roots, branches, trunk, and crown.

(w) "Tree Planting Details" means the Corporation's standards for tree planting, maintained by the Engineering Services Division of the Transportation & Works Department.

(x) "Tree Planting Guidelines" means the Corporation's standards for tree planting, maintained by the Parks Division of the Community Services Department, entitled "Guidelines and Specifications for the Planting of Boulevard Trees".

(y) "Tree Protection Details" means the Corporation's standard for tree protection, maintained by the Engineering Services Division of the Transportation & Works Department.

(z) "Tree Protection Standards" means the Corporation's standards for tree protection, maintained by the Parks Division of the Community Services Department.

(aa) "Tree Pruning Guidelines" means the Corporation's standards for tree pruning of public trees by homeowners, maintained by the Parks Division of the Community Services Department, entitled "Guidelines for Pruning Municipal Trees".

(bb) "Tree Value" means the monetary value of a tree as determined through the most current methods and procedures established by the International Society of Arboriculture, the Council of Tree and Landscape Appraisers or any other specifications adopted by the Corporation.

(cc) "Urban Forest" refers to the City's total complement of owned Trees on Municipal Property

(dd) "Woody Shrub" means any woody plant of a species which at maturity is usually less than five (5) metres in height, having usually more than one self-supporting stems, and the term includes the whole and/or all parts of: the roots, branches, stems, and crown.

1.02 Interpretation Rules:

(a) Wherever this By-law refers to a person or thing with reference to gender or the gender neutral, the intention is to read the By-law with the gender applicable to the circumstances.

(b) References to items in the plural include the singular, as applicable.

(c) The words "include", "includes", and "including" are not to be read as limiting the phrases or descriptions that precede them.

(d) Words in this By-law requiring a person to act include the requirement or authority to cause or permit the action in question to be done by others.

1.03 Severability: If a court or tribunal of competent jurisdiction declares any portion of this By-law to be illegal or unenforceable, that portion of this By-law will be considered to be severed from the balance of the By-law, which will continue to operate in full force.

1.04 References to Legislation: Each reference to Provincial legislation in this By-law is printed in Italic font and, unless otherwise specified, is a reference to the Revised Statutes of Ontario, 1990 edition, and, in every case, includes all applicable amendments to the legislation, including successor legislation. Each reference to a By-law in this By-law, unless otherwise specified, is a reference to a By-law of the Corporation, and, in every case, includes all applicable amendments to the By-law, including successor by-laws.

ARTICLE TWO: PHILOSOPHY

2.01 Tree Preservation: The Corporation adopts a philosophy which seeks to preserve rather than remove Public Trees wherever possible and expedient.

2.02 Explanation: In determining whether something is "possible and expedient" as outlined in Section 2.01, the Manager shall consider:

(a) the feasibility of relocating facilities to preserve the Tree;

(b) the use of alternate technologies for the facility or Construction that would, if implemented, preserve the Tree;

(c) the availability of the alternate technologies noted in (b) above in Thunder Bay;

(d) whether prudent advance planning could have preserved the Tree; and

(e) the cost associated with any feasible preservation alternatives.

ARTICLE THREE: AUTHORITY OF THE MANAGER IN IMPLEMENTING THIS BY-LAW

3.01 Assignment: The Manager is assigned the authority for the implementation of this By-law.

3.02 Planting and Transplanting: The Manager is authorized to plant or transplant any and all Public Trees on Municipal Property. Article Four of this By-law applies.

3.03 Care and Maintenance: The Manager is authorized to care for and maintain all Public Trees. Care and maintenance includes: pruning; fertilizing; providing support systems; and implementing preventative measures to protect Public Trees from insect or disease problems.

3.04 Removal of Objects: The Manager has the authority to remove any object or thing that has been placed on Municipal Property and which adversely affects a Public Tree. Unless the object or thing results in a hazard (in which case, Section 7.07 will be utilized), seventy-two (72) hours' verbal notice under Section 7.03 shall be provided. The notice shall be sent to either or both of the owner of the object (where ownership can be reasonably determined) or the owner of the Private Property nearest the offending object or thing. The notice shall require the person notified to remove the object or thing within the notice period. Where the notice period expires and the person notified has not taken steps to remove the object

or thing adversely affecting a Public Tree, the Corporation shall remove the object or thing without any further requirement to provide notice or compensation to any person. The Manager has the authority to extend the notice period prescribed by this Section in circumstances where people wish to comply but require more time to do so, and the Tree in question will not suffer irreparable damage through the time extension. In no case, however, can the notice period exceed six (6) months.

3.05 Removal of Non-Viable Public Trees: The Manager may remove Public Trees which are dead, which are no longer viable to maintain, or which, for any reason, constitute a hazard or a potential hazard to the public. In implementing this Section, the Manager shall have due regard to Article Two of this By-law.

3.06 Removal/Injury of Public Trees: Emergencies: The Manager may authorize the removal of, or any injury to, Public Trees where same is required to facilitate emergency work. In implementing this Section, the Manager shall have due regard to Article Two of this By-law.

3.07 Removal of Healthy Public Trees: The Manager may remove healthy Public Trees following the conditions outlined in Article Five of this By-law.

3.08 Removal of Public Trees That Contravene the By-law: Any Public Tree planted or growing on Municipal Property contrary to the provisions of this By-law, or contrary to any Council-approved agreements, may be removed by the Manager.

3.09 Requests By Others to Prune Public Trees: Any person may apply to the Manager for permission to prune small branches on a Public Tree in accordance with the Tree Pruning Guidelines, or to have a Qualified Arborist prune the branches or roots of Public Trees. Public Utilities are exempt from a requirement to obtain permission, subject to Section 6.10. This Section does not operate to prevent the City from embarking on its own programs with respect to Public Trees which may or may not involve Qualified Arborists.

3.10 Conditions: When approving any application for any permission authorized by Sections 5.01, 5.03 or 5.05 of this By-law, the Manager will impose the following conditions:

(a) Adherence to the Tree Protection Standards and/or other standards approved by Council;
(b) Payment of the removal costs of the Public Tree;
(c) Payment of the tree stump removal costs, if applicable;
(d) Payment for the purchase and planting of two trees, of the minimum size and quality required by the Tree Planting Guidelines, to replace the Public Tree that is removed; and
(e) Where any replacement tree is on Municipal Property adjacent to the applicant's property, responsibility for the watering of that replacement tree for a two-year period.

3.11 Standards: All work done to or in the vicinity of Public Trees under the Authority of this By-law or otherwise must conform to the Tree Protection Standards, Tree Protection Details, Tree Planting Details, Tree Planting Guidelines, and Tree Pruning Guidelines, as applicable. The Manager has the authority to inspect Municipal Property, and, where standards are not adhered to, to issue written notice by way of an Order to any person involved in the work. The Order shall specify the nature of the non-compliance and require correction within a reasonable time frame.

3.12 Appeal to Council: Any Applicant for permission for any matter governed by this By-law whose application is turned down by the Manager may appeal that denial to the Council. The Applicant must make a request for deputation before the Council (sitting as committee of the whole) in accordance with the requirements of the Corporation's procedure by-laws.

ARTICLE FOUR: PUBLIC TREE PLANTING

4.01 Approval of Planting Public Trees: Any person who wishes to plant a Tree on Municipal Property, making it a Public Tree by definition, must apply to the Manager for permission to do so. Approval by the Manager will include the planting location, species, and source of stock, size and condition. Adherence to the standards referenced in Section 3.11 is required.

ARTICLE FIVE: PUBLIC TREE REMOVAL, CONDITIONS AND COMPENSATION

5.01 Requests for Removal or Alteration of Public Trees by the Public: Any person who wishes to remove or Affect a Public Tree, for reasons other than those covered by Sections 5.03 and 5.05 must apply to the Manager for permission to do so. The Manager shall not grant applications for permission to remove a Public Tree unless in the opinion of the Manager all alternatives to removal have been explored and exhausted or there are exceptional circumstances which warrant such removal. Section 3.10 applies.

5.02 Requests for Removal of Public Trees from Highway for Public Service Construction: Any person who wishes to remove or alter a Public Tree for the purpose of Construction being undertaken by a Public Utility must apply to the Manager for permission to do so. The Manager may direct the removal of any Public Tree which, in the opinion of the Manager, warrants removal, and, in particular, where the Public Tree in any way interferes with or endangers Public Services. Article Two applies. A landscape plan or tree replacement plan must be received that is satisfactory to the Manager.

5.03 Requests for Removal of Public Trees from Highway for Driveway Construction in Urban Residential and Suburban Residential Land Use Designations: Any person who wishes to remove or alter a Public Tree for purposes of driveway Construction on lands designated as urban residential or suburban residential by the City's Official Plan must apply to the Manager for permission to do so. The Manager shall not grant applications for permission to remove a Public Tree when, in the opinion of the Manager, practical or economic alternatives for proper access exist. When evidence has been provided by the owner to the Manager that no other practical or economical option for proper access is possible, the Manager may direct the removal of a Public Tree from a highway which, by its very existence, denies an owner of Private Property abutting a Highway proper access to the property. Section 3.10 applies. The location of any replacement Public Tree will either be determined by the Manager, in circumstances when Site Plan Control is not required, or in accordance with Site Plan Control approval in circumstances when Site Plan Control is required.

5.04 Requests for Removal of Public Trees for Highway Construction: Any person who wishes to remove or alter a Public Tree for the purpose of Highway Construction being undertaken by the Corporation must apply to the Manager for permission to do so. The Manager may direct the removal of any Public Tree for Highway Construction, only after all alternatives to removal are explored and exhausted and all current technologies are considered for protection of existing Trees. Any plan for Highway Construction shall illustrate those Public Trees which are required to be removed due to the Construction, together with a report on the number, species and size of Public Trees being removed and the number, types and sizes of Public Trees which will replace those being removed. The tree replacement plan must be satisfactory to the Manager.

5.05 Requests for Removal of Public Trees for Land Development: Any person who wishes to remove or alter a Public Tree for the purposes of land development must apply to the Manager for permission to do so. The Manager may direct the removal of any Public Tree for land development, only after a plan is received that includes documentation of the Trees to be removed, and a landscape plan or tree replacement plan that is satisfactory to the Manager.

ARTICLE SIX: OFFENCES AND ENFORCEMENT

6.01 Affect Public Tree Without Consent: It constitutes an offence to Affect a Public Tree, either above ground or below ground, without the prior written consent of the Manager. Adherence to the standards referenced in Section 3.11 is required.

6.02 Public Utility Exemption: Section 6.01 does not prevent the pruning of Public Trees by any Public Utility as necessary to comply with safety regulations and to maintain safe operation of its facilities provided that:

> **(a)** At least three business days prior to commencing any pruning, the Public Utility provides the Manager with written notice of its intention to prune;
> **(b)** The pruning is carried out in accordance with Accepted Arboricultural Standards and Practices; and
> **(c)** The Public Utility follows any specific directions of the Manager as to how the work shall be carried out.

The Manager may order the Public Utility to stop any pruning performed by a Public Utility if appropriate arboricultural practices are not being followed.

6.03 Emergencies: Where removal or pruning of a Public Tree is determined to be necessary by Emergency Personnel responding to an emergency situation, such Public Tree or part of it may be cut or removed without first obtaining written authorization to do so. Emergency Personnel shall notify the Manager of the emergency and work done on the Public Tree as soon as possible but no later than three days after the removal or pruning of the Public Tree.

6.04 Damage a Public Tree: It constitutes an offence to Damage a Public Tree, or any part of a Public Tree, above ground or below ground.

6.05 Apply Substance to or Near Public Tree: It constitutes an offence to place, apply or spray any substance other than water on or near any Public Tree. An exception will be made for properly applied control measures around Public Trees which are placed to control insect infestations and removed before the end of that year's growing season.

6.06 Harmful Substances: It constitutes an offence to cause or permit any gaseous, liquid or solid substance which is harmful or toxic to Public Trees to come into contact with any Public Tree.

6.07 Harmful Activity: It constitutes an offence to undertake any activities on Municipal Property or on Private Property in the vicinity of a Public Tree which are contrary to the Tree Protection Standards.

6.08 Posting: It constitutes an offence to tack, paste or attach a bill, note, sign or poster or any other thing to a Public Tree, or to any stake, post, guard or other object supporting a Public Tree.

6.09 Attachments: It constitutes an offence to use any part of any Public Tree to secure or support any object, structure or animal.

6.10 Municipal Policies and Programs: Sections 6.08 and 6.09 do not operate to prohibit activities that are sanctioned by the Council through policies or programs for beautification or otherwise. For example, the placement of strings of lights in Public Trees in strict accordance with the conditions approved under the Corporation's "decorative tree lighting protocol" would not violate Section 6.08 or Section 6.09. Any person relying upon this exemption must ensure that he or she adheres to any conditions, guidelines or regulations respecting the program (including, for example, the location of electrical cords), and shall at all times ensure that he or she does not create a safety hazard.

6.11 Fire: It constitutes an offence to set or maintain a fire, or to permit another to set or maintain a fire where its location will cause damage, by either flame or heat, to any part of a Public Tree.

6.12 Protective Devices: It constitutes an offence to interfere in any way with fences, boxes or other protective devices placed around Public Trees.

6.13 Failure to Eliminate Hazard: It constitutes an offence to fail to comply with notice issued under Section 9.02 of this By-law.

6.14 Failure to Adhere to Standards: It constitutes an offence to fail to comply with notice issued under Section 3.11 of this By-law.

6.15 Destroy or Remove a Public Tree: It constitutes an offence to destroy or remove a Public Tree without the City's prior authorization.

6.16 Activity Contrary to Conditions: Where any person has been granted any permission pursuant to this By-law, it constitutes an offence to take activity under that permission which is contrary to the conditions under which the permission was granted.

ARTICLE SEVEN: ENFORCEMENT AND PENALTIES

7.01 Penalties: Any person convicted of an offence created by this By-law is subject to the penalties prescribed by the *Provincial Offences Act*.

7.02 Enforcement: This By-law may be enforced by any Municipal Law Enforcement Officer, or any other person duly appointed by law.

7.03 Verbal Notices: Where verbal notice is required pursuant to this By-law, it shall be provided by telephone or direct conversation. Verbal notice requires discussion directly with the person to whom the notice is addressed, and shall not be considered to have been delivered by messages left with other persons or left electronically.

7.04 Written Notices: Where written notice is required pursuant to this By-law, it shall be either personally delivered to the recipient, delivered to an appropriate mail receptacle at the address, or provided by regular, first class mail to the owner of the Private Property affected at the last address known to the Corporation through the municipal assessment rolls. Where the address of the owner is different than the address of the Private Property affected, and the Private Property is occupied as a residence, notice shall also be provided to the address of the affected Private Property, addressed to "occupant".

7.05 Deemed Receipt of Notice: Verbal notice under Section 7.03 is deemed to have been received by the person notified at the time of the conversation held. Written notice which is mailed under Section 7.04 is deemed to have been received by the person notified five (5) business days after the mailing of the notice. Written notice which is personally delivered to the recipient under Section 7.04 is deemed to have been received by the person to whom it was hand delivered at the time of delivery. Written notice which is delivered to an address but not handed to a person is deemed to have been received by the person to whom it was addressed on the business day next following the date of delivery.

7.06 Entry to Private Property: Where a person fails to comply with notice issued under Section 9.02 of this By-law, the Manager is authorized to enter onto the land and do, or cause to be done, any acts deemed necessary to eliminate the hazard, including removal of the Tree.

7.07 Entry to Private Property (Emergency Basis): Where, in the opinion of the Manager, a Tree is in such a condition that it constitutes an imminent danger to public safety associated with persons using a Highway, the Manager may enter onto the Private Property without notice, and do, or caused to be done, any acts considered necessary to eliminate the danger, including removal of the Tree. Where, in the opinion of the Manager, a Tree is in such a condition that it constitutes an imminent danger to public safety associated with persons using Municipal Property other than a Highway, the Manager shall take steps on the Municipal Property to isolate the danger and may, upon seventy-two (72) hours' verbal notice, enter onto the Private Property, and do, or caused to be done, any acts considered necessary to eliminate the danger, including removal of the Tree.

7.08 Cost Recovery: Where the Manager does carry out, or causes to be carried out, work pursuant to Sections 7.06 or 7.07 of this By-law, subject to the requirements of the *Municipal Act*, the cost of doing the work is a debt due and owing to the Corporation by the owner of the Private Property. This debt may be added to the municipal tax roll for the Private Property and collected as municipal taxes.

ARTICLE EIGHT: DAMAGE TO PUBLIC TREES

8.01 Costs for Damaged Public Trees: Any person who accidentally, negligently or willfully damages a Public Tree shall reimburse the Corporation for the cost of treatment. Alternatively, and with the Manager's prior written authorization, the person who caused the damage may cause the Public Tree to be repaired by a Qualified Arborist, and shall in those circumstances bear the cost of repairs, materials and labour.

8.02 Costs for Replaced Public Trees: Where a Public Tree is irreparably damaged (as determined by the Manager in his or her sole discretion), the person who caused the damage must replace the Tree. The conditions to be imposed by the Manager under Section 3.10 apply in these circumstances as if the person who caused the damage had applied for permission to do so. Where the damage was caused willfully, cost for the Tree Value will be also be applied. The time and location of tree planting will be determined by the Manager.

8.03 Remedies Cumulative: The damages and costs payable under Sections 8.01 and 8.02 of this By-law are in addition to, and not in substitution for, the payment of any penalty imposed by a court of law for the commission of an offence under this By-law or any other applicable legislation.

ARTICLE NINE: PUBLIC NUISANCE FROM PRIVATE TREES

9.01 Prevention of Hazards: Every person owning, occupying or controlling land or premises in Thunder Bay shall ensure that Trees on his, her or its property do not constitute hazards to members of the general public utilizing Municipal Property.

9.02 Removal of Hazards: Where a Tree exists which, in the opinion of the Manager, constitutes a hazard to members of the general public utilizing Municipal Property, the Manager shall provide written notice by way of an Order to any person owning, occupying or controlling Private Property upon which that Tree is located. The Order shall require that person to carry out any work necessary to eliminate the hazard within a minimum notice period of seven (7) days.

9.03 Restrictions/Notices: Where the Manager issues notice under Section 9.02 of this By-law, he or she shall, in addition, secure the Municipal Property that is affected by the hazard.

ARTICLE TEN: GENERAL PROVISIONS

10.01 Repeal: By-law No. 78-1972 is repealed.

10.02 Force and Effect: This By-law shall come into force and take effect upon the date of its final passing.

Enacted and passed this 14th day of February, A.D. 2005 as witnessed by the Seal of the Corporation and the hands of its proper Officers.

Andrew Bentz

Acting Mayor

Rosalie A. Evans

Acting City Clerk

Read a First and Second time this 14th day of February, A.D., 2005

Read a Third Time and finally passed this 14th day of February, A.D., 2005

By-law Number 144-2006

Memorandum

TO: John S. Hannam, City Clerk **FILE:**

FROM: Dwight Gessie, Manager - Parks
Parks, Community Services

DATE: December 8, 2006

SUBJECT: Amendment to By-law 8-2005 being a By-law to authorize and regulate the planting, care, maintenance, protection, preservation and removal of public **tree**s on municipal property, and to ensure the sustainability of the urban forest at various sites in the City of Thunder Bay, in the District of Thunder Bay with respect to Article 5 – Public **Tree** Removal, Conditions and Compensation – Item 5.03 and add Item 5.06 respecting "discretion with respect to the imposition of conditions for a certain class of suburban development".

MEETING DATE: **City Council** - **December 18, 2006**

By-law Description: A By-law to amend By-law 8-2005 being a By-law to authorize and regulate the planting, care, maintenance, protection, preservation and removal of public **tree**s on municipal property, and to ensure the sustainability of the urban forest at various sites in the City of Thunder Bay, in the District of Thunder Bay with respect to Article 5 – Public **Tree** Removal, Conditions and Compensation – Item 5.03 and add Item 5.06 respecting "discretion with respect to the imposition of conditions for a certain class of suburban development".

Authorization: Report No. 2006.205 (Parks) to COW October 16, 2006

By-law Explanation: The purpose of this By-law is to to amend By-law 8-2005 being a By-law A By-law to authorize and regulate the planting, care, maintenance, protection, preservation and removal of public **tree**s on municipal property, and to ensure the sustainability of the urban forest at various sites in the City of Thunder Bay, in the District of Thunder Bay with respect to Article 5 – Public **Tree** Removal, Conditions and Compensation – Item 5.03 and add Item 5.06 respecting "discretion with respect to the imposition of conditions for a certain class of suburban development".

/SN

THE CORPORATION OF THE CITY OF THUNDER BAY

BY-LAW NUMBER 144-2006

Recital:

1. It is deemed necessary and expedient to amend By-law Number 8-2005 of The Corporation of the City of Thunder Bay, by Resolution dated October 16, 2006, with respect to Article 5 – Public **Tree** Removal, Conditions and Compensation – Item 5.03 and add Item 5.06 respecting "discretion with respect to the imposition of conditions for a certain class of suburban development".

ACCORDINGLY, THE COUNCIL OF THE CORPORATION OF THE CITY OF THUNDER BAY ENACTS AS FOLLOWS:

1. THAT By-law 8-2005 Article 5 – Public **Tree** Removal, Conditions and Compensation Item 5.03 is amended by deleting the following section:

5.03 Requests for Removal of Public Trees from Highway for Driveway Construction in Urban Residential and Suburban Residential Land Use Designations: Any person who wishes to remove or alter a Public **Tree** for purposes of driveway Construction on lands designated as urban residential or suburban residential by the City's Official Plan must apply to the Manager for permission to do so. The Manager shall not grant applications for permission to remove a Public **Tree** when, in the opinion of the Manager, practical or economic alternatives for proper access exist. When evidence has been provided by the owner to the Manager that no other practical or economical option for proper access is possible, the Manager may direct the removal of a Public **Tree** from a highway which, by its very existence, denies an owner of Private Property abutting a Highway proper access to the property. Section 3.10 applies. The location of any replacement Public **Tree** will either be determined by the Manager, in circumstances when Site Plan Control is not required, or in accordance with Site Plan Control approval in circumstances when Site Plan Control is required.

And substituting with the following:

5.03 Requests for Removal of Public Trees from Highway for Driveway Construction in Certain Urban Residential and Suburban Residential Land Use Designations: Any person who wishes to remove or alter a Public **Tree** for purposes of driveway construction on all lands designated as urban residential or on those lands designated suburban residential within plans of subdivision registered after January 1, 1970 as shown in the City's Official Plan must apply to the Manager for permission to do so. The Manager shall not grant applications for permission to remove a Public **Tree** when, in the opinion of the Manager, practical or economic alternatives for proper access exist. When evidence has been provided by the owner to the Manager that no other practical or economical option for proper access is possible, the Manager may direct the removal of a Public **Tree** from a highway which, by its very

existence, denies an owner of Private Property abutting a Highway proper access to the property. Section 3.10 applies. The location of any replacement Public **Tree** will either be determined by the Manager, in circumstances when Site Plan Control is not required, or in accordance with Site Plan Control approval in circumstances when Site Plan Control is required.

2. AND THAT By-law 8-2005 be further amended with respect to Article 5 – Public **Tree** Removal, Conditions and Compensation by creating Item 5.06 and by inserting the following section:

5.06 Requests for Removal of Public Trees from Highways for Driveway Construction in all Other Suburban Residential Lands Not Covered in 5.03: Any person who wishes to remove or alter a Public **Tree** for the purposes of Driveway Construction on lands designated suburban residential outside of plans of subdivision registered after January 1, 1970 as shown in the City's Official Plan must apply to the Manager for permission to do so. The Manager shall not grant applications for permission to remove a Public **Tree** when, in the opinion of the Manager, practical or economic alternatives for proper access exist. When evidence has been provided by the owner to the Manager that no other practical or economical option for proper access is possible, the Manager may direct the removal of Public **Tree**s for up to two 9 metre-wide entrances from a highway which, by its very existence, denies an owner of Private Property abutting a Highway proper access to the property. Section 3.10 does not apply.

