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REGIONAL STREET TREE PROGRAM UPDATE

The Transportation Services Committee recommends the adoption of the recommendations contained in the following report dated March 16, 2011, from the Commissioner of Transportation Services with the following amendment:

- 3. That staff provide information on the total cost of the program at the April 21, 2011 Regional Council meeting.**

1. RECOMMENDATIONS

It is recommended that:

1. The Regional Street Tree Program be updated to reflect improvements to street tree performance, and include revisions to the Road Design Guideline to include the amendments to the soil, and watering practices as presented in this report.
2. The additional investment related to the updated Street Tree Program be considered as part of future budgets.

2. PURPOSE

This report updates Regional Council on the status of the Region's street tree health and care program and seeks approval to implement:

- A boulevard soil trench standard for Road Capital projects
- An improved street tree watering program

Further, the report seeks Council's support for a sustainable management program that reflects street trees as an important capital asset.

3. BACKGROUND

The urban forest provides considerable environmental, social and economic benefits to the Region

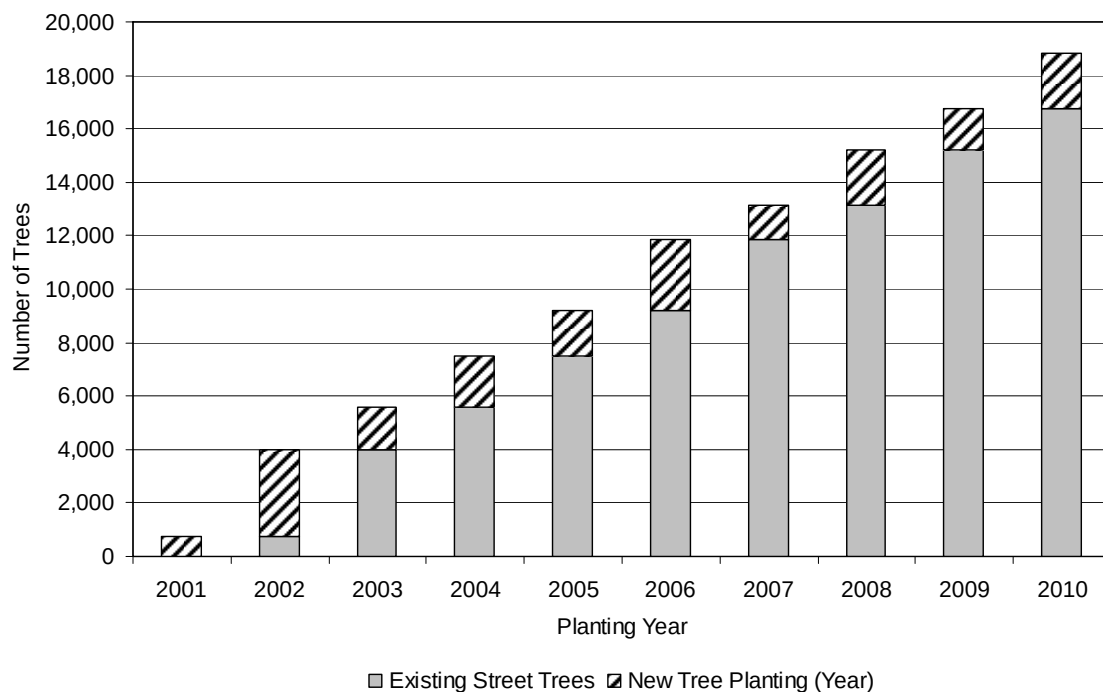
Regional street trees are an integral component of the public realm helping to define the character of our communities. Street trees provide numerous benefits to residents including shade, climate moderation, energy conservation, improved air quality, prevention of soil erosion and a contribution to stormwater management. The Region has

made a substantial investment in street trees through the Streetscape Policy (2001) and associated road capital projects and VivaNext projects.

The Region has planted about 19,000 street trees since the adoption of the Streetscaping Policy in 2001

In 2001, Regional Council adopted the Greening Strategy and the Streetscape Policy. These policies set objectives and standards for street tree planting along Regional roads. Since the adoption of the Streetscape Policy, about 19,000 street trees have been planted (Figure 1).