3. By-law 8-2005 is hereby amended.

4. This By-law shall come into force and take effect upon the final passing thereof.

Enacted and passed this 18th day of December, A.D. 2006 as witnessed by the Seal of the Corporation and the hands of its proper Officers.

Iain Angus

Acting Mayor

John S. Hannam

City Clerk

Recommendations for Soil Volume for Urban Tree Planting

The ultimate size of a tree is governed by its genetic make-up and influenced by the prevailing environmental conditions and the quality and quantity of growing media (natural or artificial soil) available for root growth and development. Current research indicates that typically in clay loam type soils, the root system of a mature tree may extend up to two to three times the spread of the crown (extent of the foliage and branches), but usually extends no deeper than one metre from the surface level. Tree roots are opportunistic; that is, they will flourish wherever soil conditions are favourable. Conversely, however, they will not grow where soil conditions are unfavourable. Three things limit root growth and development: available soil oxygen (necessary for root function and respiration), available moisture, and the resistance of the soil to root penetration (degree of soil compaction). Beyond the requirements for normal tree growth, root development is also critical for the anchorage and stability of the tree.

A tree can be sustained on a very small volume of soil (in a nursery container for example) provided that frequent and adequate water is provided. However, in a street situation, where the tree must rely on the infiltration of natural rainfall to the root zone, tree growth and development is limited by the volume and moisture holding capacity of the soil. There are many methodologies for calculating the required soil volumes for trees in a street situation; however the results are extremely variable. Most suggest a minimum volume as of:

- Between 5 and 15 cubic metres for a small tree.
- Between 20 and 40 cubic metres for a medium sized tree and
- Between 50 and 80 cubic metres for a large tree.

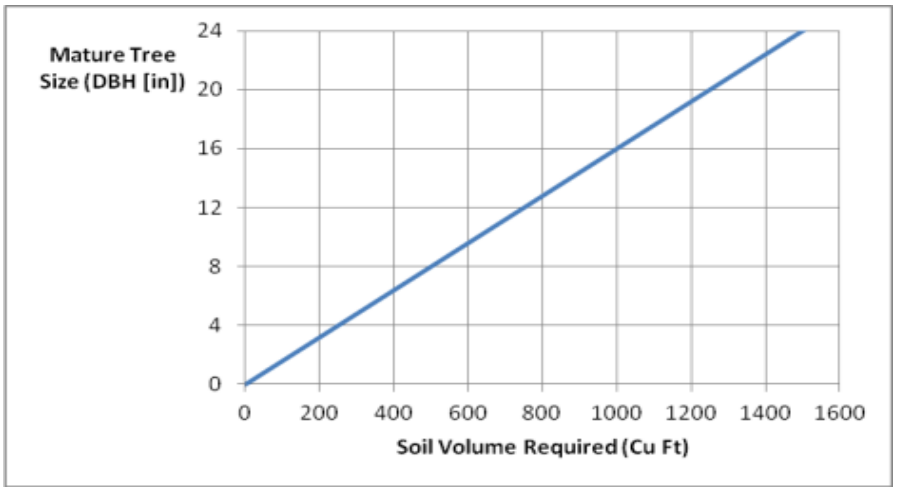
These volumes represent the unobstructed soil volume required by the tree, *i.e.,* where the roots can spread to, not the improved soil planting hole. As root growth is limited by available soil oxygen, and this oxygen depletes with depth, there is no benefit in increasing soil volume by increasing the depth of the planting zone beyond a depth of 1.0m. The greater benefit is in increasing the soil volume laterally.

Usable soil volume describes the amount of soil available for tree root growth. For example, if a tree is planted on a severely compacted clay soil, the usable soil volume will be only the soil disturbed during installation or a few inches on the surface loosened by mulching—perhaps less than 0.1 square metre.. Tree roots grow primarily in the top 70 cm of soil, and most grow very near the surface. For this reason, soil below 70 cm would not be considered in soil volume calculations in most cases. For example, if a tree is planted in a sidewalk cutout that is 1.2m x 1.2m and the soil is uncompacted, then the usable soil volume could be considered to be 1.2m x 1.2m x .7m. or approximately 1 square metre.

Large shade trees in downtown settings rarely, if ever, have sufficient soil volume to grow to their full potential size. Many models for predicting the volume of soil required have been proposed. A useful rule of thumb is that each 2.2cm (inch) of dbh (trunk diameter at 1.4m above the ground) requires about 1.9 to 2.3 square metres (20-25 square feet) of open ground with uncompacted soil. However, you will find that this amount of soil is rarely provided. Trees do survive, but do not reach their expected size. A tree may establish and grow normally for a few years. Then, when there is no longer enough soil for the tree's increasing size, growth dramatically slows and the tree declines prematurely. Some trees are able to overcome the situation by rooting under sidewalks and through cracks to access adjacent lawn areas.

There are several available soil volume models (listed below). Though the models are United States studies showing imperial values, the observations are important regardless of measurement system. As an example, let's look at a 24" dbh *Zelkova serrata* with a crown spread of 50'. Using the Lindsey & Bassuk model, this tree would require about 2,200 cu. ft. in a typical soil in Blacksburg, Virginia. The Urban *et al.* model would predict about 1,500 cu. ft. would be required. The Natural Forest method based on upland hardwoods in the Eastern U.S., would predict that between 2,700 and 4,100 cu. ft. would be required, depending on soil quality. The rule of thumb mentioned above (each 2.2cm (inch) of dbh (trunk diameter at 1.4m above the ground) requires about 1.9 to 2.3 square metres (20-25 square feet of open ground with uncompacted soil) would estimate 960 to 1200 cu. ft. To some extent, results will depend upon the species, as some species, such as *Zelkova*, are better able to exploit soil resources under pavement or in compacted areas. The larger soil volumes will support a healthier, more vigorous tree, but these volumes may be unattainable in restricted downtown areas.

- Lindsey & Bassuk. This model uses evapotranspirative demand, rainfall data, soil water holding capacity and leaf area index to calculate the amount of soil needed in a given climate to support the water demands of a tree of a given size. See Lindsey, P. and N. L. Bassuk. 1992. *Redesigning the urban forest from the ground below: A new approach to specifying adequate soil volumes for street trees*. Journal of Arboriculture 24 (3): 25-39.
- Urban *et al*. This model is for the Eastern U.S. and is based upon the tree's canopy spread and dbh. It was developed using data from a number of authors and the experience of this urban tree expert. See Urban, J. 1992. *Bringing order to the technical dysfunction within the urban forest*. Journal of Arboriculture 18(2):85-90.
- Natural Forest. This method is derived from stocking charts for upland hardwoods in the Eastern U.S. (USDA Forest Service Ag. Handbook 355). We assume that density-induced stress begins at approximately 100 ft^2 of basal area per acre.



James Urban (1992) synthesized data from Bassuk and Lindsey (1991), Thomas (1985 and 1989), and his own work (Urban, 1989) to determine a relationship between soil volume requirements and mature tree size. The larger the tree, the more soil volume if needs.

Excepted from:

Virginia Urban Tree Selector
http://dendro.cnre.vt.edu/treeselector/FAQ.shtml#modelsForCalculatingSoilVolume

street tree design guidelines; 2008
http://www.landcom.com.au/content/publication-and-programs/the-landcom-guidelines.aspx

DRAFT TREE PROTECTION POLICY AND SPECIFICATIONS FOR CONSTRUCTION NEAR TREES

Table of Contents

1. Introduction

The maintenance and enhancement of the urban forest is one of the strategic goals of Thunder Bay. Preserving and protecting healthy trees is one objective towards achieving this goal. Including trees in the initial stages of construction planning may mean the difference between preserving a healthy tree or having to remove it. When plans are created with tree preservation in mind, you can help us protect our valuable tree resource.

The tree protection policies and specifications outlined below reflect the vision of the City of Thunder Bay. Anyone failing to adhere to the tree protection policies and specifications will be financially responsible for any resulting damage to trees and may be charged under the provisions of the applicable City of Thunder Bay tree by-law.

Prior to commencing with any construction activity on your property, it is important that you consult with a tree care professional to determine the type and condition of the trees on your property and surrounding properties and to become aware of the tree protection by-laws that could impact your proposal.

All trees situated on City streets, parks and natural areas are protected under Tree By-law.

Types of Tree Damage

Physical injury to the main stem or branches of a tree will occur if construction equipment is permitted close to the trees or if structures are built into the growing space of a tree. Physical injuries are permanent and can be fatal.

Root cutting is another type of injury that can significantly impact the health of a tree. Excavation for foundations or utility installation may cut tree roots if the excavation is too close to the trees. The majority of tree roots are found in the upper 30 to 60cm of soil. Trees can also become destabilized and may fail if structural support roots are severed. Prior to commencing with any excavation, an exploratory dig should be undertaken using a low pressure hydro vac system, with water pressure less than 20 p.s.i. This method of non-intrusive excavation will determine the presence or absence of roots and provide guidance to design construction projects with tree protection in mind.

Compaction of the soil in which tree roots grow is one of the leading causes of tree decline in Thunder Bay's urban forest. Soil compaction occurs primarily from vehicles and equipment moving across the root zones. Often, you cannot see the damage being done immediately as trees typically do not show signs of decline for 3-5 years post construction. Soil compaction causes the pore space in the soil, which contains air and water necessary for root growth, to be reduced which results in tree roots suffocating. Decline of the tree will follow. Adding soil on top of tree roots can also smother them by reducing the amount of oxygen and water they are accustomed to receiving. Only a few centimetres of added soil can have a significant and sometimes detrimental impact on the health of a tree.

Protecting Your Trees

There are a number of things that you can do to protect your trees and your neighbour's trees prior to, during and after any construction project. Hiring a qualified tree expert or natural resource specialist should be the first thing you do. A professional can provide the advice you need regarding your tree's current maintenance requirements, and he/she can determine what impact your proposal will have on trees and the surrounding natural environment.

Once you have an inventory of the trees on your property and adjacent properties, and you know the tree by-laws that will apply to your site, you can begin to design your project with tree protection in mind, and prepare a tree preservation plan with a qualified tree expert. It is important to plan the location of any utilities at the beginning of any construction project as utility installation may be detrimental to tree health. Table 1 below provides minimum tree protection zones based on the diameter of the trees in question. Please consult this table when preparing tree protection plans and remember that these are minimum distances. Depending on the tree and the surrounding environment, much larger tree protection zones may be required by Urban Forestry to realistically protect the trees.

In addition to establishing and creating tree protection zones, it may be necessary to implement other protective measures, such as adding mulch to the root zone, aeration of the soil, pruning for deadwood or removing limbs that may be impacted by construction activity. This is also the time to determine the location where new trees can be planted to complement the construction project and help with the renewal and growth of the urban forest.

Communication between owners, contractors, and sub-contractors throughout the construction process is critical to ensure that everyone is aware of the issues surrounding tree protection, and fully understands the tree protection methodology. Construction damage to trees is often irreversible and may lead to tree demise.

2. Table 1 – Tree Protection Zones

The following is a chart showing minimum required distances for determining a Tree Protection Zone (TPZ) for City-owned trees located on a City Street and in parks.

Tree Protection Zones

Trunk Diameter (DBH)[1]	Minimum Protection Distances Required[2]
<10cm	1.2m
10-29cm	1.8m
30[3]-40cm	2.4m
41-50cm	3.0m
51-60cm	3.6m
61-70cm	4.2m
71-80cm	4.8m
81-90cm	5.4m
91-100cm	6.0m
>100cm	6cm protection for each 1cm diameter

[1] Diameter at breast height (DBH) measurement of tree stem taken at 1.4 metres above the ground.

[2] Tree Protection Zone distances are to be measured from the outside edge of the tree base.

[3] The drip line is defined as the area beneath the outer most branch tips of a tree.

[4] Converted from ISA Arborists' Certification Study Guide, general guideline for tree protection barriers of 1 foot of diameter from the stem for each inch of stem diameter.

Within a TPZ there must be:

- no construction;
- no altering of grade by adding fill, excavating, trenching, scraping, dumping or disturbance of any kind.
- no storage of construction materials, equipment, soil, construction waste or debris.
- no disposal of any liquids, *e.g.,* concrete sleuth, gas, oil, paint.
- no movement of vehicles, equipment, or pedestrians.
- no parking of vehicles or machinery.
- directional micro-tunnelling and boring may be permitted within the limits of a TPZ subject to approval by Urban Forestry.
- open face cuts outside a TPZ that are consistent with an approved plan and that require root pruning, require the services of a qualified arborist or approved tree professional. An exploratory dig, either by hand or using a low water pressure hydro vac method, must be completed prior to commencing with open face cuts outside the TPZ.

The above mentioned requirements are for area(s) designated as a TPZ. These requirements should also be implemented outside the TPZ in areas where tree roots are located. The roots of a tree can extend from the trunk to approximately 2-3 times the distance of the dripline.

See **Detail TP-1 and TP-3** for further information.

3. Tree Protection Barriers

Plywood tree protection hoarding, steel fence, or orange plastic construction grade fencing shall be installed in locations as detailed in an Urban Forestry approved Tree Protection Plan. Tree protection shall be installed in accordance with the City's Tree Protection Policy and Specifications for Construction near Trees and/or to the satisfaction of the Urban Forestry Section. Within a City road allowance where visibility is a consideration, 1.2m (4ft) high orange plastic web snow fencing on a 2"x 4" frame should be used.

All supports and bracing used to safely secure the barrier should be located outside the TPZ. All supports and bracing should minimize damage to roots.

Where some fill or excavate must be temporarily located near a TPZ, a plywood barrier must be used to ensure no material enters the TPZ.

Root protection shall be installed where required in construction access locations to the satisfaction of the Urban Forestry Section in order to protect tree roots from compaction during construction. Root protection shall consist of a combination of filter fabric, clear crushed stone (half to three-quarter inch diameter) or wood mulch placed in a layer 15cm deep, and steel plating or other material, as approved by the Urban Forestry Section.

Any area designated for stockpiling of excavated soil must be fenced with sediment control fencing.

Sediment control fencing shall be installed in the locations as indicated in an Urban Forestry approved Tree Protection Plan. The sediment control fencing must be installed to Ontario Provincial Standards (OPSD-219.110) and to the satisfaction of the Urban Forestry Section. The sediment control fencing can be attached to the tree protection hoarding.

Once all tree/site protection measures have been installed, you must notify the Urban Forestry Section to arrange for an inspection of the site and approval of the site protection requirements.

See Detail TP-1 for further information.

Where changes to the location of the TPZ or where temporary access to the TPZ are proposed, you must contact the Urban Forestry Section to obtain approval.

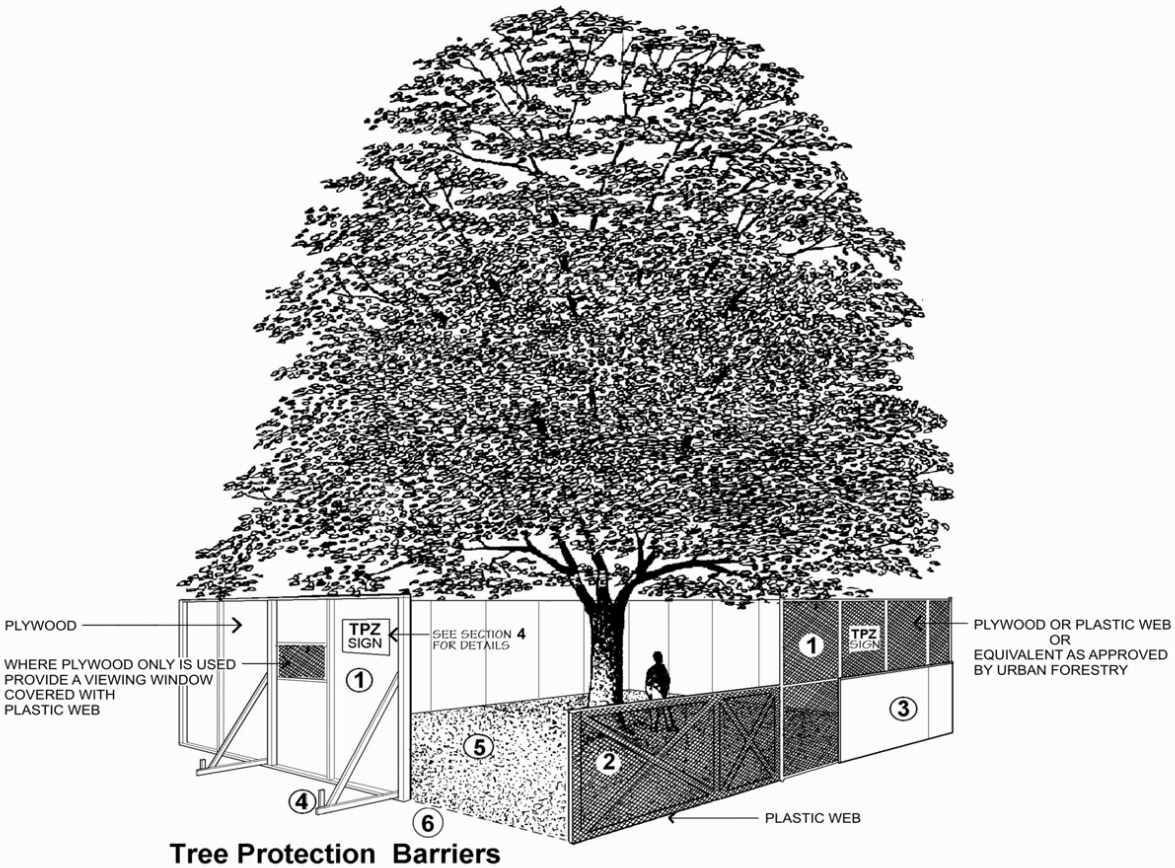
4. Tree Protection Signage:

Attach a sign on all sides of the Tree Protection Barrier for trees which are protected. The sign is a minimum 40 x 60cm of white gator board or equivalent. The sign says "TREE PROTECTION ZONE: No grade change, storage of material or equipment is permitted within the

TPZ. Tree Protection Barrier must not be removed without written authorization of the City of Thunder Bay – Urban Forestry For information call: (807) xxx-xxxx

Tree Protection Barrier

Detail TP-1



Tree Protection Barriers

1. **Tree protection barriers must be a plywood or plastic web hoarding or equivalent as approved by Urban Forestry.**
2. **Tree protection barriers for trees situated on the City road allowance where visibility must be maintained can be 1.2m (4ft.) high and consist of orange plastic web snow fencing on a wood frame made of 2"x 4"s .**
3. **Where some excavate or fill has to be temporarily located near a tree protection barrier, plywood must be used to ensure no material enters the Tree Protection Zone.**
4. **All supports and bracing should be outside the Tree Protection Zone. All such supports should minimize damaging roots outside the Tree Protection Barrier.**
5. **No construction activity, grade changes, surface treatment or excavations of any kind is permitted within the Tree Protection Zone.**
6. **Sediment control fencing shall be installed in locations indicated in an Urban Forestry approved Tree Protection Plan. The sediment control fencing must be installed to Ontario Provicial Standards (OPSD-219.110) and to the satisfaction of Urban Forestry.**

TORONTO — Parks, Forestry and Recreation

Urban Forestry — Sept 2008 **Detail TP-1**

5. Site and Landscape Plans – Tree Protection Notes and Graphics

All applications for construction projects must include a site plan and/or landscape plan that includes details on tree protection prepared by or in consultation with a qualified arborist or approved tree professional. All Site and Landscape Plans must include the following information:

Identify size and species of all existing trees on or within 6 metres of the subject site. Show extent of the crown of all existing trees.

Indicate trees to be removed.

Highlight and label tree protection barriers and tree protection zones. (See Table 1 to determine size of tree protection zone. Distances are to be measured from base of tree).

Indicate vehicular access and construction staging areas. Indicate location of any excavation that requires root pruning.

See **Detail TP – 2** for further information.

6. Tree Removal or Relocation

Any requests for removal or injury of a tree protected by City By-laws must be made on the appropriate application forms and submitted to the the Urban Forestry Section. Requests received by the Urban Forestry Section for tree removal or injury will be assessed for approval by the City Forester.. If approval is granted for removal of City owned trees, applicants will assume all costs involved, which include tree value, removal, and replacement costs.

For additional information regarding the removal or relocation of City-owned trees, please call (807) xxx-xxxx

7. Tree Guarantee Deposits

The Manager of Parks may request a Financial Security to guarantee the protection of trees, or the satisfaction of all conditions of permit issuance. In addition, the Manager of Parks may require that a Letter of Acceptance of Responsibility be signed by an applicant. Financial Securities held by the City shall be released by the City provided that the trees are healthy and in a state of vigorous growth 2 years after the completion of all construction activity. It is the applicant's responsibility to advise the Urban Forestry Section that tree protection zones have been created in accordance with approved plans.

For tree planting, the Manager of Parks may request a guarantee in an amount appropriate to secure the planting of trees. A Financial Security may be held by the City after the planting of the trees for a period of 2 years and shall be released by the City provided that the trees are healthy and in a state of vigorous growth 2 years after planting. It is the applicant's responsibility to advise the Urban Forestry Section that trees have been planted in accordance with approved plans.

It is also the applicant's responsibility to submit a written request to the Manager of Parks for the refund of a Tree Guarantee Deposit, 2 years after the completion of all construction activity and/or 2 years after tree planting.

Financial Securities must be in the form of a certified cheque, money order, or letter of credit with amounts payable to the Treasurer of the City of Thunder Bay.

8. Emergency Repairs to Utilities

Emergency repairs to underground utilities are permitted to commence immediately. The utility company concerned is responsible for notifying the Urban Forestry Section by calling as soon as possible when trees are involved, so that an inspector can be dispatched

9. Tree Protection Plan Notes

Detail TP – 2

The following notes are to be provided on all site and landscape plans submitted in support of construction related applications.

TREE PROTECTION ZONE

No construction activity including grade changes, surface treatments or excavations of any kind is permitted within the area identified on the Tree Protection Plan or Site Plan as a Tree Protection Zone (TPZ). No root cutting is permitted. No storage of materials or fill is permitted within the TPZ. No movement or storage of vehicles or equipment is permitted within the TPZ. The area(s) identified as a TPZ must remain undisturbed at all times.

TREE PROTECTION BARRIERS: For City-owned Trees:

Tree protection barriers for trees situated on the City road allowance where visibility must be maintained, can be 1.2m (4ft.) high and consist of chain link, or orange plastic web snow fencing on a 2" x 4" wood frame. All supports and bracing used to secure the barrier should be located outside the TPZ. All supports and bracing should minimize damage to roots outside the TPZ.

Where some fill or excavate has to be temporarily located near a tree protection barrier, plywood must be used to ensure no material enters the TPZ.

If the TPZ needs to be reduced to facilitate construction access, the tree protection barrier must be maintained at a lesser distance and the exposed TPZ protected with plywood and wood chips. This must first be approved by the Urban Forestry Section.

For trees on private property situated on or adjacent to construction sites on public property: Tree protection barriers must be installed around trees to be protected using plywood clad hoarding or an equivalent approved by the Urban Forestry Section. All supports and bracing to safely secure the barrier should be outside the TPZ. All such supports and bracing should minimize damage to roots outside the TPZ.

TREE PROTECTION IN PARKS

The applicant/owner shall protect all trees in the protected area that have not been approved for removal or injury, throughout development works to the satisfaction of the Urban Forestry Section.

Plywood (or chain link fence, if agreed to by the Urban Forestry Section) tree protection hoarding shall be installed in the locations as indicated in the the Urban Forestry Section approved tree protection plan. Tree protection hoarding shall be installed to standards as detailed in the City's Tree Protection Policy and Specifications for Construction near Trees and to the satisfaction of the Urban Forestry Section.

Tree protection hoarding must remain in place and in good condition during demolition and/or construction and must not be altered or moved until authorized by the Urban Forestry Section. Established tree protection zones must not be used as construction access, storage, or staging areas. Grade changes are not permitted within established TPZ.

All additional tree protection or preservation requirements, above and beyond the required tree protection hoarding, must be undertaken or implemented as detailed in the Urban Forestry Section approved arborist report and/or the approved tree protection plan and to the satisfaction of the Urban Forestry Section.

Sediment control fencing shall be installed in the locations as indicated in the Urban Forestry Section approved sediment control plan. The sediment control fencing must be installed to Ontario Provincial Standards (OPSD-219.110) and to the satisfaction of the Urban Forestry Section.

GENERAL NOTE

Prior to the commencement of any site activity, the tree protection barriers specified on this plan must be installed and written notice provided to the Urban Forestry Section. The tree protection barriers must remain in effective condition until all site activities including landscaping are complete. Where required, signs as specified in Section 4 “Tree Protection Signage” must be attached to all sides of the barrier. Written notice must be provided to the Urban Forestry Section prior to the removal of the tree protection barriers.

ARBORICULTURAL WORK

Any roots or branches which extend beyond the TPZ indicated on this plan which require pruning must be pruned by a qualified Arborist or other tree professional as approved by the Urban Forestry Section. All pruning of tree roots and branches must be in accordance with good arboricultural standards. Roots located outside the TPZ that have received approval from the Urban Forestry Section to be pruned must first be exposed by hand digging or by using a low pressure hydro vac method. This will allow a proper pruning cut and minimize tearing of the roots. The Arborist/tree professional retained to carry out crown or root pruning must contact the Urban Forestry Section no less than 48 hours prior to conducting any specified work.

Reference: City of Toronto, Urban Forestry website http://www.toronto.ca/trees/pdfs/TreeProtSpecs.pdf

Identification and Management of Nuisance Trees

Tree By-law 008-2005, Article 2: Philosophy, states:

"The Corporation adopts a philosophy which seeks to preserve rather than remove Public Trees wherever possible and expedient".

It is recommended that public trees shall be removed only when they pose hazards to people or property.

In keeping with Article 2 of the by-law, the complaint is to be assessed. The City of Brampton policy states that tree removal may be granted under circumstances where: The investigating arborist determined there is a major limb presenting a potential hazard to people or property. The City of Brampton policy also states: The following examples of requests for tree removal may be denied. They are not reasonable grounds for removing a tree:

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

In order to not negatively affect the health or structure of a tree, the City may recommend other actions to lessen a particular problem or nuisance.

City of Toronto policy considers removal of nuisance trees only in the context of presenting safety hazards, and requires payment for tree removals by the person placing the request. The policy recognizes fruit drop as a potential slip hazard, stating:

If the City-owned apple or crabapple tree in front of your house is creating a potential safety hazard due to fruit falling onto the sidewalk, private walkways or driveways, Urban Forestry may authorize the removal of the tree subject to the following conditions being met:

You must submit your request for tree removal in writing and send it to Urban Forestry. Urban Forestry staff will assess the merits of each request for tree removal on an individual basis. If tree removal is approved, you must submit payment in the amount of $350 toward the cost of removing the tree. If more than one healthy tree is requested for removal at the same address, a $275 fee will be charged for each additional tree. City staff must perform all tree removals. A standard bare-root tree (approximately 5–8 feet tall) will be planted by Urban Forestry staff as a replacement tree, but if you wish to have a larger balled-and-burlapped tree instead of the standard bare-root tree, you will be required to pay for the cost of the upgraded tree (currently $424) in addition to the $350 fee for the removal.

The City of Thunder Bay may choose to set a standard fee, similar to the City of Toronto, or may consider removal cost based on tree size. If so, removal and replacement of the tree will be offered as a solution using the following criteria:

The City of Thunder Bay will arrange the removal of the tree on its property. Under no circumstance is the homeowner permitted to prune or remove the tree on public property.

The costs are as follows:

Trees up to 10cm DBH -- $500

Trees 11-20 -- $800

Trees 21-35 -- $1500

Trees 36-60 -- $2000

Trees 61-100 -- $3000

Trees over 100 -- $4000

Municipal Trees and Natural Areas Protection By-law No. 2006-279

A by-law of the City of Ottawa respecting the protection and maintenance of trees and natural areas on municipal property.

The Council of the City of Ottawa enacts as follows:

PART I	
GENERAL	
DEFINITIONS	
1.	In this by-law: "arborist" means an expert in the care and maintenance of trees and includes an arborist qualified by the Ontario Ministry of Training, Colleges and Universities, a certified arborist with the International Society of Arboriculture, a consulting arborist registered with the American Society of Consulting Arborists, a Registered Professional Forester or a person with other similar qualifications as approved by the Director; "By-law Officer" means a person appointed by Council of the City of Ottawa as a Municipal Law Enforcement Officer to enforce the provisions of this by-law; "camp" means to stay overnight, erect a structure, hut or tent for the purpose of providing shelter; "cash value" means the cash value, plus all applicable taxes, of the tree determined to be injured or destroyed or to be replaced and will be calculated by the City in accordance with the latest edition of the International Society of Arboriculture Tree Valuation Guide in effect at the time the tree is replaced, or at a value determined by the Director and in effect at the time the injury took place, based on the tree as it existed prior to being injured or destroyed; "Chief of Police" means the Chief of Police for the City of Ottawa or authorized assistants or persons acting under his or her authority; "City" means the municipal corporation of the City of Ottawa or the geographic area of the City of Ottawa as the context requires; "Consent to Enter Permit" means written approval through which the Director gives permission for use of a Municipal Natural Area; "critical root zone" means the area of land within a radius of ten (10) cm from the trunk of a tree for every one (1) cm of trunk diameter; "Director" means the Director of Surface Operations of the Public Works and Services Department of the City of Ottawa or authorized designate, unless otherwise specified; "destroy" means to remove, cut down or in any other way damage a plant or tree to such an extent that it is deemed necessary to remove or cut down the plant or tree; "diameter" means the measurement of the trunk at a height of one hundred and twenty (120) cm for trees of fifteen (15) cm diameter or greater, and at a height of thirty (30) cm for trees of less than fifteen (15) cm diameter; "highway" means a common and public highway and includes any bridge, trestle, viaduct or other structure forming part of the highway and, except as otherwise provided, includes a portion of a highway;

	"injure" means any action which causes physical, biological, or chemical damage to a plant or tree; "Licence of Occupation Agreement" means a written agreement through which the Director of Real Property and Asset Management, on behalf of the City of Ottawa gives permission to a person for use of municipal property; "motorized vehicle" means an automobile, truck, motorcycle, snow vehicle, all terrain vehicle, or any other vehicle propelled or driven by means other than muscular power but does not include a wheelchair or motorized vehicles operating pursuant to the approval of the Director; "municipal natural areas" means natural environment areas, urban natural features, rural natural features, significant wetlands South and East of the Canadian Shield and major open space designated as such in the City of Ottawa Official Plan and includes municipal conservation forests, municipal conservation lands and community woodlands; "municipal property" means any City owned land or property under the jurisdiction of the City and includes, but is not limited to lands designated as municipal natural areas, parks and highways; "park" means a playground, playing field, ball diamond, sports field, beach, recreation centre, community building, facility, square, garden, water, pedestrian walkway or any other area owned, leased or used by the City and devoted to active or passive recreation and includes any lane or walkway or public parking area leading thereto; "person" includes a corporation and the heirs, executors, administrators or other legal representatives of a person to whom the context can apply according to law; "plant" means any specimen, whether living or dead, of any species of flower, shrub or plant and includes any seed, spore, pollen or tissue culture of any such flower, shrub or plant; "trail" means hiking trails, walking paths, snowshoeing paths, cross country ski trails and bicycle trails; "tree" means any species of woody perennial plant, including its root system, which has reached or can reach a minimum height of four hundred and fifty (450) cm at physiological maturity; "tree paint" means a specialized paint that is applied to a cut surface of a tree after pruning; and "waste" means paper, bottles, broken glass, cans, rags, garbage, any plant matter, animal carcass, rubbish, debris, or refuse.
SCOPE	
2.	This by-law applies only to a tree, the trunk of which is located entirely on municipal property.
INTERPRETATION	
(1)	In this by-law, a word interpreted in the singular number has a corresponding meaning when used in the plural.
	It is declared that if any section, subsection, or part or parts thereof be declared by any Court of Law to be bad, illegal or ultra vires, such section, subsection or part or parts shall be deemed to be severable and all parts hereof are declared to be separate and independent and enacted as such.
	In this by-law, the word "centimeter" shall be represented by the abbreviation "cm", and the word "hectare" shall be represented by the abbreviation "ha".
EXEMPTIONS	
4.	The provisions of this by-law do not apply to:
	(a) activities or matters undertaken by a municipality or a local board of a municipality;

	(b)		activities or matters undertaken under a licence issued under the *Crown Forest Sustainability Act, 1994*;
	(c)		the injuring or destruction of trees by a person licensed under the *Surveyors Act* to engage in the practice of cadastral surveying or his or her agent, while making a survey;
	(d)		the injuring or destruction of trees imposed after December 31, 2002 as a condition to the approval of a site plan, a plan of subdivision or a consent under section 41, 51 or 53, respectively, of the *Planning Act* or as a requirement of a site plan agreement or subdivision agreement entered into under those sections;
	(e)		the injuring or destruction of trees imposed after December 31, 2002 as a condition to a development permit authorized by regulation made under section 70.2 of the *Planning Act* or as a requirement of an agreement entered into under the regulation;
	(f)		the injuring or destruction of trees by a transmitter or distributor, as those terms are defined in Section 2 of the *Electricity Act*, 1998, for the purpose of constructing and maintaining a transmission system or a distribution system, as those terms are defined in that Section;
	(g)		the injuring or destruction of trees undertaken on land described in a licence for a pit or quarry or a permit for a wayside pit or wayside quarry issued under the *Aggregate Resources Act*; or
	(h)		the injuring or destruction of trees undertaken on land in order to lawfully establish and operate or enlarge any pit or quarry on land,
		(i)	that has not been designated under the *Aggregate Resources Act* or a predecessor of that Act; and
		(ii)	on which a pit or quarry is a permitted land use under a by-law passed under section 34 of the *Planning Act*.
PART II			
TREES ON MUNICIPAL PROPERTY			
TREE PLANTING			
5.	(1)		The Director may approve the planting of a tree on municipal property.
	(2)		No person shall plant a tree on municipal property without the written approval of the Director.
	(3)		Where a tree is to be planted on municipal property in a hard surfaced area, no person shall plant a tree unless,
		(a)	the tree is installed in a hard surface tree well;
		(b)	the proposed installation of the hard surface tree well is in accordance with the Hard Surface Tree Well Design Standards, as approved by the City;
		(c)	the person agrees to plant and maintain the tree in accordance with the Planting and Maintenance Quality Standards, as approved by the City; and,
		(d)	written approval of the Director for the installation of the hard surface tree well and the tree planting has been obtained.
	(4)		The Director may refuse to permit the planting of a tree, or the planting of any one or more species of trees, on municipal property where, by reason of the nature of the total municipal property needs, the planting of any tree or a particular species of tree is inappropriate or impracticable.

TREE PROTECTION			
6.		No person shall:	
		(a)	injure or destroy the trunk of a tree,
		(b)	affix a poster, notice or sign to a tree,
		(c)	affix any guy line or other fastening or fixture to a tree,
		(d)	utilize a tree paint, or
		(e)	remove branches, trim or alter any tree.
7.	(1)	No person shall carry out work within the critical root zone of a tree whether the work is on municipal property or private property unless the written approval of the Director has been obtained prior to commencing any work.	
	(2)	In making a request for approval pursuant to subsection (1), the following information shall be provided:	
		(a)	the nature of the work to be carried out,
		(b)	the location of the work,
		(c)	the name of the person that will be undertaking the work,
		(d)	the proposed method of carrying out the work, and
		(e)	any additional information as requested by the Director.
8.		Approval of the Director is subject to the person who has requested approval agreeing in writing to the following conditions prior to the commencement of the work:	
		(a)	in the event of injury to any tree as determined by the Director, to reimburse the City for the cost of treatment for the tree or cause the tree to be repaired by a qualified arborist and bear the cost of repairs and labour;
		(b)	in the event that the tree is irreparably injured as determined by the Director, to reimburse the City for the cost of removal and replacement of the tree and pay the City the cash value of the injured tree and the cash value of a replacement tree;
		(c)	to tunnel or bore under the critical root zone unless otherwise approved by the Director;
		(d)	to protect the tree by placing protective fencing around the tree at a distance not closer than the critical root zone or at a location as approved by the Director to ensure minimal damage to the tree;
		(e)	not to use a vehicle or place or store any construction-related materials of any kind within the critical root zone of the tree;
		(f)	not to install or extend a hard surface further into the critical root zone unless approved by the Director;
		(g)	not to lower or raise the existing grade around the tree unless approved by the Director; and
		(h)	such other conditions deemed appropriate by the Director to protect the tree.
9.		For the purposes of clause (b) of Section 8,	
		(a)	a replacement tree shall have a minimum diameter of seven (7) cm measured at thirty (30) cm above ground level and be of a species approved by the Director, and

	(b)	the value of the tree to be replaced will be determined by the Director in accordance with the latest edition of the International Society of Arboriculture Tree Valuation Guide, or at a value determined by the Director and in effect at the time the injury took place.
10.		No person shall fail to comply with the conditions of an approval issued by the Director pursuant to Section 8.
TREE REMOVAL BY CITY		
11.		The Director may approve the removal from municipal property by the City of,
	(a)	dead tree; or,
	(b)	a dangerous, diseased, dying, decayed or broken tree.
TREE REMOVAL BY OTHER PERSONS		
12.	(1)	No person shall destroy a tree unless the person has obtained approval from the Director.
	(2)	Despite subsection (1) where a tree is injured as a result of a motor vehicle accident or other occurrence and must be replaced, as determined by the Director, the person who caused such injury shall reimburse the City for the cost of removal and replacement of the tree and pay the City the cash value of the injured tree and the cash value of a replacement tree.
	(3)	The Director may approve the removal of a tree from municipal property for the purpose of construction of public services including drainage works or by public utilities at the expense of the person requesting its removal, provided that the person requesting its removal:
		(a) obtains a road cut permit issued pursuant to By-law No. 2003-445, as amended, the Road Activity By-law if required;
		(b) agrees in writing to bear the cost of the removal of the tree determined to be injured; and
		(c) agrees in writing to pay the City the cash value of the tree that was removed and the cash value of the replacement tree, prior to the road cut permit being issued.
	(4)	The Director may approve the removal of a tree from a highway which tree by its very existence denies an owner of a property abutting a highway proper access to such owner's property provided that the owner of the property abutting the highway has requested the removal of the tree and has provided evidence to the Director that no practical or economical option for proper access is possible, and has agreed to pay the City the cash value of the tree that was removed and the cash value of a replacement tree.
	(5)	For the purposes of subsections (2), (3), and (4),
		(a) a replacement tree shall have a minimum diameter of seven (7) cm measured at thirty (30) cm above ground level and be of a species approved by the Director, and
		(b) the value of the tree to be replaced will be determined by the Director in accordance with the latest edition of the International Society of Arboriculture Tree Valuation Guide, or at a value determined by the Director and in effect at the time the injury took place.
	(6)	Any tree planted or growing on municipal property contrary to the provisions hereof or contrary to access rights provided by any other municipal by-law may be removed by the Director without notice or recompense.
PART III		
PROTECTION OF MUNICIPAL NATURAL AREAS		
ASSET PROTECTION		

13.	No person shall, in a municipal natural area;	
	(a)	injure or destroy any plant;
	(b)	leave or deposit any waste, except in a receptacle provided for that purpose;
	(c)	wash, clean, polish, service, maintain or, with the exception of any emergency, repair any motorized vehicle;
	(d)	enter onto a municipal natural area where it is signed to prohibit or restrict admission to the public;
	(e)	plant any hedge, tree, shrub or garden;
	(f)	construct or place any fence, building, retaining wall or other structure of any kind;
	(g)	keep any composting receptacle or compost pile; or
	(h)	place any string, wire, chain, rope or similar material.
CONSENT TO ENTER PERMITS		
14.	No person shall, in a municipal natural area,	
	(a)	camp or erect any tent or other structure;
	(b)	set or maintain any open air fire as provided for in the Open Air Fire By-law;
	(c)	conduct scientific research;
	(d)	play any game, sport or activity, with the exception of lawful hunting or fishing activities;
	(e)	discharge, dump or leave any construction material, earth, dirt, rock, snow, stone, or other material;
	(f)	drive any motorized vehicle in an area designated as a trail; or
	(g)	undertake any maintenance activities or alter existing grounds or facilities;
	unless a valid Consent to Enter Permit has been issued by the Director.	
APPLICATION FOR A CONSENT TO ENTER PERMIT		
15.	(1)	A written application for a Consent to Enter Permit may be made by any person provided that person is eighteen (18) years of age or older and the application is made at least fifteen (15) days prior to entry.
	(2)	The Consent to Enter Permit application shall include:
		(a) the name, address and phone number of the applicant;
		(b) the purpose of entry onto a municipal natural area;
		(c) the lot and concession of the location of the activity;
		(d) the time frame, including the commencement date and end date; and
		(e) such other information as may be required by the Director.
16.	The applicant for a Consent to Enter Permit shall indemnify and save harmless the City of Ottawa from any and all claims, demands, causes of action, losses, costs or damages that the City of Ottawa may suffer, incur or be liable for resulting from the use of the natural area whether with or without negligence on the part of the applicant, the applicant's employees,	

	directors, contractors and agents.		
CONDITIONS FOR ISSUANCE OF A CONSENT TO ENTER PERMIT			
17.	No person shall be issued a Consent to Enter Permit for a municipal natural area unless the person,		
	(a)	is eighteen years of age or older;	
	(b)	agrees to indemnify the City in accordance with the provisions of Section 16;	
	(c)	agrees to use the natural area only for the activity specified on the Consent to Enter Permit;	
	(d)	agrees to follow the incident reporting procedures outlined in the Consent to Enter Permit in the event of an incident including contacting City staff and police, paramedic or fire services, as appropriate;	
	(e)	agrees to enter into a License of Occupation Agreement where considered necessary by the Director;	
	(f)	agrees to comply with any other conditions of the Consent to Enter Permit issued by the Director pursuant to Section 18.	
18.	The Director may attach such additional conditions to the Consent to Enter Permit as deemed necessary to ensure public safety, to protect City property or to maintain the enjoyment of the municipal natural area for the public.		
19.	A Consent to Enter Permit issued by the Director is valid only on the date or dates and for the specified activity shown on the Consent to Enter Permit.		
20.	A Consent to Enter Permit issued by the Director is not transferable.		
21.	No holder of a Consent to Enter Permit shall fail to comply with all applicable federal and provincial legislation and regulations and all applicable municipal by-laws.		
22.	No holder of a Consent to Enter Permit shall fail to comply with the conditions of issuance of the Consent to Enter Permit.		
23.	The provisions of this Part shall not apply to the City of Ottawa or its agents, employees or contractors during the course of performing their duties in relation to construction or maintenance activities or other necessary activities in a municipal natural area.		
PART IV			
AMINISTRATION AND ENFORCEMENT			
OFFENCES AND PENALTIES			
24.	(1)	Every person who contravenes any of the provisions of this by-law is guilty of an offence.	
	(2)	Any person who is convicted of an offence under this by-law is liable,	
		(a)	on first conviction, to a fine of not more than $10,000 or $1,000 per tree, whichever is greater;
		(b)	on any subsequent conviction, to a fine of not more than $25,000 or $2,500 per tree, whichever is greater;
		(c)	despite subsection (a) and (b), where the person convicted is a corporation,
			(i) the maximum fines in clause (a) are $50,000 or $5,000 per tree, whichever is greater, and

			(ii)	the maximum fines in clause (b) are $100,000 or $10,000 per tree, whichever is greater.
	(3)	If a person is convicted of an offence for contravening this by-law, the court in which the conviction has been entered, and any court of competent jurisdiction thereafter, may order the person to rehabilitate the land or to plant or replant trees in such a manner and within such period as the court considers appropriate, including any silvicultural treatment necessary to re-establish the trees.		
ENFORCEMENT				
25.	(1)	This by-law shall be enforced by the Chief of Police or by the By-law Officers of the City.		
	(2)	No person shall obstruct or interfere with a By-law Officer in the discharge of his or her duties under this by-law.		
REPEAL				
26.	The following by-laws or portions of by-laws of the former municipalities are repealed:			
	(a)	Chapter 7 of the Regional Regulatory Code, being By-law No 252 of 1992 of the former Regional Municipality of Ottawa-Carleton entitled ''Trees'', as amended; and,		
	(b)	By-law No. 55-93 of the former Corporation of the City of Ottawa entitled “A by-law respecting the protection, maintenance and control of trees on highways and property of the Corporation within the City of Ottawa”, as amended; and,		
	(c)	By-law No. 93-15 of the former Corporation of the Village of Rockcliffe Park entitled “A by-law of the Corporation of the Village of Rockcliffe Park to regulate the planting of shade or ornamental trees upon any highway and prohibiting the removal, cutting, down or injuring of any tree growing upon a highway”, as amended; and,		
	(d)	Part 3 of By-law Number 79-89 of the former Corporation of Rideau entitled “Planting, Removal and Maintenance of Trees” as amended; and		
	(e)	Part 4 of By-Law No 93-64 of the former Corporation of the Township of Nepean entitled “Care of Streets By-law”, as amended.		
SHORT TITLE				
27.	This by-law may be referred to as the “Municipal Trees and Natural Areas Protection By-law”.			
EFFECTIVE DATE				
28.	This by-law shall come into effect on the 1st day of September, 2006.			
	ENACTED AND PASSED this 12th day of July, 2006.			
CITY CLERK	MAYOR			
A by-law of the City of Ottawa respecting the protection and maintenance of trees and natural areas on municipal property.				
Enacted by City Council at its meeting of July 12, 2006.				

Toronto Ravine and Natural Feature Protection Policy

Excerpts:

1.0 Definitions

As used in this chapter, the following terms shall have the meanings indicated, and any abbreviation of a term as noted in brackets shall have a corresponding meaning:

APPLICANT—The registered owner of the property that is the subject of an application under this policy or the registered owner's authorized agent.

APPLICATION—A completed permit application form with supporting documentation as identified in the application package or requested by Urban Forestry for permission to injure or destroy trees, to place or dump fill or refuse, or to alter the grade of land within a protected area.

ARBORIST—A person who is a specialist or expert in the area of the care and maintenance of trees and includes an arborist qualified by the Ontario Training and Adjustment Board Apprenticeship and Client Services Branch, a certified arborist qualified by the International Society of Arboriculture, a consulting arborist registered with the American Society of Consulting Arborists, a registered professional forester or a person with other similar qualifications as approved by the General Manager.

DESTROY—To remove, cut down or in any other way injure a tree to such an extent that it is deemed to be an imminent hazard or it becomes necessary to remove the tree.