Figure 1
Street Tree Planting 2001 - 2010



Street trees are a capital asset that appreciates in value over time. To manage this significant asset, a comprehensive street tree inventory has been completed. Currently there are 32,500 street trees in our inventory with an estimated replacement value of \$18,000,000. This inventory includes trees planted by the Region, trees planted by adjacent development and trees that already existed along the road right-of-way.

Street trees require adequate amounts of quality soil, growing space and water to become established, thrive and provide the intended benefits

Healthy trees require adequate growing space (both above and below ground), good quality soil, nutrients and water. The right-of-way (ROW) is an extremely harsh environment for the establishment and growth of trees. The combination of drought conditions, wind exposure, road salt, minimal soil quantity, poor soil quality and other factors make tree performance an ongoing challenge. To ensure success, a program built on adaptive management and continuous improvement is required.

The 2003 street tree health assessment identified only 29% of recently planted street trees were in healthy condition

In the early 2000s it became evident newly-planted street trees were performing poorly. To identify the extent and factors contributing to this poor performance, the Region undertook a comprehensive street tree health assessment in 2003. The results of the study identified only 29% of recently planted trees were in satisfactory or good health. The study further identified that, following planting, there is a critical establishment period of three to five years. During this period there is often minimal growth, decline or death.

To address poor tree performance, the Region implemented critical improvements in tree planting and watering programs

The street tree health assessment identified a multitude of factors that impacted street tree performance including:

- Lack of water during the critical establishment period
- Poor boulevard soil conditions (quantity and quality)
- Quality of tree nursery stock and planting practices
- Post planting maintenance practices

In 2004, the Region implemented significant program improvements to address these issues including:

- Increased tree watering from four to ten times per year
- Introduced Tree Gator watering bags to improve watering efficiency
- Tree nursery inspections and selective/ top performer tree tagging
- Revised tree planting specification and contractor audit procedure (current 40 - 60% tree rejection deficiency rate)
- Increased mulching and tree pruning improvements
- Boulevard soil improvement trials (e.g. soil amendment, radial trenching)

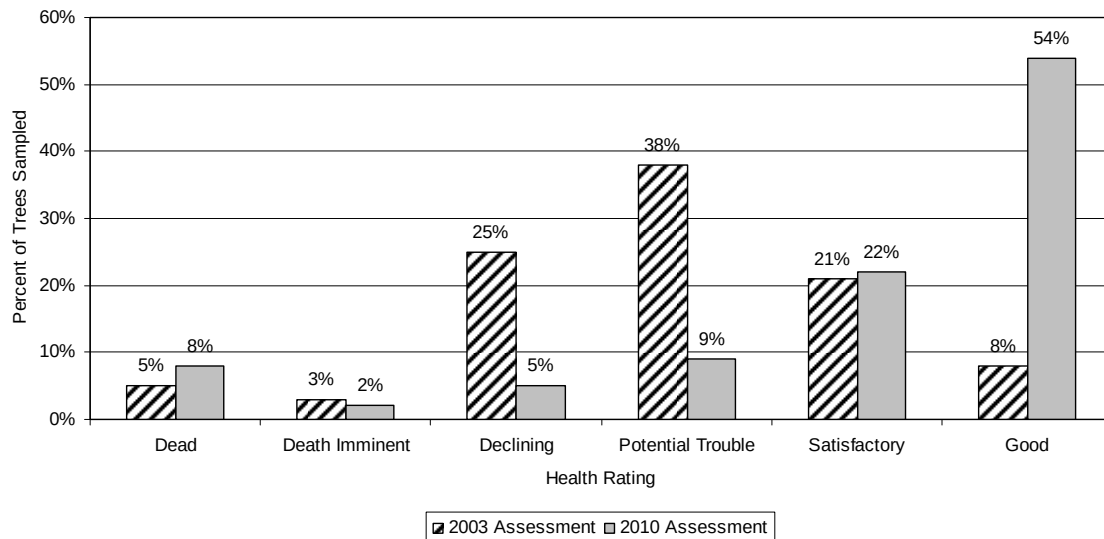
4. ANALYSIS AND OPTIONS

In 2010, a street tree health assessment identified 76% of recently planted trees were healthy, representing a significant improvement since the last assessment in 2003

In 2010, a follow-up street tree health assessment study was completed to measure the effectiveness of program improvements (*Attachment 1 – Executive Summary*). A detailed assessment of 1,410 street trees was completed to determine tree health, and further assess factors affecting tree survival.