EMERGENCY WORK—Includes work associated with drain repairs, utility repairs or structural repairs to a building, work to prevent soil erosion, slipping of soil or damage to trees or any other work of an emergency nature.

FILL—Earth, sand, gravel, rubble, rubbish, garbage, or any other material whether similar to or different from any of these materials, whether originating on the site or elsewhere, used or capable of being used to raise, lower, or in any way effect the contours of the ground.

GENERAL MANAGER—The General Manager of Parks, Forestry and Recreation

GRADE—A defined elevation of land that has been established as a result of geologic, hydrologic, or other natural processes or by human alteration; that defines ravines, depressions, hills, stream channels, eskers or steepness of terrain.

HERITAGE TREE—A tree that has been designated under Part IV of the Ontario Heritage Act

IMMINENT HAZARD—Where a tree has been destabilized or structurally compromised, the supporting roots have failed or are cut or a main stem has cracked and is in immediate danger of breaking causing potential damage or injury to life or property.

INJURE—

A. Not protecting trees in accordance with the City's "Tree Protection Policy and Specifications for Construction Near Trees" or other standards set by the General Manager.

B. Any act or omission that will harm a tree's health in any manner.

OFFICER—Includes an inspector and means a person designated from time to time by Council to enforce this Chapter 5.

OWNER—

A. The registered owner of the property that is the subject of an application under this chapter.

B. For purposes of making an application involving trees, "owner" shall include the owner of either property where the base of a tree straddles a property line or whose property is physically impacted by the roots or crown of a tree on adjacent property.

PERMIT—A permit required under this chapter.

PROTECTED AREA—A shaded area on any Data Map in Schedule 1 including woodlands and buffers.

PROTECTED FEATURE—Any tree, woodland vegetation, or slope in a protected area including:

A. Tableland forests/woodland

B. Ravines.

C. Publicly owned parks and golf courses.

RAVINE—

A. A discernable land form with a minimum two-metre change in grade between the highest and lowest points of elevation that may have vegetation cover and that has or once had water flowing through, adjacent to, or standing on, for some period of the year;

B. Contiguous buffer areas, areas of tree canopy, and environmentally significant areas that contribute to the ecological function of a ravine.

REFUSE—Includes leaves, branches, and logs that have not fallen naturally, roots, construction material, debris, and household garbage.

SPECIFICATIONS FOR CONSTRUCTION NEAR TREES — The most recent version of the City's "Tree Protection Policy and Specifications for Construction Near Trees."

STANDARDS—Minimum requirements or guidelines established by the General Manager pertaining to the protection and preservation of trees and ravines or slopes.

TABLELAND FOREST—Woodland areas that are not contiguous with ravines, including small non-wooded openings that contribute to the ecological function of the woodland.

TREE—A tree of any species and any size.

WOODLAND—A treed area that provides environmental benefits, including erosion prevention, water retention, provision of habitat or recreation.

2.0 Permit Required for Prohibited Activities

A. No person shall, on any land in a protected area, injure or destroy any tree unless authorized by permit to do so.

B. No person shall, on any land in a protected area, place or dump fill or refuse or alter the grade of the land unless authorized by permit to do so.

3.0 Interpretation

A. The City Surveyor may plot the boundary line defining a protected area on a plan or map drawn to a suitable scale, upon request, at the expense of the requestor.

4.0 Exceptions

A. Despite 2A, a permit is not required for protected areas on private property in the following circumstances:

(1) Removal of a dead tree as certified by the General Manager.

(2) Destruction of a tree that represents an imminent hazard to persons or property as certified by the General Manager.

(3) Pruning of a tree in accordance with good arboricultural practice to maintain the health of the tree.

(4) Pruning of tree branches that interfere with utility conductors as certified by the General Manager.

(5) Pruning or removal of fruit trees maintained for fruit production

(6) Emergency work as certified by the General Manager.

(7) Normal maintenance and play enhancement activities within manicured areas of turf of an existing golf course as certified by the General Manager.

(8) Farming, maintenance and management activities.

(9) The erection of any fence if the fence is erected in accordance with the applicable provisions of any zoning by-law or fence by-law, provided that the fence is maintained such that the fence is kept clear of refuse and fill.

B. Despite 2B, a permit is not required in the following circumstances:

(1) Cultivation or tilling of garden beds as long as such work does not affect tree health.

(2) Placing of soil involving an amount of less than five cubic metres for the purposes of maintaining existing manicured areas.

(3) Emergency work as certified by the General Manager.

(4) Normal maintenance and play enhancement activities within manicured areas of turf of an existing golf course as certified by the General Manager.

(5) Farming, maintenance and management activities.

(6) The erection of any fence if the fence is erected in accordance with the applicable provisions of any zoning by-law or fence by-law, provided that the fence is maintained such that the uphill side of the fence is kept clear of refuse and fill

5.0 Filing of Applications; Form and Content

A. An owner who wishes to do any of the following within a protected area shall submit a completed application to the General Manager:

(1) Injure or destroy a tree.

(2) Place or dump fill or refuse.

(3) Alter the grade of land.

B. A completed application shall consist of the following:

(1) The applicant's name, address, and telephone number.

(2) The purpose for which the permit is required.

(3) In the case of an application to injure or destroy a tree:

(a) An inventory of trees and other vegetation.

(b) A tree protection plan.

(c) A tree removal plan.

(d) A tree replacement, woodland management, stewardship, or rehabilitation plan.

(4) In the case of an application to dump fill or refuse or to alter the grade of land:

(a) A grading plan showing existing and proposed conditions

(b) A drainage plan.

(c) A geotechnical report.

6.0 Review of Applications; Issuance of Permits; Conditions

A. Issuance of permits, which may include conditions.

The General Manager shall review all completed permit applications and is authorized to issue permits to injure or destroy trees and to place or dump fill or refuse or alter the grade of land in the following circumstances:

(1) When trees cause or are likely to cause structural damage to load-bearing structures.

(2) Where site plan approval, subdivision approval, consent or Committee of Adjustment approval under the Planning Act 6 has been obtained, and:

(a) Tree injury or destruction is required based on plans approved by the Ontario Municipal Board, City Council, or a final and binding decision of the Committee of Adjustment.

(b) The placing or dumping of fill or the alteration of the grade of land is required based on plans approved by the Ontario Municipal Board, City Council, or a final and binding decision of the Committee of Adjustment.

(3) Where a building permit, front yard or boulevard parking permit or permission for driveway widening has been obtained, and:

(a) Tree injury or destruction is required to facilitate construction in accordance with an approved permit or permission.

(b) The placing or dumping of fill or the alteration of the grade of land is required in order to facilitate construction in accordance with an approved permit or permission.

(4) Pruning of tree roots in accordance with good arboricultural practice causing minimal damage to the trees, provided that the pruning takes place under the direction of an arborist approved

by the General Manager.

(5) In protected areas that have undergone a Schedule B or C Municipal Class Environmental Assessment process.

(6) Where injury or destruction of trees is required to remediate contaminated soil.

(7) Where placement of fill or alteration of grade is required to remediate contaminated soil.

B. Conditions; replacement trees and site restoration.

(1) Where a tree is to be injured or destroyed, the issuance of a permit shall be subject to conditions ensuring that replacement trees are planted to the satisfaction of the General Manager in accordance with the approved tree removal or replacement plan or woodland management or rehabilitation plan submitted by the applicant.

(2) Where replacement planting is not physically possible on site, the General Manager may:

(a) Require replacement planting at another suitable location; or

(b) Accept a cash in lieu payment in an amount equal to 120 percent of the City's cost of replanting and maintaining the required trees for a period of two years.

(3) The General Manager shall obtain a guarantee from the applicant to ensure that the tree removal or replacement plan or woodland management or rehabilitation plan is carried out, and where substantial replanting or site restoration is required or where the applicant has previously violated conditions to a permit, the General Manager may require an applicant to post security acceptable to the General Manager in an amount equal to 120 percent of the total cost of replanting and maintaining the trees for a period of two years or restoring the lands, or both.

(4) Where a tree is to be injured, the issuance of a permit shall be subject to conditions that ensure that the tree is protected in accordance with good arboricultural practices.

7.0 Council Approval Required

The injury or destruction of trees, the placing or dumping of fill or refuse or the alteration of the grade of land must be authorized by City Council in the following circumstances:

A. The tree is a heritage tree.

8.0 Permit Appeals

A. Where the General Manager refuses to issue a permit, an applicant may within 30 days of the date of refusal appeal to City Council through the community council having jurisdiction over the area in which the subject property is located, by written notice delivered to the General Manager setting out the reasons why the applicant believes a permit should be issued and requesting to be heard by the community council.

B. Where an applicant has filed an appeal, the General Manager shall prepare and forward a report on the application to the next community council meeting, setting out the grounds for refusal of the application.

C. Upon reviewing the recommendation on appeal of the community council, City Council may uphold the decision of the General Manager or may direct the General Manager to issue a permit subject to any conditions Council may deem appropriate.

9.0 Power of Entry; Inspection Powers

A. An employee or officer of the City may enter upon on any lands at any reasonable time for the purpose of carrying out an inspection to determine whether:

(1) This policy is being complied with.
(2) The conditions of any permit issued under this policy are being complied with.

B. A person carrying out an inspection under 9A may:

(1) Require the production of documents relevant to the inspection.
(2) Inspect and remove documents or things relevant to the inspection for the purpose of making copies.
(3) Require information from any person concerning a matter related to the inspection.
(4) Alone or in conjunction with a person possessing special or expert knowledge, make examinations and take tests, samples and photographs necessary for the purposes of the inspection.

10.0 Restoration of Site

A person who injures or destroys a tree or places or dumps fill or refuse, or alters the grade of land in a protected area without a permit or in contravention of a condition of a permit, shall replace the tree and remove the fill, or refuse, regrade the area, and take any other steps required to restore the site to its original condition to the satisfaction of the General Manager.

10.1. Removal of Dangerous Trees

The owner or person in charge of any land upon which a tree is situated shall remove or prune to remove any dead, diseased, decayed, damaged, or dangerous tree or branch, certified as such by the General Manager, that poses a danger to persons or property.

11. 0 Offences; Additional Remedies

A. A person who contravenes any provision of this policy is guilty of an offence.

B. A director or officer of a corporation who knowingly concurs in the contravention of this policy is guilty of an offence.

C. A person convicted of an offence under this policy is liable

(1) To a minimum fine of $500 per tree and a maximum fine of $100,000 for the injury or destruction of any tree in a protected area.
(2) To a minimum fine of $500 and maximum fine of $100,000 for any other offence under this policy.
(3) To a special fine of $100,000.

D. Despite 11C, an offence under 2B of this policy is a continuing offence and subject to a minimum fine of $500 and a maximum fine of $10,000 for each day or part of a day that the offence continues

E. Despite 11C, failure to comply with permit conditions in accordance with 6B is a continuing offence and subject to a minimum fine of $500 and a maximum fine of $10,000 for each day or part of a day that the offence continues. **[**

12.0 Remedial Action

Wherever this policy directs or requires any matter or thing to be done by a person, in default of its being done by the person directed or required to do it, the matter or thing may be done under the direction of the General Manager, and the City may recover the costs incurred, from the person directed or required to do it by action or by adding the costs to the tax roll and collecting them in the same manner as property taxes.

13. 0 Conflicting Provisions

To the extent of any conflict between the provisions of this policy and any by-laws of the former municipalities respecting woodlands/buffers, fill and grading and injury or destruction of trees, the provisions of this chapter shall prevail.

Appendix F
Sample Public Relations Materials

ELGIN 2010 CAMPAIGN: The Fit Forest

Trimming the branches
Toning the trees
Pumping the planting
Running the waters
Exercising the ecosystem
Fortifying the future

The Fit Forest is a collaboration to grow a healthy community forest in Elgin today, tomorrow and for generations to come.

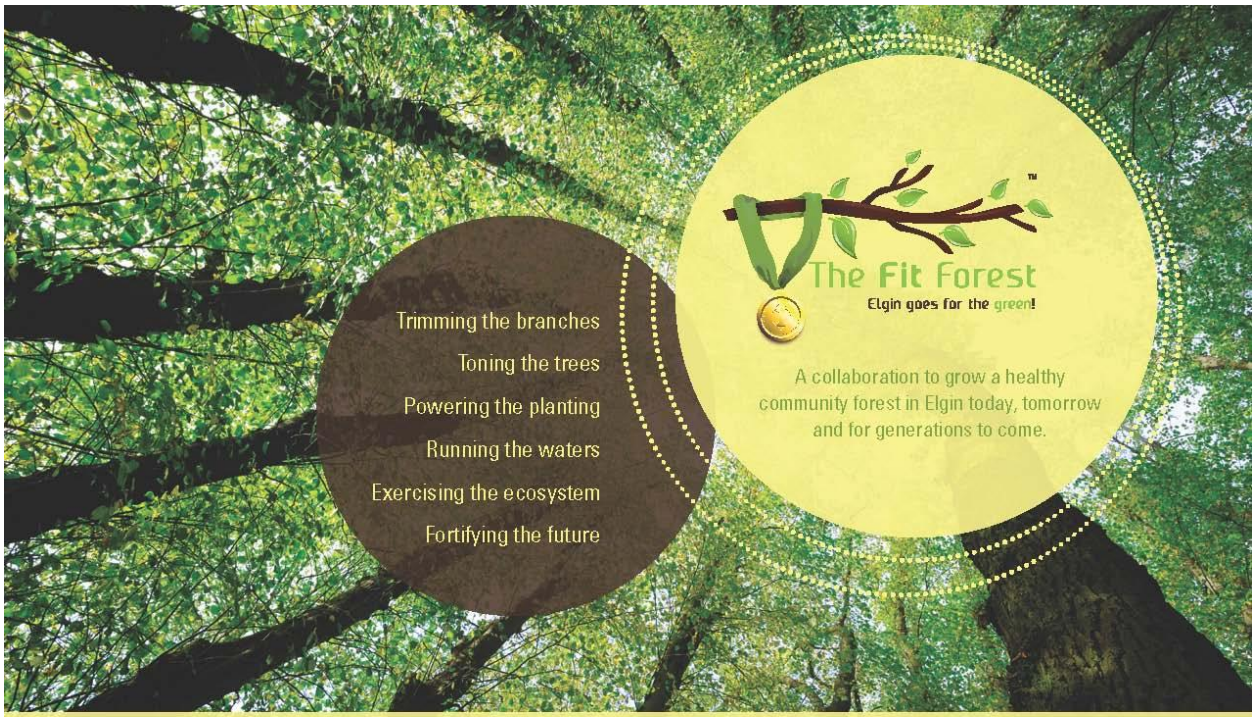
Our city has received a monetary award through the American Recovery and Investment Act of 2009 for Elgin's Public and Community Forest Program. We invite you to work with us throughout the coming year as we invest in preserving and improving the health of the trees in our community through tree maintenance, tree risk reduction, tree planting, maximizing tree benefits (air/water quality, energy use reduction, property value increases, carbon storage, storm water control), controlling invasive pests and diseases, reusing and recycling wood waste and improving the ecosystem.

Campaign elements:

- Residents wear green on campaign launch day and/or other designated day.
- Medals and certificates awarded to residents and businesses by city officials for taking the time to care for Elgin's community forest in their backyard, at their business, in the park, etc. Certificates are printed with blanks to be filled in by city officials.
- Medals hung on trees in key visible locations around Elgin.
- Produce a podcast - visitors go to the campaign page on the city website and tune into news and information on the campaign to get tips on creating a Fit Forest.
- Distribute campaign collateral at fitness centers, sporting goods stores, golf courses, recreation clubs, city-run facilities, and the Elgin Sports Complex. Also consider Kane County Eagles and Lake County Tsunami (semi-pro) team venues, if applicable.
- Create a website or web page on the City website focused on how to plant and care for trees.
- Hold an art contest and display the winning art at the campaign kick-off or at city hall.
- Hold a 5k or 10k Walk/Run for The Fit Forest. Money raised will go to a local charity, environmental organization or the beautification of Elgin.
- Create a Community Tool Kit – Contents include elements ranging from printed educational materials to promotional items including:
  - Collateral piece – Contents include:
    - Front: campaign logo, key messaging, ARRA stimulus and Elgin commitment website address.
    - Back: Education/warning signs of Emerald Ash Borer and other invasives, Tree Benefits Calculator description, web address and instructionsCoupon for a discount on a tree purchase at participating nurseries.
  - Coupon for a discount on a tree purchase at participating nurseries.
  - Refrigerator magnet with seasonal tree care information and instructions for accessing the Tree Benefit Calculator.
  - Magnet or business card with web address and instructs for accessing the Tree Benefit Calculator – designed to calculate the value of trees on your property. Could also be included on the seasonal tree care magnet.
  - Elastic bracelets (like Lance Armstrong bracelets) for residents to wear that say "Elgin goes for the green!" Bracelets can be sold by non-profit groups as a fundraiser and/or sponsored/purchased by businesses to be given out on Arbor Day and other special events . Bracelets can include their business logo.

  **Cost estimates will be provided in advance*

Optional elements: Find a local radio frequency for car radios to tune into to get information on the campaign while sitting in a car in front of 5-10 of the Fit Forest campaign stops.



We invite you to work out with us to grow a healthy community forest in Elgin.

FIT FOREST FACTS

TREES PAY YOU BACK SO GROW YOUR INVESTMENT! A 50-75 year old tree can increase the value of your home $1500 - $2250. For every dollar we invest in public trees, we get $4.61 back in benefits in Elgin.

DISCOVER THE DOLLAR VALUE OF THE TREES ON YOUR PROPERTY WITH THE NATIONAL TREE BENEFIT CALCULATOR. Go to **www.treebenefits.com/calculator**. It only takes a few minutes.

THERE ARE 49,000 PARK AND STREET TREES IN ELGIN. The majority of them are strong and healthy, but small percentages are diseased or present a risk to your street or home. Those trees are being removed for safety reasons and to prevent the spread of disease. New trees will be planted to sustain our public forest.

EMERALD ASH BORER HAS BEEN DETECTED IN ELGIN. This is an insect with the potential to kill every ash tree on our streets and in our parks and yards. And it's spreading rapidly through the transportation of firewood and other ash products.

The most effective defense is early detection. Watch for these warning signs:

- Small, bright metallic green beetle
- Thin, short vertical splits in the bark
- Cream colored, bell-shaped larvae
- Branches start to die at the top of the tree
- "S" shaped patterns across the wood below the bark
- Unusual sprouting of new branches on the trunk and at the base
- Increased woodpecker activity/damage – foraging for the beetle
- D-Shaped emergence holes; 1/8-inch in diameter
- Infected trees can die within two-three years

Find out what you can do! For more information on Emerald Ash Borer, go to **www.agr.state.il.us/eab**

GO FOR THE GREEN

Help us maintain a fit community forest! A greener and cleaner place to live, work and play.

For more information on how you can grow a fit forest in your backyard and in our community, go to **www.cityofelgin.org/trees**
Questions on tree planting and care? Email us at **elginpr@cityofelgin.org** or call Elgin Public Works at **847.931.6069**

The Fit Forest is a partnership between the U.S. Forest Service, the City of Elgin, and the Davey Tree Expert Company. This brochure is printed on recycled paper.

The work upon which this publication is based was funded in whole or in part through a grant awarded by the Northeastern Area State and Private Forestry, U.S. Forest Service.


FIT FOREST CAMPAIGN
Helping you grow a healthy forest in your community. Customize for your city.
© Copyright C.E.L. Public Relations, Inc. and Davey Resource Group 2010.
Fit Forest Brochure
Trimming the branches
Toning the trees
Powering the planting
Running the waters
Exercising the ecosystem
Fortifying the future
The Fit Forest
Elgin goes for the green
A collaboration to grow a healthy community forest in Elgin today, tomorrow and for generations to come.
We invite you to work out with us to grow a healthy community forest in Elgin.
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Unusual sprouting of new branches on the trunk and at the base
Increased woodpecker activity/damage – foraging for the beetle
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The Fit Forest is a partnership between the U.S. Forest Service, the City of Elgin, and the Davey Tree Expert Company. This brochure is printed on recycled paper.
Business Card
The Fit Forest
DISCOVER THE DOLLAR VALUE OF TREES ON YOUR PROPERTY WITH THE NATIONAL TREE BENEFIT CALCULATOR.
Go to www.treebenefits.com/calculator.
It only takes a few minutes.
The Fit Forest is a collaboration to grow a healthy community forest in Elgin today, tomorrow and for generations to come.
Educate residents and distribute at events.
Coupon
GO FOR THE GREEN! PLANT A TREE! Help build a healthy community forest in Elgin today, tomorrow and for generations to come.
This coupon entitles bearer to 10% OFF the purchase of a container tree at John Doe Nursery in Elgin.
Discount on tree purchase at local nursery.
Gold Plated Medallion
A visible award for effort.
Nomination Card
NOMINATE SOMEONE FOR A FIT FOREST AWARD
Do you know an Elgin resident, business or group that is trimming the branches, toning the trees, powering the planting, running the waters, exercising the ecosystem and fortifying the future? Nominate them or yourself for a FIT FOREST AWARD!
Winners receive a Fit Forest gold medal to wear or display proudly on their trees and a Certificate of Merit from the City of Elgin.
To make your nomination, go to www.cityofelgin.org/trees and click on 'Make a Fit Forest Award Nomination' or pick up a nomination form at Elgin City Hall or any Elgin library.
The Fit Forest is a collaboration to grow a healthy community forest in Elgin today, tomorrow and for generations to come.
Reward residents for their efforts.

FIT FOREST CAMPAIGN

Helping you grow a healthy forest in your community. Customize for your city.

Magnet

Seasonal tree care information.

Recycled Gift Bag

A campaign container.

Bracelet

Debossed campaign message "(City) goes for the green". Residents wear proudly.

Certificate

A visible award for effort.

Large Medal for Tree

Custom-made for trees in your community to inspire and inform.

Duffel Bag

A campaign container.


Trees Pay Us Back - Volume 1
i-Tree Results from Minneapolis, MN
iTree


This tree gives back
$1,781
worth of environmental benefits
over the next 15 years.
The Morton Arboretum
RMB
TREES
EVERY TREE COUNTS
CHICAGONOW.COM/GARDEN


$224

Appendix G
City of Thunder Bay Technical Documents
Tree Protection Standards

CURRENT AS OF 23 MARCH 2011-03-23

CTB TREE PROTECTION STANDARDS

The contractor will be responsible for implementing the following Specifications to ensure protection of existing trees within the construction zone:

Trees involved within and immediately adjacent to proposed construction areas shall require strapping or a double wrap of wood slat snow fencing, or other suitable wood planks strapped to the tree trunk to completely protect the tree trunk from impact damage. The minimum size of strapping will be 25 x 150 x 2440mm.

For designated areas, a snow fence or other barrier shall be erected around the tree to at least as far as the brances spread (known as the 'drip line' of the tree) or preferable at a 3.0 m radius protection zone.

No heavy equipment shall be driven over the tree lawn area, to alleviate soil compaction around the tree roots.

No equipment or materials shall be allowed to hit, abrade or otherwise damage the trunk or branches of a tree.

No soil or construction materials shall be piled over the tree lawn areas or around the trunks.

In the event of major reconstruction efforts, the Contractor shall root prune along the length of the work in an approved manner, such as with a chain saw or root pruner. A clean severance of the root system is required. The depth of the cut shall be the same depth as the excavation at the maximum distance from the tree trunk allowed by the pavement within the street right-of-way.

Where excavation and backfill must occur within the 3.0 m radius protective zone, approval must be received from the Contract Administrator. Low-impact methods such as the hydrovac system and trenchless methods such directional drilling under existing trees will be the recommended method of underground installations. Open trenches at the base of trees are not acceptable. Destroying roots in this zone will make the tree structurally unsound and subject to toppling.

Backfilling within the 3.0 m radius protection zone to a depth of 300mm of the finished grade shall be with a 1:1:1 soil mix of soil, sand and peat moss to allow for proper root regeneration.

During the course of construction, the Contractor is to inform the Contract Administrator of any significant damage to a tree. All remedial action must be performed by a qualified tree service that is subject to the approval of the Parks Division. A meeting with a representative of the Parks Division must be held prior to the initiation of remedial action.

If a tree is damaged beyond repair, the Contractor will be responsible for a replacement tree of similar species to the largest transferable caliper.

No additional compensation will be paid for the protection of trees in the work zone.

GUIDELINES AND SPECIFICATIONS FOR THE PLANTING OF MUNICIPAL TREES AND SHRUBS

2011 EDITION

COMMUNITY SERVICES DEPARTMENT
PARKS DIVISION
THUNDER BAY, ONTARIO

GUIDELINES AND SPECIFICATIONS FOR THE PLANTING OF MUNICIPAL TREES AND SHRUBS

The City of Thunder Bay requires that municipal trees must be planted in accordance with the following plans and specifications approved by the Manager. These guidelines and specifications have been prepared to provide Developers and Contractors with the necessary details and criteria for municipal tree planting, in order to avoid delays and facilitate approval processes.

It will be the responsibility of the Developer/Contractor to retain a competent landscape contractor and to ensure that the current City specifications associated with these guidelines are adhered to in every detail.

In this document, reference to Manager indicates either:

a. Manager – Parks Division or his designate for Subdivision Development Agreements, or
b. Project Manager or designate for all other municipal projects that involve tree planting.

This document provides the following information to Developers or Contractors:

1. Approval procedure
2. Guidelines for tree species selection and tree planting locations
3. Specifications for Topsoil for Planting
4. Specifications for the Planting of Trees and Shrubs

This document is to be read in conjunction with the City of Thunder Bay Engineering Tree Planting Details:

1. Engineering Standard Drawing M-104-1 Deciduous Tree Bare Root Planting
2. Engineering Standard Drawing M-104-2 Coniferous Tree Planting
3. Engineering Standard Drawing M-104-3 Deciduous Tree Planting
4. Engineering Standard Drawing M-104-6 Shrub Planting

Section 1. TREE PLANTING APPROVAL PROCEDURE

The approval procedure applies to tree planting on all municipal lands, which includes:

- planting through Subdivision Development Agreements
- planting through Engineering Construction projects
- planting through all other municipal projects

Item 1.1 applies only to Subdivision Development Agreements, whereas items 1.2 to 1.7 inclusive, apply to all municipal tree planting projects.

1.1 Subdivision Plan Approval

1. The Developer shall submit to the Planning Division a Street Plan, clearly indicating the details as listed below.
2. Generally, one boulevard tree shall be planted in front of each lot as well as two along the flankage of corner lots.
3. A review by the Manager - Parks Division will not be undertaken unless all of the details listed have been provided and are conforming to Section 2.2: Guidelines for Tree Planting Locations.

   .1 Location of curbs and boulevards
   .2 Location of public sidewalks
   .3 Location of private driveways
   .4 Location of underground structures
   .5 Location of above ground structures
   .6 Proposed location of boulevard trees
   .7 Proposed species Botanical Name of boulevard trees

4. After Plan approval has been received, the Developer shall provide the Manager – Parks Division with a final copy of the approved Planting Plan.

1.2 Utility Locates

1. The Developer/Contractor at their own expense, if any, shall obtain utility locates prior to marking tree locations.

1.3 Marking of Tree Locations

1. The Developer/Contractor shall mark or stake tree locations on municipal property while conforming to Section 2.2: Guidelines for Tree Planting Locations and then request an on-site inspection by the Manager.
2. The Developer/Contractor shall be responsible for the layout of all work areas, in accordance with the drawings, and shall take care to protect all base lines or control points until construction is completed.

1.4 Approval of Tree Locations

1. The Manager will inspect the staked tree locations in a timely manner and notify the Developer/Contractor of any revisions that may be required, or will approve the proposed tree locations as staked.
2. After approval has been received, the Developer/Contractor shall proceed with the planting project in accordance with the approved plans and specifications.

1.5 Notification of Planting

The Developer/Contractor shall provide the Manager with:

.1 A minimum 14 day notification of the start of a planting project to facilitate inspections during the process.

.2 Notification of completion of planting.

1.6 Acceptance Inspection

1. Plant material will be accepted by the Project Manager 60 days after planting operation is completed providing that plant material exhibits a healthy growing condition and is free from disease, insects and fungal organisms.
2. Plant material installed less than 60 days prior to frost will be accepted in the following spring, 30 days after start of growing season provided that acceptance conditions are fulfilled.

1.7 End of Warranty Inspection

1. Prior to expiration of the Developer/Contractor's maintenance and warranty period (2 years or as amended), the Manager will inspect the trees and notify the Developer/Contractor of any replacements required or other deficiencies, which may require correction.
2. It is expected that trees will be healthy as defined in Specification Section 02950 Tree and Shrub Planting. Upon satisfactory completion, the Manager will issue a letter of acceptance, which will release the Developer/Contractor of all further responsibilities for the municipal trees.

Section 2 TREE PLANTING GUIDELINES

2.1 Acceptable Tree Species for Boulevard and Park Planting

1. In subdivisions, generally only one deciduous tree species will be planted on any one residential street block, although a species change may be required according to the requirements of 2.1.4.
2. It is recommended that a variety of tree species be planted on boulevards to encourage biodiversity in neighbourhoods.
3. Depending on the width of the existing or proposed boulevard, an appropriate species shall be chosen by selecting a smaller- to medium-sized species for narrow boulevards (generally less than 2 m) and a larger species for wider boulevards (generally greater than 2 m).

4. Small-stature trees shall be selected for planting under utility wires, in proximity to light standards and in small planting spaces.
5. Large-stature trees are greater than 15m in height; medium-stature trees are between 7.5m and 15m in height; small-stature trees are less than 7.5m in height.
6. Deciduous trees shall have the minimum caliper size specified. Coniferous trees shall have the minimum height size specified. All trees shall be machine dug into wire basket.
7. The following is a list of tree species and their minimum planting sizes, which are acceptible for boulevard and park planting:

.1 **Large-stature Trees:**

	Common Name	Botanical Name	Size	Condition
Suitable for Subdivision Planting	Manitoba Maple	*Acer negundo* 'Baron'	60 mm	Wire basket
	Silver Maple	*Acer saccharinum*	60 mm	Wire basket
	Delta Hackberry	*Celtis occidentalis* 'Delta'	60 mm	Wire basket
	Northwest Poplar	*Populus x jaackii* 'Northwest'	60 mm	Wire basket
	Bur Oak	*Quercus macrocarpa*	60 mm	Wire basket
	Red Oak	*Quercus rubra*	60 mm	Wire basket
	American Linden/Basswood	*Tilia americana*	60 mm	Wire basket
	Dropmore Linden	*Tilia flavescens* 'Dropmore'	60 mm	Wire basket
	Norlin Linden	*Tilia cordata 'Norlin'*	60 mm	Wire basket
Suitable to Park Planting: In addition to above species	Laurel Leaf Willow	*Salix pentandra*	60 mm	Wire basket
	White Spruce	*Picea glauca*	1500 – 1750mm	Wire basket
	Blue Spruce	*Picea pungens*	1500 – 1750mm	Wire basket
	Red Pine	*Pinus resinosa*	1500 – 1750mm	Wire basket
	Larch/Tamarack	*Larix laricina*	1500 – 1750mm	Wire basket
	American White Cedar	*Thuja occidentalis*	1500 – 1750mm	Wire basket

.2 **Medium-stature Trees:**

	Common Name	Botanical Name	Size	Condition
Suitable for Subdivision Planting	Northwood Red Maple	*Acer rubrum* 'Northwood'	60 mm	Wire basket
	Unity Sugar Maple	*Acer saccharum* 'Jefcan'	60 mm	Wire basket
	Discovery Elm	*Ulmus davidiana* 'Discovery'	60 mm	Wire basket
Suitable to Park Planting: In addition to above species	Ohio Buckeye	*Aesculus glabra*	60 mm	Wire basket
	Northern Acclaim Honeylocust	*Gleditsia triacanthos* 'Harve'	60 mm	Wire basket
	Butternut	*Juglans cinerea*	60 mm	Wire basket
	Tower Poplar	*Populus x canescens* 'Tower'	60 mm	Wire basket
	Jack Pine	*Pinus banksiana*	1500 – 1750mm	Wire basket

.3 **Small-stature Trees:**

c)

Common Name	Botanical Name	Size	Condition
Amur Maple	*Acer ginnala*	50 mm	Wire basket
Goldrush Amur Chokecherry	*Prunus maackii* 'Jefree'	60 mm	Wire basket
Spring Snow Crabapple	*Malus* x 'Spring Snow'	60 mm	Wire basket
Pink Spires Crabapple	*Malus x adstringens* 'Pink Spires'	60 mm	Wire basket
Japanese Tree Lilac	*Syringa reticulata*	60 mm	Wire basket
Russian Mountain Ash	*Sorbus aucuparia* 'Rossica'	60 mm	Wire basket

Suitable for subdivision or park planting

N.B. Other tree species may be acceptable to the Manager but require prior approval before using. All plants, trees, and their rootstocks shall meet the criteria set out by the "Plant Research Institute of Agriculture Canada" and be proven hardy for Zones 3A or 3B. The origin of root stock or seed source may be requested.

2.2 Tree Planting Locations

1. Trees shall be planted as close as possible to the centre line of the boulevard while respecting setbacks identified in 2.2.3 and 2.2.4. They should be located at least 1.7 m from back of curb, whenever possible, unless otherwise specified by the Manager - Parks Division.
2. In general, boulevard trees shall be planted at equal intervals, which may vary depending on their ultimate size, in accordance with the following schedule:

.1	Large-stature trees	13-16 m apart
.2	Medium-stature trees	10-13 m apart
.3	Small-stature trees	7-10 m apart

3. Boulevard and park trees shall be planted at minimum distances from above ground structures as indicated below:

.1	Minimum distance from street intersections	9 m
.2	Minimum distance from light standards	3 m
.3	Minimum distance from private approaches	3 m
.4	Minimum distance from hydrants	3 m
.5	Minimum distance from hydro poles	3 m
.6	Minimum distance from manholes	3 m
.7	Minimum distance from water valves	3 m
.8	Minimum distance from stop or yield sign	15m
.9	Minimum distance from traffic signals	30m

4. Boulevard and park trees shall be planted at minimum distances from below ground structures as indicated below:

.1	Minimum distance from sewer and water	3 m
.2	Minimum distance from fibre optics	2 m
.3	Minimum distance from gas	1 m
.4	Minimum distance from hydro	1 m
.5	Minimum distance from telephone	1 m

Section 3. SPECIFICATIONS

This section contains the following technical specifications that must be adhered to for all tree and shrub planting on Municipal lands:

1. Specification section 02921 Topsoil for Planting
2. Specification section 02950 Planting of Trees and Shrubs

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 02950: Planting of Trees and Shrubs.

1.2 REFERENCES

.1 Agriculture and Agri-Food Canada
  .1 The Canadian System of Soil Classification, Third Edition, 1998.

.2 Canadian Council of Ministers of the Environment
  .1 PN1340-2005, Guidelines for Compost Quality.

.3 U.S. Environmental Protection Agency (EPA)/Office of Water
  .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 DEFINITIONS

.1 Project Manager: Project Manager or designate

.2 Compost:
  .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
  .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
  .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below 50, and contain no toxic or growth inhibiting contaminates).
  .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category A.

.3 Native Soil: Soil excavated from the planting hole location; all stone, rubble and other deleterious material greater than 50mm shall be removed.

1.4 SUBMITTALS

.1 Provide submittals as required in accordance with drawings.

.2 Quality control submittals :
  .1 Soil testing: submit certified test reports showing compliance with specified performance characteristics and physical properties as described in PART 2.3 - SOURCE QUALITY CONTROL.
  .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 QUALITY ASSURANCE

.1 Pre-installation meetings: conduct pre-installation meeting, if required, to verify project requirements, installation instructions and warranty requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with local regulations.

.2 Divert unused soil amendments from landfill to official hazardous material collections site approved by Project Manager.

.3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

2 PRODUCTS

2.1 TOPSOIL

.1 Topsoil for planting, seeded and sodded areas: mixture of mineral particulates, micro organisms and organic matter which provides suitable medium for supporting healthy plant growth.
- .1 Soil texture based on The Canadian System of Soil Classification, to consist of 45 % sand, 35 % silt, and 20 % clay by weight, with 5 to 10% organic matter.
- .2 PH value 6.0 to 7.5.
- .3 Contain no toxic elements or growth inhibiting materials.
- .4 Finished surface free from:
  - .1. Debris and stones over 50 mm diameter.
  - .2. Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
  - .3. Couch or crabgrass rhizomes.
- .5 Consistence: friable when moist.

2.2 SOIL AMENDMENTS

.1 Fertilizer to be added as required to achieve the following minimum standards:
- .1 Fertility: major soil nutrients present in following amounts:
  - .1. Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
  - .2. Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
  - .3. Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
  - .4. Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of

intended vegetation.
.2 PH value: 6.5 to 8.0.
.3 Fertilizer containing phosphorus may only be applied subsurface.
.4 Surface application of fertilizer may only be conducted using phosphorus-free fertilizers.

.2 Peatmoss:
.1 Derived from partially decomposed species of Sphagnum Mosses.
.2 Elastic and homogeneous, brown in colour.
.3 Free of wood and deleterious material which could prohibit growth.
.4 Shredded particle minimum size: 5 mm.

.3 Sand: washed coarse silica sand, medium to course textured.

.4 Organic matter: compost Category A in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.

.5 Use composts meeting Category B requirements for land fill reclamation and large scale industrial applications.

.6 Limestone:
.1 Ground agricultural limestone containing minimum calcium carbonate equivalent of 85%.
.2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.

.7 Bone Meal:
.1 Finely ground with a minimum analysis of 20% phosphoric acid.

.8 Manure:
.1 Well rotted and aged a minimum of three years.
.2 May be sheep or steer manure.

.9 Mushroom Compost

2.3 SOURCE QUALITY CONTROL

.1 Advise Project Manager of sources of topsoil to be utilized with sufficient lead time for testing, a minimum of 7 days in advance of starting work.

.2 Contractor is responsible for soil analysis and requirements for amendments to supply topsoil as specified.

.3 Soil testing by recognized testing facility for PH, P and K, and organic matter.

.4 Testing of topsoil will be carried out by testing laboratory approved by Project Manager.
.1 Soil sampling, testing and analysis to be in accordance with Provincial standards.

3. EXECUTION

3.1 SURPLUS MATERIAL

.1 Dispose of materials except topsoil not required where directed by Project Manager off site.

3.2 CLEANING

.1 Ensure all excess material on hard surfaces to be cleaned and washed away.

.2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

1 GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 Materials and installation for plant material, accessories, mulch, planting, tree support, mulching and maintenance.

.2 Related Section:
- .2 Section 02921 – Topsoil for Planting

1.2 REFERENCES

.1 Agriculture and Agri-Food Canada (AAFC).
- .1 Plant Hardiness Zones in Canada-2000.

.2 Canadian Nursery Landscape Association (CNLA).
- .1 Canadian Standards for Nursery Stock, 8th Edition.

.3 City of Thunder Bay Engineering Tree Planting Details (in effect at time of planting)

1.3 DEFINITIONS

.1 Mycorrhiza: association between fungus and roots of plants. This symbiosis enhances plant establishment in newly landscaped and imported soils. For this project, the MYKE Pro Landscape product from Premier Tech Biotechnologies or an equivalent approved by the Canadian Food Inspection Agency (CFIA) must be used. Note that this product has an expiration date and an application chart which must be respected.

.2 Healthy Trees: structurally sound with structure and habit typical of the species; well furnished with living foliage; have normal colour; show adequate annual growth and formation of buds; and free from blight of any description.

.3 Project Manager: Project Manager or designate.

1.4 SUBMITTALS

.1 Make submittals as required.

.2 Submit product data for:
- .1 Fertilizer.
- .2 Mycorrhiza: Proof of purchase is required to show that the appropriate quantity of product was obtained. The quantity required is established from the application chart and depends on the number and sizes of plants.
- .3 Guying assembly including stakes and jute.
- .4 Mulch.

1.5 QUALITY ASSURANCE

.1 Health and Safety:
- .1 Conduct construction occupational health and safety in accordance with City of Thunder Bay Health and Safety Policies and Procedures.

1.6 STORAGE AND PROTECTION

.1 Store mycorrhizae product in an area to prevent freezing and intense heat.

.2 Protect plant material from frost, excessive heat, wind and sun during delivery.

.3 Immediately store and protect plant material which will not be installed within 1 hour after arrival at site in storage location approved by Project Manager. All trees that cannot be planted immediately upon arrival on the site shall be well protected to prevent drying out and shall be kept moist until commencement of planting.

.4 Protect plant material from damage during transportation:
- .1 When delivery distance is less than 30 km and vehicle travels at speeds under 80 km/h, tie tarpaulins around plants or over vehicle box.
- .2 When delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/h, use enclosed vehicle where practical.
- .3 Protect foliage and root balls using tarpaulins, where use of enclosed vehicle is impractical due to size and weight of plant material.
- .4 Trees shall be transported with care taken to prevent tissue damage. Branches shall be carefully tied in such a manner so as not to break or damage trunks. Points of contact with equipment shall be padded. Trees with broken or abraded trunks or branches are not acceptable. Trees with damaged trunks, however caused, will be rejected. No exceptions will be made in this respect.

.5 Protect stored plant material from frost, wind and sun and as follows:
- .1 For bare root plant material, preserve moisture around roots by heeling-in or burying roots in sawdust or topsoil and watering to full depth of root zone.
- .2 For pots and containers, maintain moisture level in containers.
- .3 For balled and burlapped and wire basket root balls, place to protect branches from damage. Heel in root balls and maintain moisture level in root zones.

.6 Waste Management and Disposal:
- .1 Separate waste materials for reuse and recycling in accordance with local regulations.
- .2 Forward empty bags of the MYKE Pro Landscape to the Project Manager. Make sure that the lot number and the expiration date are readable.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling.

.5 Separate for reuse and recycling and place in designated containers Steel, Metal, and Plastic waste.
.6 Place materials defined as hazardous or toxic in designated containers.
.7 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.
.8 Divert unused metal materials from landfill to metal recycling facility as approved by Project Manager.
.9 Fold up metal and plastic banding, flatten and place in designated area for recycling.
.10 Divert discarded plastic plant containers materials from landfill to plastic recycling facility approved by Project Manager.
.11 Dispose of unused fertilizer at official hazardous material collection site approved by Project Manager.
.12 Divert unused wood and mulch materials from landfill to composting facility approved by Project Manager.

1.7 SCHEDULING

.1 Obtain approval from Project Manager of schedule14 days in advance of shipment of plant material.

.2 Schedule to include:
.1 Quantity and type of plant material.
.2 Shipping dates.
.3 Arrival dates on site.
.4 Planting dates.

1.8 WARRANTY

.1 The Contractor hereby warrants that plant material as itemized on plant list will remain free of defects in accordance with General Conditions (GC) - CCDC GC 12.3, for **two full years** after planting providing adequate maintenance has been provided.

.2 End-of-warranty inspection will be conducted by Project Manager.

.3 Project Manager reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

2 PRODUCTS

2.1 PLANT MATERIAL

.1 Type of root preparation, sizing, grading and quality: comply with Canadian Standards for Nursery Stock.
- .1 Source of plant material: grown in location no greater than Zone 4 in accordance with Plant Hardiness Zones in Canada.
- .2 Plant material must be planted in zone indicated as appropriate for its species and be proven hardy for Zones 3A or 3B.
- .3 Plant material planted in a location appropriate for its species.

.2 Plant material: free of disease, insects, rodent damage, sun scald, frost cracks and other abrasions or scars to the bark. Will be structurally sound with strong fibrous undamaged root system. All parts of the trees shall be moist and show live, green cambium tissue when cut.

.3 Plant material: root pruned regularly, but not later than one growing season prior to arrival on site.

.4 Trees: shall be nursery grown and of species and sizes indicated on the drawings(s), except that plants larger than specified may be used if approved by the Project Manager. Tree quality and referent measurements shall be in accordance with the Canadian Standards for Nursery Stock, 8th Edition. Trees shall have straight trunks and be well and characteristically branched for species, except where specified otherwise.

.5 Balled and burlap stock: all burlap and twine used shall be non-treated and 100% biodegradable.

.6 Bare root stock: nursery grown, in dormant stage, not balled and burlapped or potted.

.7 Collected stock: maximum 40 mm in caliper, with well developed crowns and characteristically branched; no more than 40% of overall height may be free of branches. The use of collected stock will not be permitted unless approved by the Project Manager.

.8 Specifications for deciduous trees: Relationship between caliper (measured 300 mm above ground level), overall height (not exceeding the upper limit of the range), branching height, minimum number of branches in head and minimum root spread.

Caliper	Acceptable range of overall Height	Minimum Branching Height	Min. No. of Branches	Minimum Root Spread	Stock Type
50mm	2500 - 3500 mm	1000 mm	10	650 mm	Balled & Burlapped, Wire Basket
60mm	2500 - 3500 mm	1500 mm	12	700 mm	Balled & Burlapped, Wire Basket
75mm	2500 - 3500 mm	1500 mm	14	800 mm	Balled & Burlapped Wire Basket

Note: Caliper shall be considered minimum measurements.

.9 Substitutions – All materials shall be supplied as specified, unless the Manager approves substitutions in writing.

2.2 WATER

.1 Free of impurities that would inhibit plant growth.

2.3 STAKES

.1 Wood, pointed one end, 38 x 38 x 2300 mm.

2.4 GUYING COLLAR

.1 75mm wide Jute affixed to stake with 12mm long steel staples.

2.5 MULCH

.1 Shredded wood: varying in size from 25 to 125 mm in length, from coniferous trees or approved equal.

2.6 FERTILIZER

.1 In quantities and ratio as required by soil testing.

.2 Fertilizer containing phosphorus may only be applied subsurface.

.3 Surface application of fertilizer may only be conducted using phosphorus-free fertilizers and scheduled fertilizing may only be conducted using phosphorus-free fertilizers.

2.7 MYCORRHIZA

.1 Powdered form soil additive.
.2 Myke Pro Landscape or approved equal. PremierTech Biotechnologies (800) 606-6926

.3 Application rates as specified by the manufacturer shall be adhered to.

2.8 SOURCE QUALITY CONTROL

.1 Approval of plant material shall be obtained from Project Manager prior to planting.

.2 The origin of root stock or seed source may be requested.

.3 Imported plant material must be accompanied with necessary permits and import licenses. Conform to Federal, Provincial or Territorial regulations.

.4 All trees to retain original nursery tags indicating full botanical name until acceptance inspection.

3 EXECUTION

Trees must be planted by an established, professional landscaping contractor or under the direct supervision of an individual with demonstrated experience in urban tree planting. The Developer/Contractor shall submit the names of either the landscaping contractor or planting supervisor to the Project Manager prior to planting.

3.1 TIME OF PLANTING

.1 For Subdivision Tree Planting: Boulevard tree planting shall not commence until the lot is improved, all underground structures have been installed and the boulevard is finish graded.
.2 Trees shall not be planted when the ground is in frozen condition or during periods of extreme heat.
.3 The City reserves the right to refuse acceptance of any or all trees failing to meet the above timing restrictions.