The results of the assessment show that 76% of recently planted trees were in satisfactory or good condition. This is a significant improvement over the 2003 assessment results where only 29% of trees were in healthy condition (Figure 2). These results clearly demonstrate that improvements implemented are having a positive effect on street tree performance.

Figure 2
Change in street tree health ratings 2003 - 2010



Despite these significant improvements in tree health, recently planted street trees continue to die or exhibit signs of stress during the first three to five years following planting. The number of trees replaced under warranty (two year) is an additional measure of tree performance. Currently up to 30% of trees planted are replaced under warranty. This warranty replacement rate is significantly higher than the desired target of 10%.

The 2010 study identified the key factors which continue to strongly influence the performance of street trees including:

- Inspection and selection/tagging of trees in nurseries
- Tree planting contractor education, inspections and audits (currently high rejection/deficiency rates)
- Lack of quality soil in the boulevard
- Insufficient water during the growing season

Street tree health assessments have identified that newly-planted street trees have an establishment period of three to five years

The 2003 and 2010 health assessments both confirm that trees require a period of three to five years to establish themselves following planting. During this period trees go into shock, show little growth and often exhibit signs of stress and decline. The most limiting factors to tree survival and performance during the establishment period are water and quality soil. Watering during this period is critical to ensuring the survival of planted trees. Following the establishment period, trees are watered only under severe drought conditions. Access to quality soil is required for the tree to develop a suitable root system to support future growth.

Watering of newly-planted trees should be increased during the first three years following planting from the current ten to 14 times per year

The street tree health assessments, and other technical studies, have confirmed the critical role water plays during the establishment period for newly-planted trees. These studies recommend that, for optimal growth, trees should receive 17 waterings per tree during the growing season for the first three years. Each year our local climate has proven to be unreliable in providing sufficient rainfall to meet this need. In addition, rainwater from our summer rainfall events does not penetrate the compact soils to nourish the root system efficiently

Currently, the Region waters newly-planted trees ten times per year for the first three years. The Gator Bags, installed at the time of planting, help to provide drip irrigation to the growing root system. Capital project funds currently support both the cost of planting and also tree establishment costs (e.g. watering) for the first three years. In accordance with the recommendations of the study to provide more water, staff proposes to increase the number of waterings from ten to 14 per year for the first three years following planting. This watering regime still allows for natural rainfall to provide some of the needs of the tree to make up for the optimum 17 waterings. The increase in watering will cost an additional 40% per year (\$144,000 capital).

Research, experience and assessments have identified the need to improve the soil and rooting environment for trees through the installation of a soil trench in the boulevard

The performance and growth of street trees is directly related to the amount of quality soil available for root system development. In 2006, Council directed staff to review and refine the Regional Road Design Guidelines for street tree soil improvements. Over the past four years, staff have assessed soil quality, and evaluated a variety of techniques and approaches to deliver soil improvements. Soil improvements have been evaluated as pilot projects in both new road sections and retrofit projects.

The current Regional boulevard standard requires the placement of ten cm of uncontaminated topsoil. This standard does not support the establishment and growth of healthy street trees. To increase the quantity of suitable soil, it is proposed that a boulevard soil trench be included in the Road Design Guidelines and implemented through road capital projects. The soil trench would be 30 cm deep by 3 m wide and filled with quality soil. The estimated cost to implement this soil trench is \$35,000 per km which represents an increase of 0.6% per km of the total project capital cost (i.e., \$6.2M per km in a project to upgrade a four lane road to six lanes).

Continued growth of the street tree inventory combined with urbanization initiatives such as VivaNext, present additional pressures and challenges

Street trees are recognized as a key ingredient for successful urban growth initiatives. Each year the street tree population continues to increase as transportation corridors are urbanized. The increase in the street tree population has placed additional pressures on existing resources, and tree audit/maintenance activities are falling short of established standards.

With urbanization, new streetscape features are being introduced including raised planters and landscaped medians. The maintenance requirements and practices for this living asset in the new urban environment will be different and more intensive than existing programs.