3.2 PRE-PLANTING PREPARATION

.1 Conduct construction occupational health and safety in accordance with City of Thunder Bay Health and Safety Policies and Procedures.

.2 Ensure plant material acceptable to Project Manager.

.3 Prune damaged roots and branches from plant material. Only remove minimum amount necessary. Pruning shall be done according to accepted horticultural standards and in such a manner as to preserve the natural character of the plants. Leaders shall not be removed. Only clean, sharp tools shall be used. All cuts shall be clean. Branches will be cut at the branch collar, leaving no stubs.

.4 Refer to relevant Engineering Planting Detail(s):
.1 M-104-1 Deciduous Tree Bare Root Detail

.2 M-104-2 Coniferous Tree Planting Detail
.3 M-104-3 Deciduous Tree Planting Detail
.4 M-104-6 Shrub Planting Detail

3.3 EXCAVATION AND PREPARATION OF PLANTING BEDS

.1 For individual planting holes:
- .1 Stake out location and obtain approval from Project Manager prior to excavating.
- .2 Excavate to depth and width as indicated. Also, refer to 3.3.3.
- .3 Remove subsoil, rocks, roots, debris and toxic material from excavated material that will be used as planting soil for trees and individual shrubs. Dispose of excess material.
- .4 Scarify sides of planting hole.
- .5 Remove water which enters excavations prior to planting. Notify Project Manager if water source is ground water.

3.4 PLANTING

.1 Trees shall be lifted by the root ball and **not** by the trunk when being moved or set into the planting hole.

.2 Root systems of balled specimens shall be handled with sufficient care so that root balls shall not be broken. Broken balls or balls consisting of loose soil will not be accepted and shall be replaced.

.3 Whenever necessary, remove soil from the top of the root ball to uncover the root collar, which is the point of attachment of root to trunk and coincides with the area of root flare. Depth of planting hole shall be determined based on location of the root collar according to the following criteria:
- .1 In moist, well-drained soils, set the root ball so that the root collar is exactly at finished grade.
- .2 In poorly drained and/or compacted soils, set the root ball so that the root collar is 75-100 mm above the finished grade.
- .3 In very sandy or droughty soils, set the root ball so that the root collar is slight deeper than finished grade.

.4 For bare root stock, place 50 mm backfill soil in bottom of hole. Plant trees and shrubs with roots placed straight out in hole.

.5 For trees that are balled and burlapped or have wire baskets, once the root ball has been set in its final position, cut away and remove the top one half of burlap wrapping, twine and wire basket. Do not pull burlap, rope or wire basket from under root ball.

.6 For container stock, remove entire container without damaging root ball.

.7 Plant vertically in locations as indicated. Orient plant material to give best appearance in relation to structure, roads and walks.

.8 Add mycorrhiza around root ball prior to backfilling as per manufacture's recommended application rate.

.9 For trees and shrubs:
- .1 Backfill soil in 150 mm lifts with a mixture of 60% native soil and 40% approved topsoil. Tamp each lift to eliminate air pockets. When two thirds of depth of planting pit has been backfilled, fill remaining space with water. After water has penetrated into soil, backfill to finish grade.
- .2 Form a soil saucer around tree base as indicated.

.10 Water plant material thoroughly and in such a way as to prevent surface erosion.

.11 After soil settlement has occurred, fill with soil to finish grade.

.12 Remove all twine, flagging tape, and wrap from branches and stem of trees.

.13 Dispose of burlap, wire and container material off site.

3.5 TREE SUPPORTS

.1 Install tree supports as indicated on the relevant Engineering Planting Detail, ensuring that branches are not broken.

3.6 MULCHING

.1 Ensure soil settlement has been corrected prior to mulching.

.2 Spread mulch as indicated on the Engineering Planting Detail.

3.7 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following maintenance operations from time of planting to acceptance by Project Manager.
- .1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
- .2 For evergreen plant material, water thoroughly in late fall prior to freeze-up to saturate soil around root system.
- .3 Remove weeds as required.
- .4 Replace or respread damaged, missing or disturbed mulch.
- .5 If required to control insects, fungus and disease, use appropriate control methods in accordance with Federal, Provincial and Municipal regulations. Obtain product approval from Project Manager prior to application.
- .6 Remove dead or broken branches from plant material. Pruning shall be done in such a manner as to preserve the natural character of the plants

and according to accepted horticultural standards.. Leaders shall not be removed. Only clean, sharp tools shall be used. All cuts shall be clean and at the branch collar, leaving no stubs.

.7 Keep tree support in proper repair and adjustment.

.8 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.

3.8 ACCEPTANCE

.1 Plant material will be accepted by Project Manager 60 days after planting operation is completed providing that plant material exhibited healthy growing condition and is free from disease, insects and fungal organisms.

.2 Plant material installed less than 60 days prior to frost will be accepted in the following spring, 30 days after start of growing season provided that acceptance conditions are fulfilled.

3.9 MAINTENANCE DURING WARRANTY PERIOD

.1 From time of acceptance by Project Manager to end of warranty period, perform following maintenance operations.

.1 Water to maintain soil moisture conditions to a depth of 300 mm min. for optimum growth and health of plant material without causing erosion.

.2 Reform damaged soil saucers.

.3 Remove weeds as required.

.4 Replace or respread damaged, missing or disturbed mulch.

.5 If required to control insects, fungus and disease, use appropriate control methods in accordance with Federal, Provincial and Municipal regulations. Obtain product approval from Project Manager prior to application.

.6 Apply fertilizer in early spring as indicated by soil test.

.7 Remove dead, broken or hazardous branches from plant material.

.8 Keep tree supports in proper repair and adjustment.

.9 Remove tree supports and remaining species labels and level soil saucers at end of warranty period.

.10 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.

.11 Submit monthly written reports to Project Manager identifying:

.1. Maintenance work carried out.

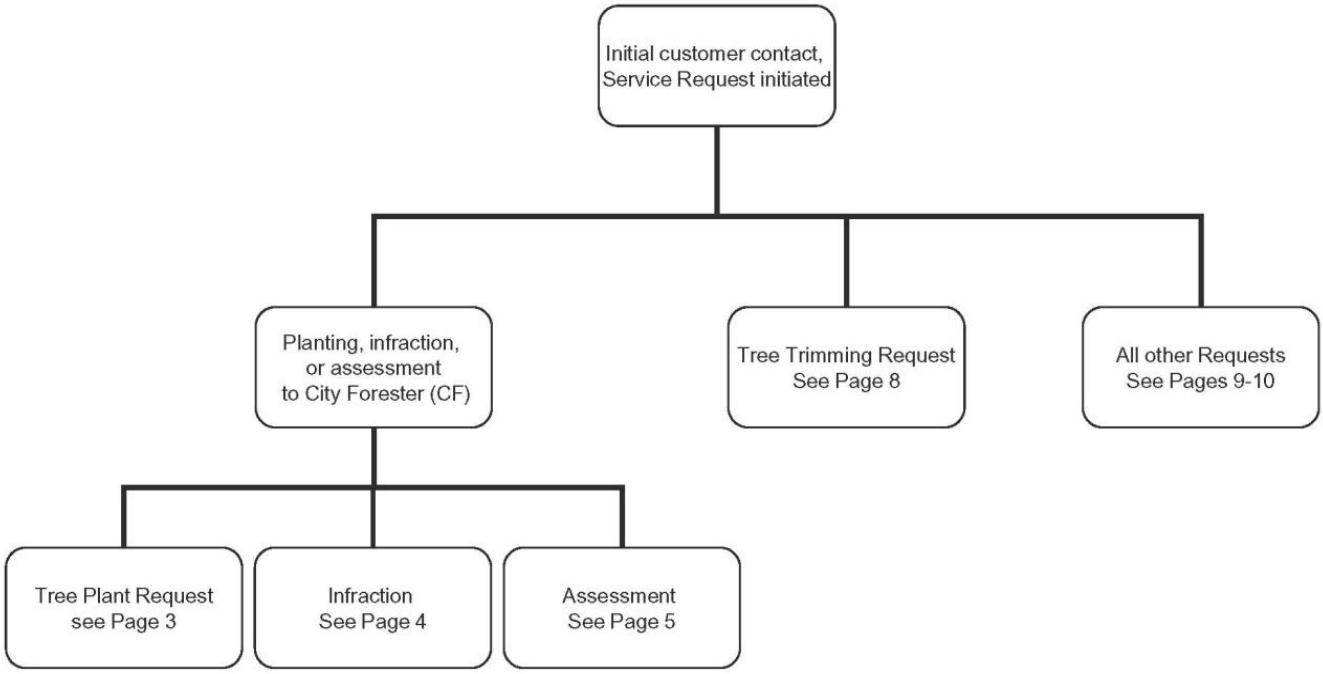
.2. Development and condition of plant material.

.3. Preventative or corrective measures required which are outside Contractor's responsibility.

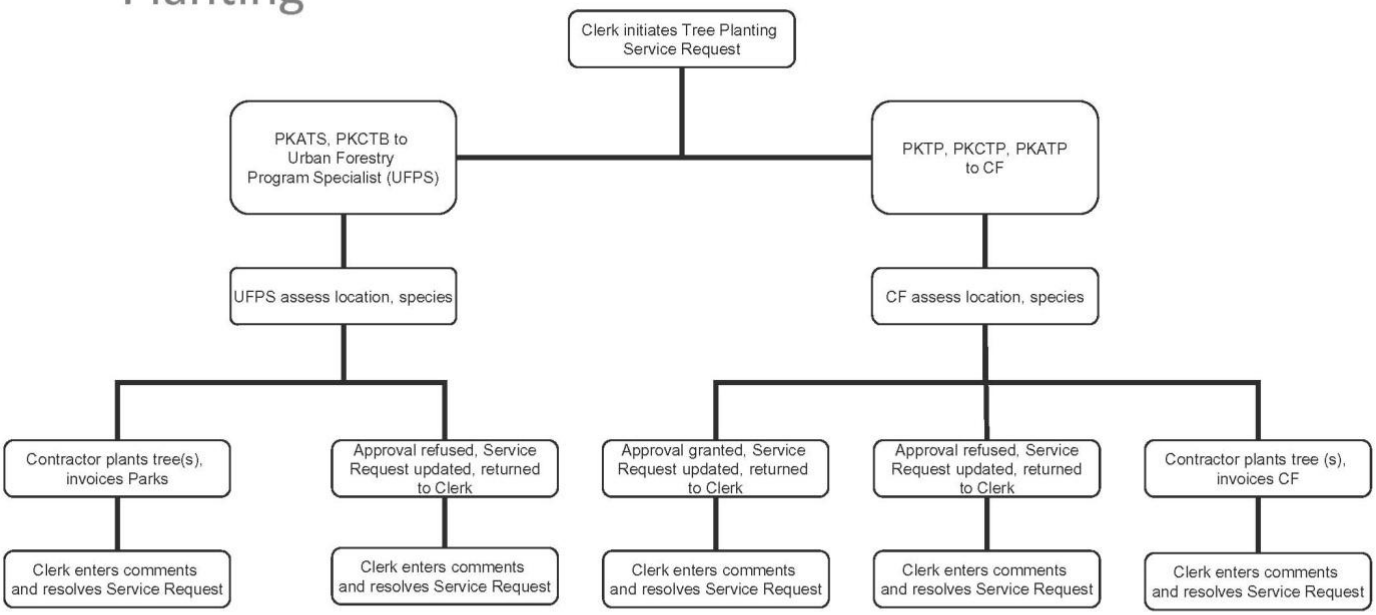
END OF SECTION

Workflow - Parks Division Service Requests

Service Requests



Planting



PKATS – Parks Approval Tree Stewardship Program

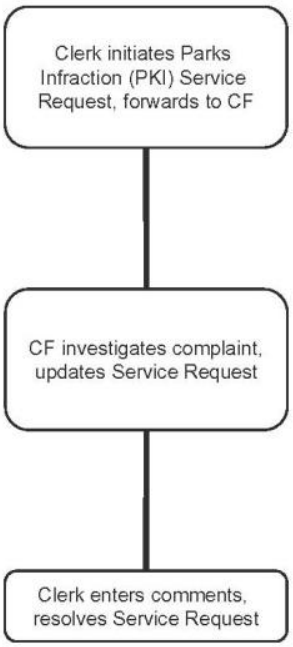
PKCTB – Parks Commemorative Tree & Bench Program