Resources to deliver the current base program have fallen behind the demands of the existing street tree population. To accommodate future growth and achieve the expected benefits, additional support will also be required. Maintenance activities like watering, mulching and large tree pruning can be delivered through contracted services, while establishment pruning and auditing of contractors may require additional staffing resources. As part of the 2012 budget cycle and multi year business planning, the base and growth funding requirements will be assessed. A review will explore the cost benefits of internal and contracted service delivery, focussing on priority areas to ensure delivery of a sustainable Street Tree Program.

To monitor progress made in improving street tree performance, a street tree health assessment will be completed again in 2015

The street tree program is built on continuous improvement and adaptive management whereby practices are continually assessed and revised based on results observed. Street tree health is a key indicator used to assess the effectiveness of the program. A street tree health study is proposed for 2015 to assess the improvements in street tree performance. Following the completion of the assessment in 2015, staff will report back to Council.

5. FINANCIAL IMPLICATIONS

Street trees are the only Regional road asset that appreciates in value over time. Healthy street trees provide considerable benefits and services to Region residents. The current replacement value of the Region's street trees is conservatively estimated at \$18 million. This value will continue to increase over time as trees increase in size and the street tree population keeps pace with urbanization initiatives.

Street tree performance is improving, but base and growth demands associated with the current program and future growth, present additional pressures and challenges on this significant asset. To address base deficiencies staff propose to improve the tree watering program and implement soil trenches. The four additional waterings per tree will cost an additional \$24 per tree. Implementation of the tree watering program improvements are estimated to cost an additional \$144,000 per year (capital during establishment period only) for all newly-planted trees. The road boulevard soil improvements are estimated to cost an additional \$35,000 per road km (0.6% increase per km in total project capital cost).

Maintaining performance expectations with the anticipated growth and urbanization of the Region will require further resources and expertise. Maintenance activities and planting services can be effectively delivered through contracted services, while the expertise to manage this asset and audit contracted services is best delivered through staff.

A multi-year business plan (2012-2015) built on the elements of this report will be prepared during the 2012 budget cycle. This plan will address the base deficiencies and growth pressures noted above, and identify the resources required to sustainably manage this Regional asset.

6. LOCAL MUNICIPAL IMPACT

The Region's street trees play a significant role in defining the character of local communities. Improvements identified in this report will help to ensure street trees provide the expected benefits to local residents. The results of the street tree health

assessments and the continuous improvement measures implemented are also directly applicable to local municipal street tree programs. Staff will be working with local municipal staff through our Urban Forestry Forum to transfer this information to assist with program delivery at the local level.

7. CONCLUSION

Street trees are a significant Regional asset, providing many benefits to Region residents. They are a capital asset that appreciates in value over time. To achieve the expected benefits, trees require resources to ensure their growth and long term performance.

The 2010 street tree health assessment has documented significant improvements in the performance of Region's street trees. However, the report clearly identifies program weaknesses and confirms street trees are falling short of performance targets. There is a need to increase the investment in the management and care of these trees. Vigilant contractor auditing practices, coupled with soil improvements and additional waterings are all critical factors contributing to improve street tree performance. Future growth of the existing trees, the street tree population and urbanization of the Region will present further challenges to the street tree program. As part of the 2012 budget, a multi-year business plan will identify the resources required to sustainably manage street trees as a capital asset.

For more information on this report, please contact Ian D. Buchanan, Manager of Natural Heritage and Forestry Services at Ext. 5204.

The Senior Management Group has reviewed this report.

(The attachment referred to in this clause is attached to this report.)

York Region Street Tree Health Assessment 2010



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Transportation Services Department
Regional Municipality of York

Prepared by:

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January 27, 2011

Executive Summary

York Region Street Tree Health Assessment 2010

Trees are widely recognized as being a vital part of York Region's character, and their health is a reflection of the Region's well-being and liveability. Trees are an integral part of the Region's Streetscaping Program, and their proper planting, maintenance, and monitoring is considered critical to its success.

As part of York Region's proactive street tree management program, a health assessment of 1,410 trees was undertaken in September 2009 by Silv-Econ Ltd. to identify their health status and determine potential causes of health issues. This exercise is part of a long-term monitoring program initiated by the Region to support development of thriving communities of street trees that begin to grow well immediately following planting.