PKTP – Parks Tree Planting

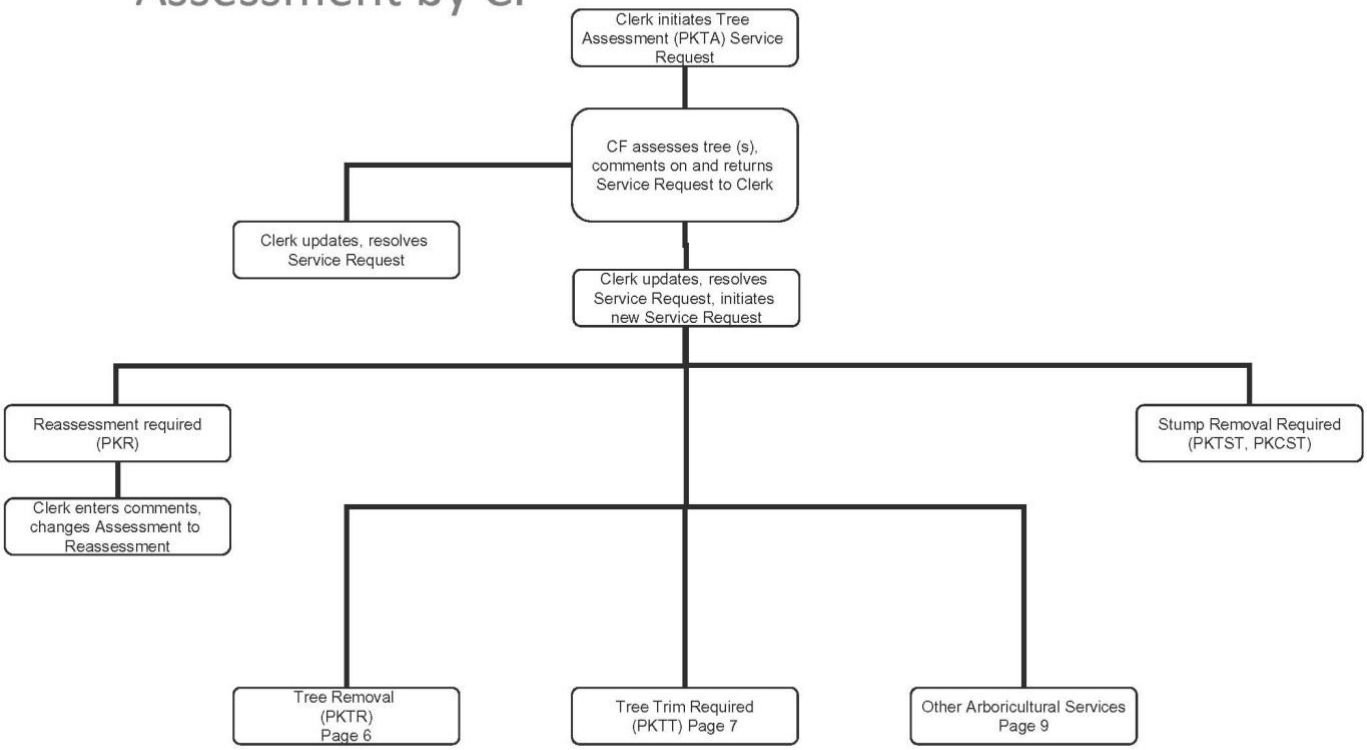
PKATP – Parks Approval Tree Planting

PKCTP – Parks Contract Tree Planting

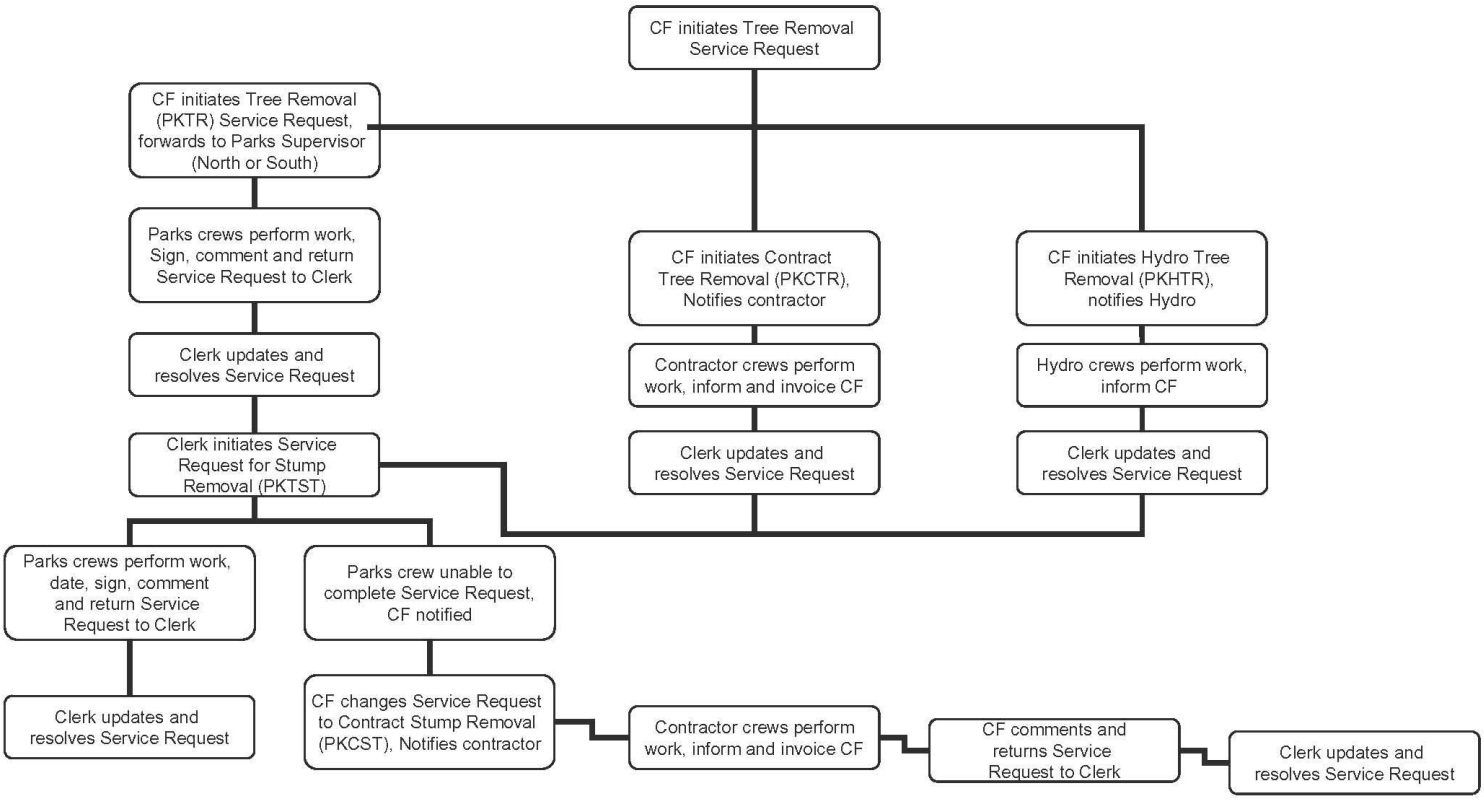
Infractions



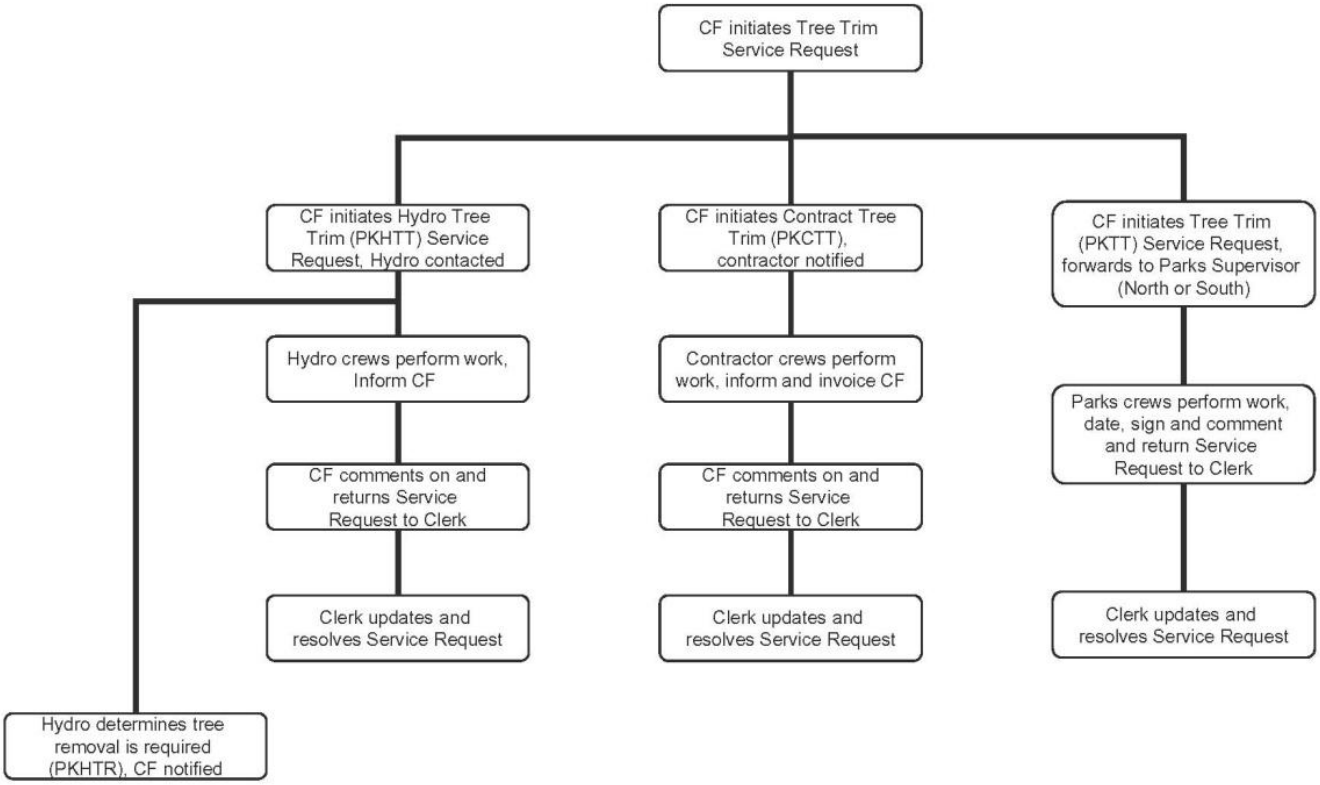
Assessment by CF



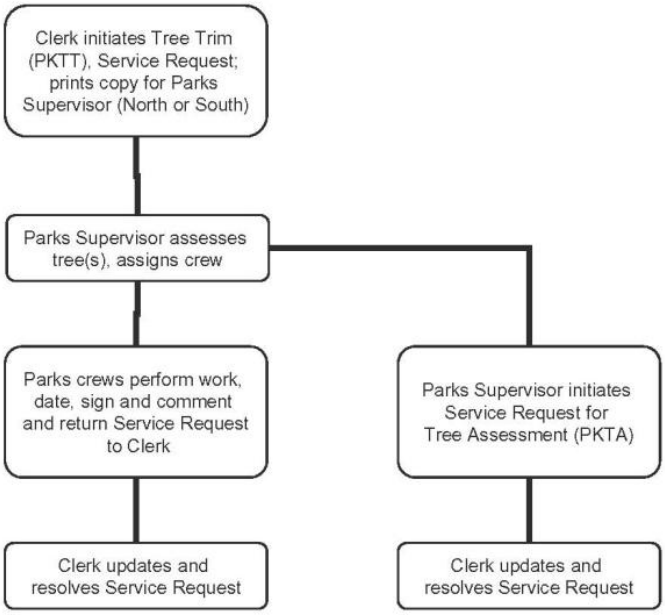
Tree Removals – Initiated by CF only

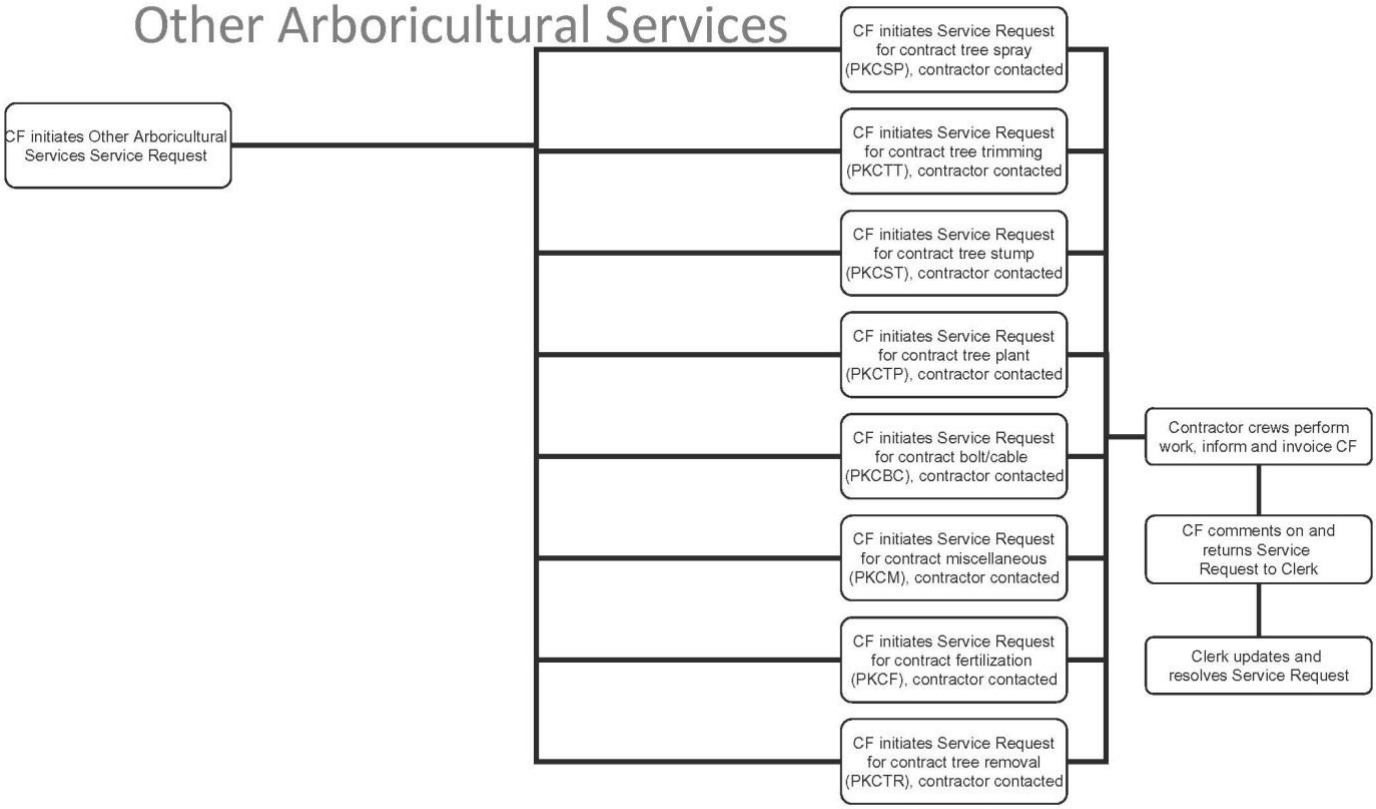


Assessment Tree Trim

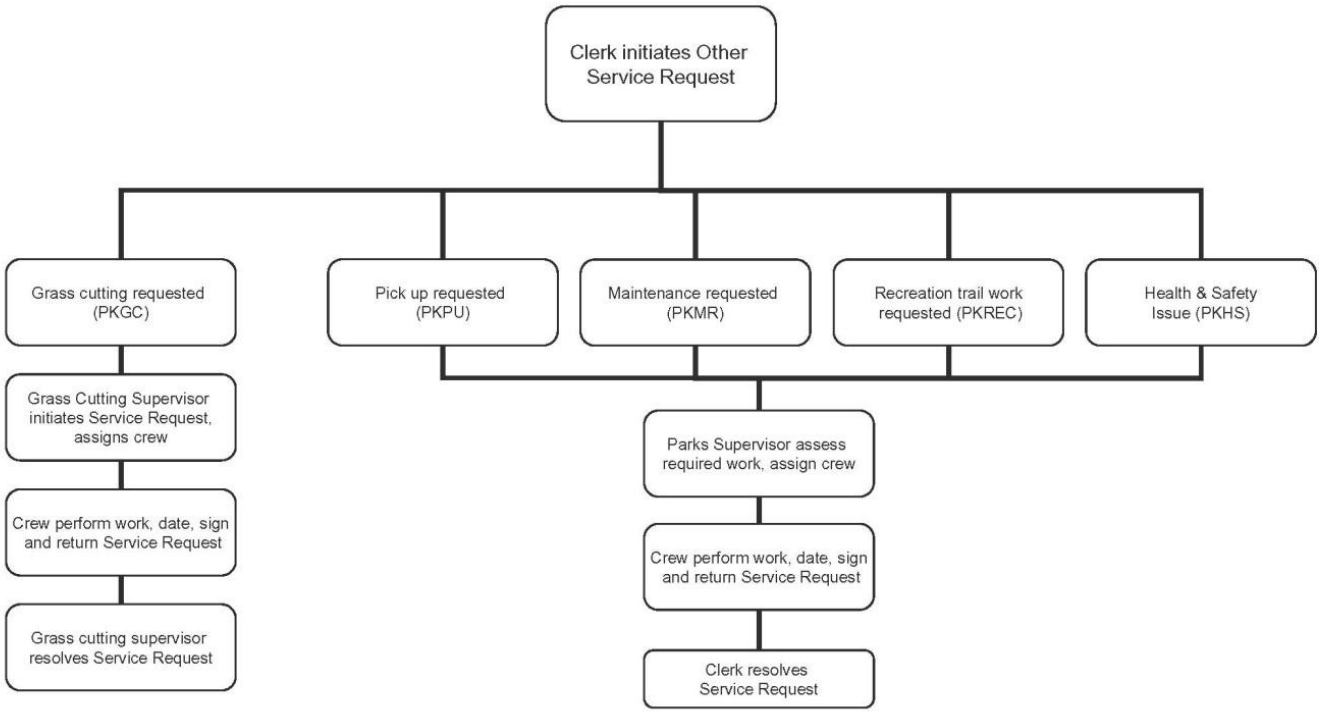


Tree Trim – Initiated by Clerk




Other Arboricultural Services
CF initiates Other Arboricultural Services Service Request
CF initiates Service Request for contract tree spray (PKCSP), contractor contacted
CF initiates Service Request for contract tree trimming (PKCTT), contractor contacted
CF initiates Service Request for contract tree stump (PKCST), contractor contacted
CF initiates Service Request for contract tree plant (PKCTP), contractor contacted
CF initiates Service Request for contract bolt/cable (PKCBC), contractor contacted
CF initiates Service Request for contract miscellaneous (PKCM), contractor contacted
CF initiates Service Request for contract fertilization (PKCF), contractor contacted
CF initiates Service Request for contract tree removal (PKCTR), contractor contacted
Contractor crews perform work, inform and invoice CF
CF comments on and returns Service Request to Clerk
Clerk updates and resolves Service Request

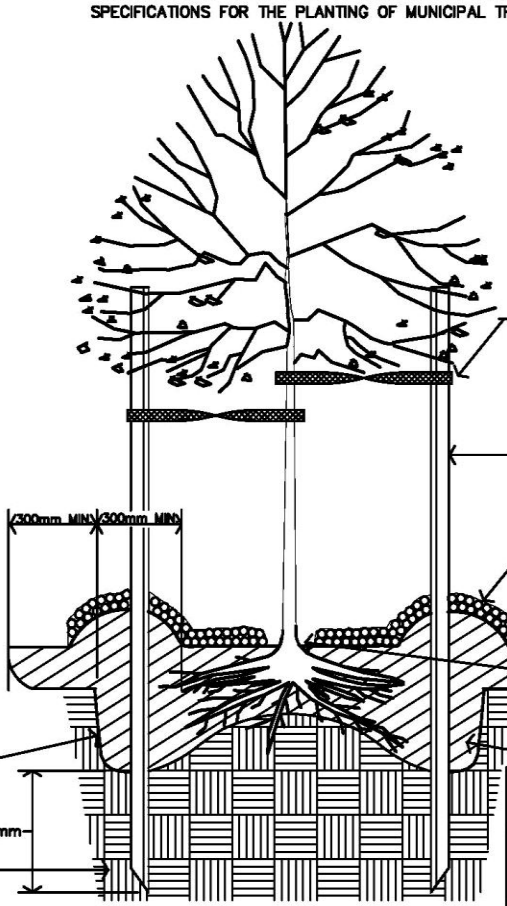
Other Service Requests



NOTES:

- Caliper is measured at 300 mm from grade level.
- Prune at planting to carefully remove dead, broken, damaged and interfering branches, double leaders and narrow angle branch unions. Thin head when and where applicable.
- Confirm underground utilities before commencing any excavation.
- Actual hole to be 300 mm wider than around the perimeter of the rootball.
- Wooden stakes MUST be installed prior to back-filling hole. Hammer stakes into solid footing.
- Spread out roots in hole. Excessively long, broken or frayed roots should be cut cleanly with secateurs. DO NOT curl or jack knife roots in the planting hole.
- In moist, well-drained soils, the tree shall be placed so that the root collar (point of attachment of root to trunk) is exactly at grade. The root collar will coincide with the area of root flare.
- In poorly drained and/or compacted soils, tree shall be placed so that the root collar is 75 – 100 mm above the finished grade. Care should be taken to avoid excessive settlement of roots following planting.
- In very sandy or droughty soils, the tree shall be placed so that the root collar is slightly deeper than grade.
- Hole to be backfilled with soil that is native to the site, amend if required. Concurrently tamp and water to eliminate air pockets.
- Remove all labels, twine, flagging tape and wrap from tree.
- All dimensions in millimetres minimum and maximum. Allowances are given.

*THIS DETAIL IS TO BE READ IN CONJUNCTION WITH "GUIDELINES AND SPECIFICATIONS FOR THE PLANTING OF MUNICIPAL TREES".



NOTE: CARE SHOULD BE TAKEN TO AVOID EXCESSIVE SETTLEMENT OF ROOTS FOLLOWING PLANTING.

CITY OF Thunder Bay Superior by Nature

ENGINEERING STANDARDS

TITLE: DECIDUOUS TREE BARE ROOT PLANTING DETAIL
TYPICAL INSTALLATION FOR 45 mm CALIPER TREES OR LESS
THIS TREE DOES NOT REPRESENT ANY PARTICULAR SPECIES

DWN.	D.W.	DATE	FEB./02	MANAGER, ENGINEERING DIVISION
REVISED: JAN 2010				DWG. NO. M-104-1
SCALE	N. T. S.			

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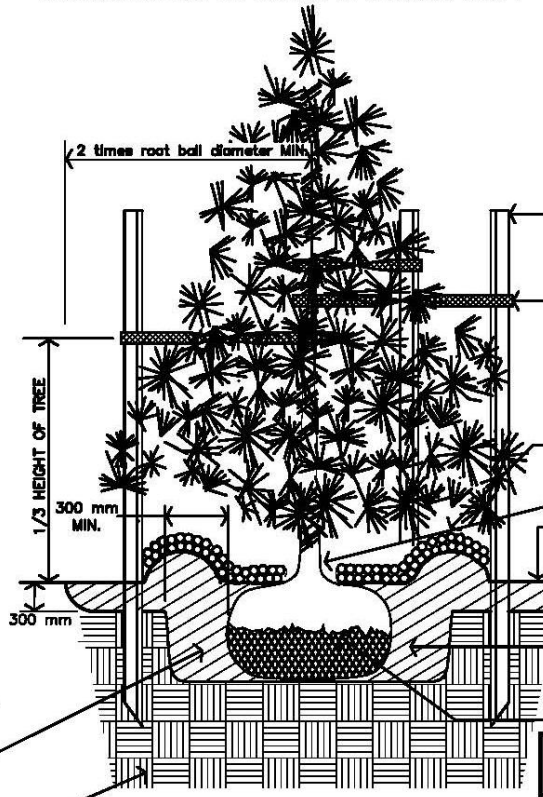
NOTES:

- Tree shall be measured to height of previous years growth.
- Pruning at planting shall be limited to the removal of dead or broken branches and double leaders. Maintain original shape of tree, do not prune, cut or damage a healthy double leader branch.
- Confirm underground utilities before commencing any excavation.
- Actual hole to be 300 mm wider than around the perimeter of the rootball.
- Wooden stakes MUST be installed prior to back-filling hole. Hammer stakes into solid footing.
- Whenever necessary, remove soil from top of rootball to uncover the root collar (point of attachment of root to trunk). The root collar will coincide with the area of root flare.
- In moist, well-drained soils, the rootball shall be set so that the root collar is exactly at grade.
- In poorly drained and/or compacted soils, the rootball shall be set so that the root collar is 75 – 100 mm above the finished grade. This helps to provide sufficient aeration to fibrous roots in the top of the ball by ensuring gravitational drainage of water.
- In very sandy or droughty soils, the rootball shall be set so that the root collar is slightly deeper than grade.
- Hole to be backfilled with soil that is native to the site, amend if required. Concurrently tamp and water to eliminate air pockets.
- Remove all labels, twine, flagging tape and wrap from tree.
- All dimensions in millimetres minimum and maximum. Allowances are given.

*THIS DETAIL IS TO BE READ IN CONJUNCTION WITH "GUIDELINES AND SPECIFICATIONS FOR THE PLANTING OF MUNICIPAL TREES".



3 WOOD STAKES SECURED INTO GROUND AND EVENLY SPACED AROUND TREE – MIN. 2000 mm LONG. SET TREE STAKES JUST INSIDE EDGE OF BRANCHES AS SHOWN.

75 mm JUTE TIES SECURED AROUND TREE TRUNK. ADJUST JUTE UNTIL DRAWN TIGHT AND STAPLE TO STAKES.

CONSTRUCT 100 mm SOIL SAUCER AROUND TREE BASE AND COVER WITH 75 mm APPROVED SHREDDED WOOD MULCH. KEEP MULCH 150 mm AWAY FROM TREE TRUNK

ROOT COLLAR AT GRADE

FINISHED GRADE

LOOSEN SOIL – 300mm DEEP IN AN AREA 4 TIMES DIAMETER OF A ROOT BALL

SOIL TO BE TAMPED AND SETTLED WITH WATER BY PROBING WITH HOSE-END TO ELIMINATE AIR POCKETS

CUT AND REMOVE TOP 1/2 OF BURLAP & WIRE BASKET INCLUDING ALL TIE ROPE

SCARIFY, IRRIGATE AND FERTILIZE THE INSIDE OF THE TREE PIT PRIOR TO PLANTING

COMPACTED SUBGRADE BOTTOM OF ROOT BALL TO SIT ON UNDISTURBED SUBGRADE

CITY OF Thunder Bay Superior by Nature

ENGINEERING STANDARDS

TITLE: CONIFEROUS TREE PLANTING DETAIL
TYPICAL INSTALLATION FOR 2000 mm HEIGHT TREES OR LESS
THIS TREE DOES NOT REPRESENT ANY PARTICULAR SPECIES

DWN. D.W. | DATE JAN./02

MANAGER, ENGINEERING DIVISION

REVISED: JAN. 2010

SCALE N. T. S.

DWG. NO. M-104-2

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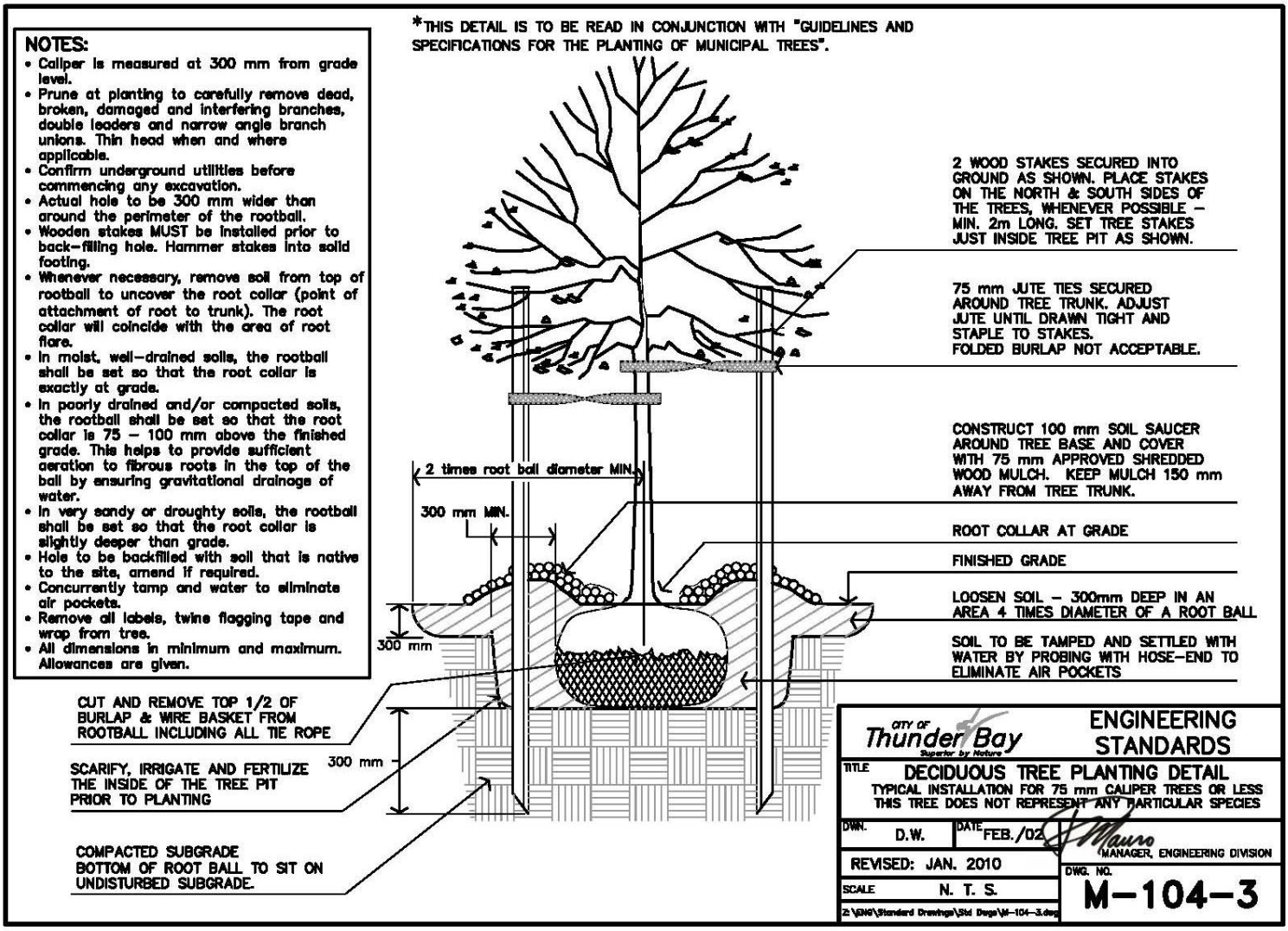
NOTES:
• Caliper is measured at 300 mm from grade level.
• Prune at planting to carefully remove dead, broken, damaged and interfering branches, double leaders and narrow angle branch unions. Thin head when and where applicable.
• Confirm underground utilities before commencing any excavation.
• Actual hole to be 300 mm wider than around the perimeter of the rootball.
• Wooden stakes MUST be installed prior to back-filling hole. Hammer stakes into solid footing.
• Whenever necessary, remove soil from top of rootball to uncover the root collar (point of attachment of root to trunk). The root collar will coincide with the area of root flare.
• In moist, well-drained soils, the rootball shall be set so that the root collar is exactly at grade.
• In poorly drained and/or compacted soils, the rootball shall be set so that the root collar is 75 – 100 mm above the finished grade. This helps to provide sufficient aeration to fibrous roots in the top of the ball by ensuring gravitational drainage of water.
• In very sandy or droughty soils, the rootball shall be set so that the root collar is slightly deeper than grade.
• Hole to be backfilled with soil that is native to the site, amend if required.
• Concurrently tamp and water to eliminate air pockets.
• Remove all labels, twine flagging tape and wrap from tree.
• All dimensions in minimum and maximum. Allowances are given.
*THIS DETAIL IS TO BE READ IN CONJUNCTION WITH "GUIDELINES AND SPECIFICATIONS FOR THE PLANTING OF MUNICIPAL TREES".
2 WOOD STAKES SECURED INTO GROUND AS SHOWN. PLACE STAKES ON THE NORTH & SOUTH SIDES OF THE TREES, WHENEVER POSSIBLE – MIN. 2m LONG. SET TREE STAKES JUST INSIDE TREE PIT AS SHOWN.
75 mm JUTE TIES SECURED AROUND TREE TRUNK. ADJUST JUTE UNTIL DRAWN TIGHT AND STAPLE TO STAKES. FOLDED BURLAP NOT ACCEPTABLE.
CONSTRUCT 100 mm SOIL SAUCER AROUND TREE BASE AND COVER WITH 75 mm APPROVED SHREDDED WOOD MULCH. KEEP MULCH 150 mm AWAY FROM TREE TRUNK.
2 times root ball diameter MIN.
300 mm MIN.
ROOT COLLAR AT GRADE
FINISHED GRADE
LOOSEN SOIL – 300mm DEEP IN AN AREA 4 TIMES DIAMETER OF A ROOT BALL
SOIL TO BE TAMPED AND SETTLED WITH WATER BY PROBING WITH HOSE-END TO ELIMINATE AIR POCKETS
300 mm
CUT AND REMOVE TOP 1/2 OF BURLAP & WIRE BASKET FROM ROOTBALL INCLUDING ALL TIE ROPE
SCARIFY, IRRIGATE AND FERTILIZE THE INSIDE OF THE TREE PIT PRIOR TO PLANTING
300 mm
COMPACTED SUBGRADE BOTTOM OF ROOT BALL TO SIT ON UNDISTURBED SUBGRADE.
CITY OF Thunder Bay Superior by Nature
ENGINEERING STANDARDS
TITLE
DECIDUOUS TREE PLANTING DETAIL
TYPICAL INSTALLATION FOR 75 mm CALIPER TREES OR LESS
THIS TREE DOES NOT REPRESENT ANY PARTICULAR SPECIES
DWN. D.W.
DATE FEB./02
MANAGER, ENGINEERING DIVISION
REVISED: JAN. 2010
DWG. NO. M-104-3
SCALE N. T. S.
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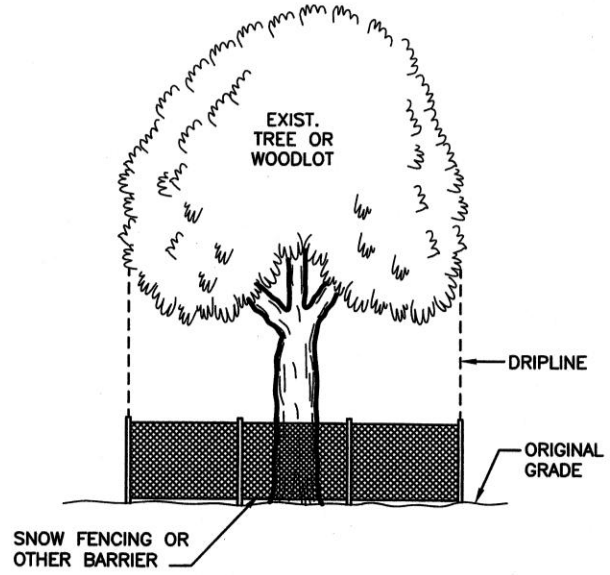
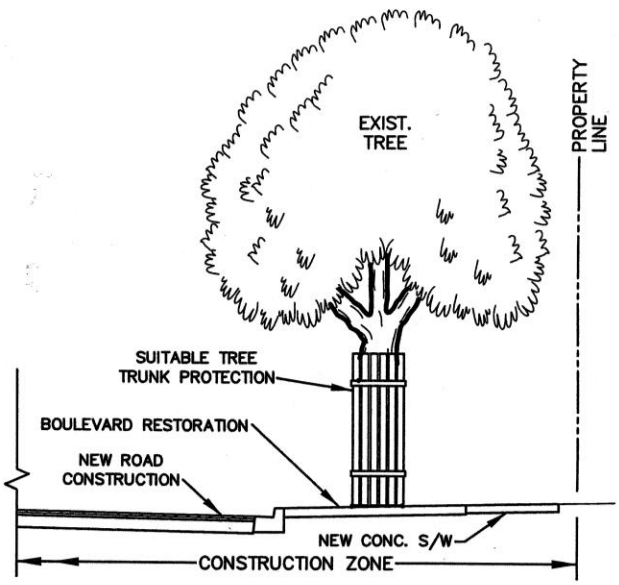




NOTE: The Contractor will be responsible for implementing the following Specifications in order to ensure protection of existing trees within or adjacent to the construction zone.