The present study investigated the health of a subset of trees (304 trees) that were part of the Region's first street tree health assessment (2003), as well as a new sample of trees (1,106 trees) most of which were planted between 2002 and 2009. It was observed that 76% of trees were in good (54%) to satisfactory (22%) condition. This represents more than double the number of healthy trees compared to findings previously observed (2003). The best performing species included Kentucky coffee tree, ornamental pear, ivory silk lilac, Shubert choke cherry, and Ohio buckeye. The Region's "top performing species list" includes these and other species, and was confirmed to be accurate in listing species which perform well in roadside environments. Recommended modifications to this list include adding red oak for sandy sites and considering removal of little leaf linden from the list.

In 2008, the Region began implementing enhanced planting and mulching practices, custom selection and tagging of nursery stock, as well as regular watering of newly planted trees. These efforts appear to have enhanced the health condition of young trees with improved foliage densities, and fewer symptoms of dehydration (e.g., trunk tissue necrosis, twig dieback). For example, 96% of the trees planted in 2009 and assessed the same year were in good to satisfactory condition, compared to only 60% for trees planted and assessed in 2003. The level of tree decline observed in the first three years following planting has also been reduced, as shown by improved health ratings of two and three year old trees. For instance, 82% of two year old trees were in good to satisfactory condition compared to 0% for similarly aged trees evaluated in 2003.

Although newly planted trees were found to be in better health condition than shown in past assessments, they continue to show a decline in health and little growth during their first 3 years (Figure 1). This decline is a reflection of the critical 3 year establishment period. This is followed by a three year period of recovery during which trees maintain or improve their health condition. By their seventh year, tree health tends to significantly improve together with noticeable diameter growth. This study found that healthy trees have the potential to grow 1.1 cm in diameter once they have become well established by their tenth year.

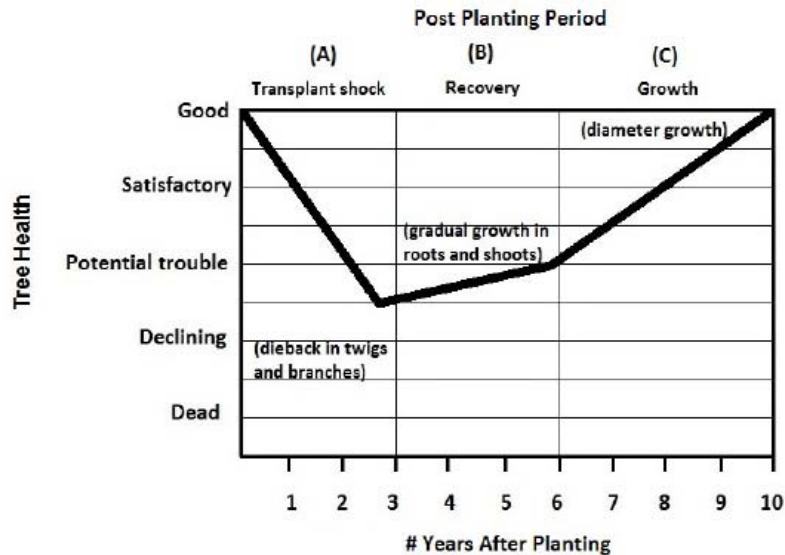


Figure 1. Generalized relationship between tree health and the number of years following planting. During the post-plant period "A" which lasts about three years, tree health typically declines. This is often observed as dieback in twigs and branches. This period is followed by period "B" which involves recovery by growing new branches and roots. Measureable diameter growth occurs during period "C" when trees restore their healthy appearance.

Evaluation of the growing environment including biological factors, soils, and planting site locations suggests that the major cause of declining tree health and slow growth is attributed to unsuitable soil conditions. Concerns include: high soil compaction, poor soil texture (e.g., fine textured soils such as clays), low soil fertility, road-salt impacts, soil drought, as well as wind exposure. The following sections describe the Region's present establishment and maintenance practices together with recommendations to enhance the health of both existing trees and those that will be planted in the future.

1.0 Tree watering

The Region currently waters newly planted street trees ten times per year for the first three years (June to September). Water is delivery to each tree using a Tree Gator watering bag which is installed at planting. The results of this and other studies indicate that trees should be watered weekly following planting to maintain tree health (Watson and Himelick 1997). This weekly watering equates to 17 applications per year for the first three years following planting (May to August). The first three years following planting have been noted as critical to tree health and is when newly planted trees typically decline. Rainfall events have proven to be unreliable and supplemental watering is required to ensure trees receive an adequate amount of water. It is recommended that the Region increase the number of water applications from 10 to 14 per year for the first three years following planting.

2.0 Soil moisture monitoring

The Region's tree watering program is implemented by contractors who are monitored using global positioning system (GPS) vehicle transmitters. Regional staff inspect gator watering bags to ensure trees receive the appropriate volume of water, however this monitoring does not investigate the effect of watering on actual soil moisture. A soil moisture monitoring field trial is recommended to be applied in concert with a watering program to verify that trees are obtaining adequate amounts of water, or are not being over watered. An automated system that uses soil moisture probes and data loggers on selected trees will ensure monitoring is done efficiently, and provides useful data to refine future watering programs so they are cost effective and beneficial to trees.

3.0 Soil

The following sub-sections provide recommendations to further improve upon the Region's current soil quality measures.

3.1 Soil quality

Current design guidelines for Regional boulevards states that "soils must not be contaminated and shall be a depth of 150mm". This study found that not enough quality soil is available for trees to thrive.

1. For road sections that will undergo future construction, more quality soil is required to support sustainable populations of trees. Increasing the soil depth to 300 mm and applying the Region's soil specification for tree planting (York Region 2008) will help to achieve this. These soil specifications were found to be suitable for tree growth which include the use of coarse textured, fertile soils. Tree health was observed best in soils containing large amounts of sand (>62%) and little clay (<12%).
2. Utilize strategic tree planting treatments such as raised beds, soil trenching, radial trenching, and soil cells to improve existing soil conditions where trees are showing poor performance. Such treatments could also be integrated into new construction projects (see York Region 2008 for practical examples), or retrofit in older areas.

3.2 Soil pH

Almost all planting sites on Regional roads (98%) have unfavorably high pH levels (> 7.5 pH) that impede tree growth. This is likely due to the lack of suitable topsoil placed in boulevards, as well as road salt pollution. Soil pH is a measure of soil acidity. Healthy topsoil should ideally have pH measures of about 6.5. As pH increases, tree growth may be negatively impacted, often showing deficiencies of phosphorus and micronutrients in foliage samples, which was observed in this study.

Chemical treatments that reduce soil pH on Regional boulevards have not been traditionally applied because they are considered expensive to implement and are not a long-term solution; a result of the high buffering capacity of the alkaline soils. Two effective treatments recommended to help trees grow in alkaline soils include,

1. Healthy soils should have an organic matter content of about 5%; soils on Regional roads have only 3% on average which suggests that about twice as much organic materials should be added compared to traditional approaches. The Region should incorporate organic matter into boulevard soil at the time of planting. The organic matter will lower the pH around the root ball over time, while increasing microbial life and improving soil structure.
2. Plant trees that tolerate alkaline soils. Planting species selected from the Region's top performing species list will help to maximize tree health since these species have been proven to tolerate alkaline soils.

3.3 Soil Compaction

This study found that 75% of the planting sites have compacted soils that inhibit tree growth. Compaction often results from construction activities and vehicle traffic. To protect soils from compaction during construction, the Region presently incorporates tree protection fencing and signage around trees and their soil. Regional staff and utility contractors should also be encouraged to reduce their job-related vehicle traffic on boulevards, particularly around trees.

3.4 Fertilization

The Region applies granular fertilizer to each newly planted tree in the fall of its third year, and every three years during routine maintenance until the tree is mature (15-20 cm in diameter). The Region should refine fertilization treatments according to laboratory recommendations made as part of this study. Soils were often deficient in potassium (86% of the samples) and phosphorus (78%), and generally had sub-optimal levels of organic matter. To address these nutrient deficiencies Cargill of Mount Albert recommends 1.36 kg / tree of granular fertilizer (12N-14P-19.6K-2.6Mg-0.35Zn) be applied to mulch beds during the growing season.