1. For designated areas, a snow fence or other barrier shall be erected and maintained around the Tree Protection Zone which is an area on the ground corresponding to the 'drip line' of the tree or a minimum radius of 3.0 metres, whichever is larger.
2. Trees located within 3 metres of proposed construction areas shall require strapping or a double wrap of wood slat snow fencing or other suitable wood planks strapped to the tree trunk to completely protect the tree trunk from impact damage. The minimum size of strapping will be 25 x 150 x 2400 mm.
3. Trees situated adjacent to the construction zone shall require snow fencing to protect and separate them from construction activities.
4. No heavy equipment shall be driven over the Tree Protection Zone so as to avoid soil compaction around the tree roots.
5. No soil, equipment, machinery, or construction materials including washroom facilities shall be stored in the Tree Protection Zone.
6. No excavation or backfill shall occur within the Tree Protection Zone without prior approval of the Manager – Parks Division.
7. No equipment or materials shall be allowed to hit, abrade, or otherwise damage the trunk or branches of a tree.

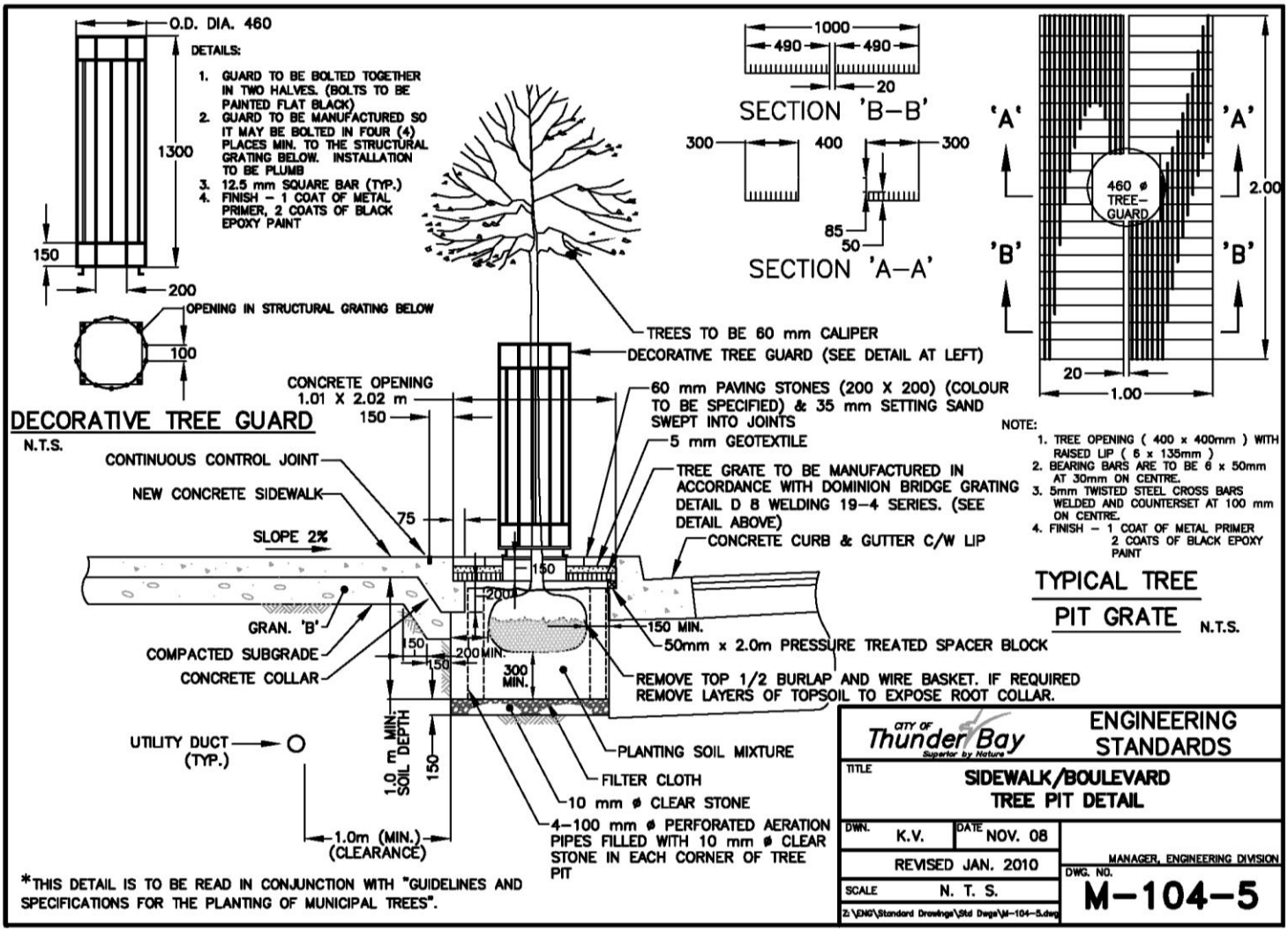
CITY OF Thunder Bay Superior by Nature — ENGINEERING STANDARDS

TITLE: TREE PROTECTION

DWN. D.W./L.T.G.	DATE FEB./02
REVISED: FEB. 2004	
SCALE N. T. S.	
PATH E:\ENG\STD DWGS\M-104-4	

CITY ENGINEER

DWG. NO. M-104-4


O.D. DIA. 460
DETAILS:
1. GUARD TO BE BOLTED TOGETHER IN TWO HALVES. (BOLTS TO BE PAINTED FLAT BLACK)
2. GUARD TO BE MANUFACTURED SO IT MAY BE BOLTED IN FOUR (4) PLACES MIN. TO THE STRUCTURAL GRATING BELOW. INSTALLATION TO BE PLUMB
3. 12.5 mm SQUARE BAR (TYP.)
4. FINISH – 1 COAT OF METAL PRIMER, 2 COATS OF BLACK EPOXY PAINT
1300
150
200
OPENING IN STRUCTURAL GRATING BELOW
100
DECORATIVE TREE GUARD
N.T.S.
1000
490
490
20
SECTION 'B–B'
300
400
300
85
50
SECTION 'A–A'
'A'
'B'
460 ø TREE–GUARD
2.00
20
1.00
NOTE:
1. TREE OPENING (400 x 400mm) WITH RAISED LIP (6 x 135mm)
2. BEARING BARS ARE TO BE 6 x 50mm AT 30mm ON CENTRE.
3. 5mm TWISTED STEEL CROSS BARS WELDED AND COUNTERSET AT 100 mm ON CENTRE.
4. FINISH – 1 COAT OF METAL PRIMER 2 COATS OF BLACK EPOXY PAINT
TYPICAL TREE PIT GRATE N.T.S.
TREES TO BE 60 mm CALIPER
DECORATIVE TREE GUARD (SEE DETAIL AT LEFT)
CONCRETE OPENING 1.01 X 2.02 m
150
60 mm PAVING STONES (200 X 200) (COLOUR TO BE SPECIFIED) & 35 mm SETTING SAND SWEPT INTO JOINTS
5 mm GEOTEXTILE
TREE GRATE TO BE MANUFACTURED IN ACCORDANCE WITH DOMINION BRIDGE GRATING DETAIL D 8 WELDING 19–4 SERIES. (SEE DETAIL ABOVE)
CONCRETE CURB & GUTTER C/W LIP
CONTINUOUS CONTROL JOINT
NEW CONCRETE SIDEWALK
75
SLOPE 2%
150
200
GRAN. 'B'
COMPACTED SUBGRADE
CONCRETE COLLAR
150
200 MIN.
150
300 MIN.
150 MIN.
50mm x 2.0m PRESSURE TREATED SPACER BLOCK
REMOVE TOP 1/2 BURLAP AND WIRE BASKET. IF REQUIRED REMOVE LAYERS OF TOPSOIL TO EXPOSE ROOT COLLAR.
UTILITY DUCT (TYP.)
1.0 m MIN. SOIL DEPTH
150
PLANTING SOIL MIXTURE
FILTER CLOTH
10 mm ø CLEAR STONE
4–100 mm ø PERFORATED AERATION PIPES FILLED WITH 10 mm ø CLEAR STONE IN EACH CORNER OF TREE PIT
1.0m (MIN.) (CLEARANCE)
*THIS DETAIL IS TO BE READ IN CONJUNCTION WITH "GUIDELINES AND SPECIFICATIONS FOR THE PLANTING OF MUNICIPAL TREES".
CITY OF Thunder Bay Superior by Nature
ENGINEERING STANDARDS
TITLE
SIDEWALK/BOULEVARD TREE PIT DETAIL
DWN. K.V.
DATE NOV. 08
REVISED JAN. 2010
SCALE N. T. S.
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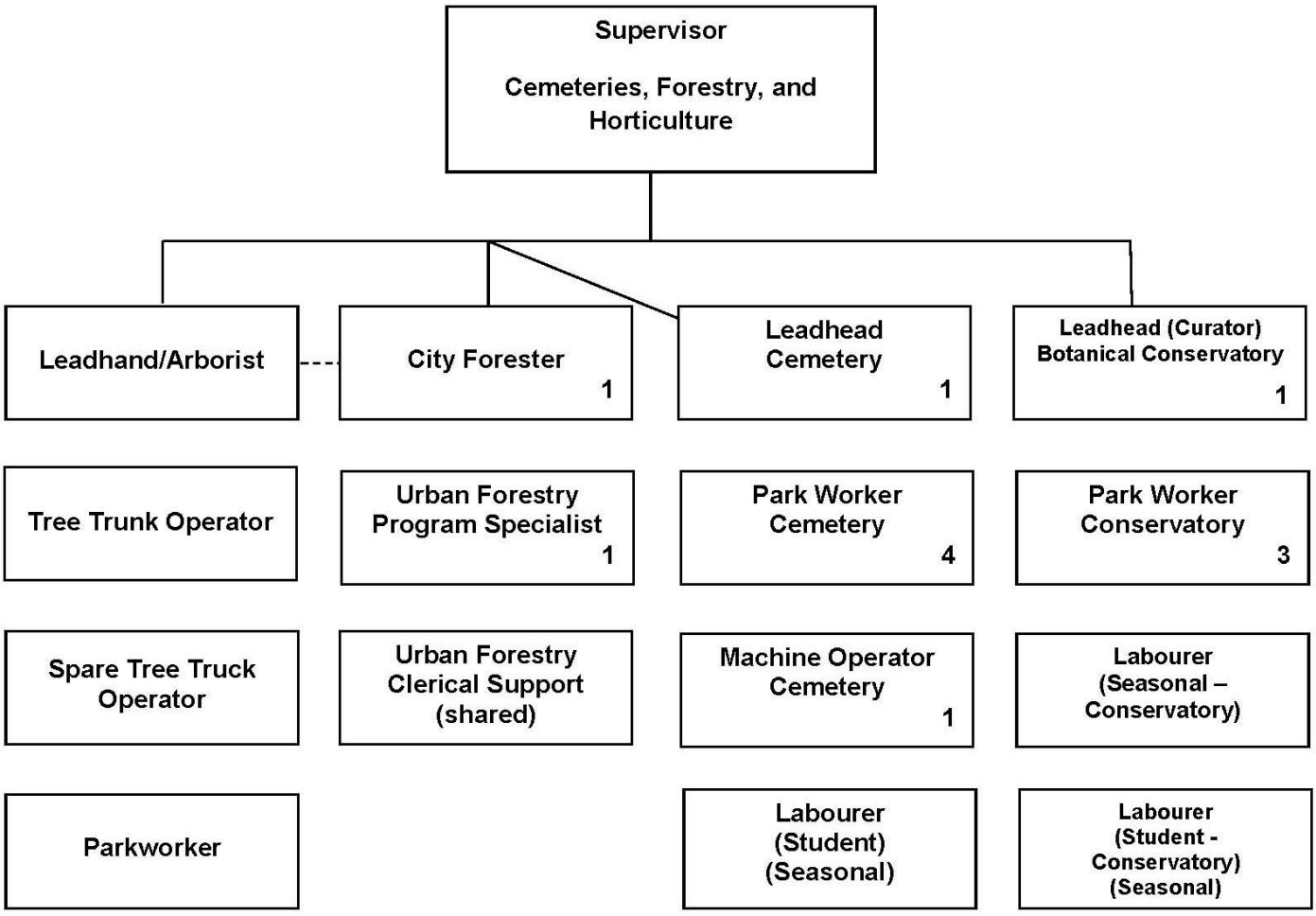
MANAGER, ENGINEERING DIVISION
DWG. NO.
M-104-5

PROPOSED PARKS DIVISION
CEMETERIES, FORESTRY AND HORTICULTURE SECTION



Appendix H
The Benefits of the Urban Forest

The urban forest provides a multitude of aesthetic and environmental benefits to citizens, businesses, and visitors alike. Beyond shade and beauty, trees also have practical benefits and a real monetary value. The urban forest provides a community with valuable public services and benefits such as stormwater mitigation and improved water quality, improved air quality, reduced energy demands, increased real estate values, and improved retail sales, and other sociological benefits.

> *"Urban Forestry is the sustained planning, planting, protection, maintenance, and care of trees, forests, greenspace, and related resources in and around our communities. Trees on public and private lands beautify our community, increase civic pride, and enhance our sense of well-being. Every year, Thunder Bay loses more than 400 trees on public land due to age, disease, and injury, with more than 10,000 empty spots waiting for trees on city boulevards. Urban trees exist in a difficult environment—lack of growing space above and below ground, contaminated and compacted soils, de-icing salt, and the physical damage caused by trenching, lawn mowers, people, and cars. Suburban development and large-scale, unregulated tree cutting on private land threaten the biodiversity and ecology of our rural forests."*
>
> FROM: *The EarthWise® Community Environmental Action Plan*

Together, these benefits could be worth over a million dollars to your community. And, unlike other public infrastructure components, the urban forest can increase in value over time. The following sections describe some of the benefits that trees provide.

Stormwater Mitigation and Improved Water Quality

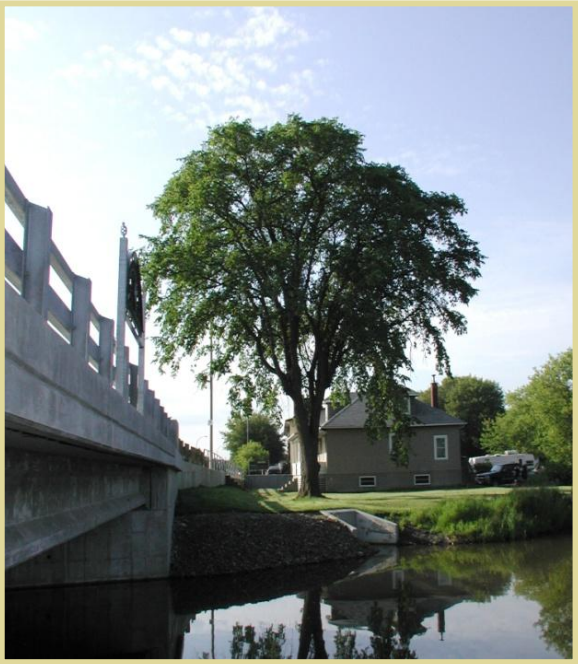
- Trees reduce topsoil erosion, prevent harmful land pollutants contained in the soil from getting into our waterways, slow down water run-off, and ensure that our groundwater supplies are continually being replenished
- For every 5 percent of tree cover added to a community, stormwater runoff is reduced by approximately 2 percent (Coder, 1996)
- Research by the United States Department of Agriculture Forest Service (USDA Forest Service) shows that in a 2.5 cm rainstorm over 12 hours, the interception of rain by the canopy of the urban forest in Salt Lake City reduces surface runoff by about 42.8 million litres, or 17 percent. These values would increase as the canopy increases (American Forests, 1999).
- Along with breaking the fall of rainwater, tree roots remove nutrients harmful to water ecology and quality (American Forests, 1999). http://www.coloradotrees.org/benefits.htm - 13.
- Trees act as natural pollution filters. Their canopies, trunks, roots, and associated soil and other natural elements of the landscape filter polluted particulate matter out of the flow toward the storm sewers. Reducing the flow of stormwater reduces the amount of pollution that is washed into a drainage area. Trees use nutrients like nitrogen, phosphorus, and potassium—byproducts of urban living which can pollute streams (American Forests, 1999).

Carbon Dioxide Reductions and Improved Air Quality

- Trees remove (sequester) carbon dioxide (CO_2) from the atmosphere during photosynthesis to form carbohydrates that are used in plant structure/function and return oxygen back to the atmosphere as a byproduct. Trees, therefore, act as a carbon sink by removing the carbon and storing it as cellulose in their trunk, branches, leaves, and roots while releasing oxygen back into the air.
- Trees shade homes and office buildings. Shading reduces air conditioning needs up to 30 percent, thereby reducing the amount of fossil fuel burned to produce electricity. This combination of CO_2 removal from the atmosphere, carbon storage in wood, and the cooling effect makes trees a very efficient tool in fighting the greenhouse effect (Michigan State University Extension, 2003).
- One tree that shades your home in the city will also save fossil fuel, cutting CO_2 buildup as much as 15 forest trees (National Arbor Day Foundation, 1990).
- Planting trees remains one of the cheapest, most effective means of drawing excess CO_2 from the atmosphere (Prow, 1999).
- A single, mature tree can absorb carbon dioxide at a rate of 21.8 kg per year and release enough oxygen back into the atmosphere to support 2 human beings (McAliney, 1993).
- The USDA Forest Service estimates that all the forests in the United States combined sequestered a net of approximately 309 million tons of carbon per year from 1952 to 1992, offsetting approximately 25 percent of United States human-caused emissions of carbon during that period (USDA Forest Service, 1992).
- Over a 50-year lifetime, a tree generates $31,250 worth of oxygen, provides $62,000 worth of air pollution control, recycles $37,500 worth of water, and controls $31,250 worth of soil erosion (USDA Forest Service, 1992).
- Trees remove other gaseous pollutants by absorbing them with normal air components through the stomates in the leaf surface (International Society of Arboriculture, 2005).
- Dr. Kim Coder found that:
    - There is up to a 60 percent reduction in street level particulates with trees.
    - In one urban park (212 ha), tree cover was found to remove daily 21.8 kg of particulates, 4.1 kg of nitrogen dioxide, 2.7 kg of sulfur dioxide, 0.9 kg of carbon monoxide, and 45.4 kg of carbon.
    - One sugar maple (30 cm diameter at breast height) along a roadway removes in one growing season 60 mg cadmium, 140 mg chromium, 820 mg nickel, and 5,200 mg lead from the environment (Coder, 1996).

Reduced Energy Demands

- Trees lower local air temperatures by transpiring water and shading surfaces. Because they lower air temperatures, shade buildings in the summer, and block winter winds, they can reduce building energy use and cooling costs (Nowak, 1995).
- The maximum potential annual savings from energy conserving landscapes around a typical residence ranged from 13 percent in Madison up to 38 percent in Miami (McAliney, 1993).
- Trees help to cool cities by reducing heat sinks. Heat sinks are 6-19 degrees Fahrenheit warmer than their surroundings (Global Releaf, Georgia). A tree can be a natural air conditioner. The evaporation from a single, large tree can produce the cooling effect of 10 room-sized air conditioners operating 24 hours/day (USDA Forest Service, 1992).



Large trees such as this American elm (*Ulmus americana*) provide many benefits to a community.

Increased Real Estate Values and Improved Retail Sales

Studies have shown that:

- Trees enhance community economic stability by attracting businesses and tourists.
- People linger and shop longer along tree-lined streets.
- Apartments and offices in wooded areas rent more quickly and have higher occupancy rates.
- Businesses leasing office spaces in developments with trees find their workers are more productive and absenteeism is reduced (Michigan State University Extension, 2003).
- Property values increase 5 to 15 percent when compared to properties without trees (depends on species, maturity, quantity, and location).
- A 1976 study that evaluated the effects of several different variables on homes in Manchester, Connecticut found that street trees added about $2,686 or 6 percent to the sale price of a home (McAliney, 1993).
- A study indicated that trees added $9,500, or more than 18 percent, to the average sale price of a residence in a suburb of Rochester, New York (Nowak, 1995).

Better Social Climate

- Two University of Illinois researchers (Kuo and Sullivan) studied how well residents of the Chicago Robert Taylor Housing Project (the largest public housing development in the world) were doing in their daily lives based upon the amount of contact they had with trees, and came to the following conclusions:
  - Trees have the potential to reduce social service budgets, decrease police calls for domestic violence, strengthen urban communities, and decrease the incidence of child abuse according to the study. Chicago officials heard that message last year. The city government spent $10 million to plant 20,000 trees, a decision influenced by Kuo's and Sullivan's research, according to the Chicago Tribune (Kuo and Sullivan, 2001).
  - Residents who live near trees have significantly better relations with and stronger ties to their neighbours.
- Researchers found fewer reports of physical violence in homes that had trees outside the buildings. Of the residents interviewed, 14 percent of residents living in barren conditions have threatened to use a knife or gun against their children versus 3 percent for the residents living in green conditions (Prow, 1999).
- Studies have shown that hospital patients with a view of trees out their windows recover much faster and with fewer complications than similar patients without such views (American Forests, 1999).

Trees in Waverly Park are a valued asset in Thunder Bay.