3.2 Soil Salinity

The Region has been implementing a number of best practices to strategically reduce salt use and associated contamination of boulevard soils as part of winter maintenance. Sodium, which is an element of road salt, was found to be ubiquitous in soils where trees are planted along Regional roads; 73% of the soil samples had sodium levels that are considered to negatively affect tree health. To alleviate the impacts to tree health caused by sodium, the Region should continue to use salt-tolerant species such as those listed in the Region's "top performing" list, and improve soil quality and quantity. Additionally, providing the trees with more quality soil containing large amounts of sand and organic matter and little clay will help to prevent accumulation of sodium.

4.0 Wind exposure

The Region should continue with its current practice of avoiding wind exposed, undeveloped locations (e.g., future development areas). Planting sites in residential urban areas are often least exposed to wind and offer the best protection to trees. This is a result of the many buildings, and other vegetation which modify the micro climate and act as a buffer, absorbing wind energy and reducing dehydration effects caused by wind chill during the winter. Compared to sites with low wind exposure, a greater proportion of trees

growing on windy sites showed signs of dehydration and stress including twig dieback (27% more), and epicormic sprouts (41% more). Species that have a history of poor performance should not be planted in windy areas, and conversely only those listed on the Region's top performing list should be considered for such sites. When options are available to select planting sites, the Region may find the wind exposure criteria provided in section 6.4.1 useful to identify sites that are least exposed to wind.

5.0 Mulch application

The Region should continue its mulching practice which involves application at the time of planting and every three years thereafter until the tree is mature (15-20 cm in diameter). Previous assessments have noted mulch beds to be less than 10 cm deep and 150 cm wide, and should be replenished on a 3 year maintenance cycle. The present health assessment found deeper and wider mulch beds; 45% of mulch beds were wider than 150 cm and 33% were deeper than 10cm. Continuing to create large mulch bed is encouraged since this practice promotes root growth, retention of soil moisture, modifies the soil quality, and improves tree health.

6.0 Tree stem protection

The Region should continue to install arborguard rodent guards on all newly planted trees. Newly planted trees should be protected with a tree guard made from plastic piping to prevent rodent damage; an occasional problem on rural sites where herbaceous vegetation is not maintained. Similar guards also help protect tree trunks from weed trimmers where they are used to maintain vegetation.

7.0 Urban forest health monitoring

York Region employs an adaptive management approach to ensuring the sustainability of the Region's street tree population. For new plantings, Regional staff carefully inspect trees at the nursery prior to planting and again when the trees are planted. Trees which appear unhealthy or damaged are rejected. Two years following planting, the young trees are re-inspected as part of the warranty program, and every three years thereafter as part of routine maintenance until the tree is mature (15-20 cm diameter). In addition to the Region's inspection for healthy trees during operations, a formal health assessment of a sample of the street tree population is conducted periodically. The first formal assessment was conducted in 2003, and again in 2006 and 2009. This report recommends that such assessments be conducted on a 5-year cycle to examine the health condition of the tree population and the environmental conditions in which they are growing. Results will help to serve as a feedback mechanism to fine tune cultural procedures. At the same time, these assessments will allow for new health issues to be identified before they can develop into serious problems. The next field assessment is scheduled in September of 2015.

Conclusions

Through monitoring, audits and adaptive management practices the Region has demonstrated continuous improvement in achieving improved tree health conditions since 2003. However, many factors continue to negatively impact the street tree population. These factors present ongoing challenges and opportunities for improvement.

Key recommendations include:

1. The Region must work towards achieving better soil quality and quantity in its boulevards to ensure long term tree growth.
2. Continued implementation of a watering program will be critical to early survival and growth of newly planted trees.
3. Continuing to apply mulch and fertilizer as prescribed on a 3 year cycle should be standard practice.
4. Utilize tree protection guards (arborguard) to protect trees from rodents and gas powered weed trimmers.
5. Avoid planting wind prone, exposed sites and plant only species selected from the Regions top performing list on such sites.
6. Work with the aboricultural industry to test new species cultivars that are tolerant of roadside conditions and to improve the quality of nursery stock.
7. Update the top performing species list and utilize species from this list for planting.
8. Implement tree preservation around trees on construction sites to protect trees and their soil from physical damage.
9. Increase maintenance activities (e.g. mulching) of trees located in rural areas.
10. Commit to continued monitoring, auditing and adaptive management including routine monitoring of tree health and environmental conditions to identify future challenges, and to understand influences on future performance.