

Urban Forest Management Plan

2026-2046

for the City of Markham



Executive Summary

- This, the City of Markham's first *Urban Forest Management Plan* (UFMP) will support the City of Markham's *Strategic Plan 2020-2026* and support Markham as a safe, sustainable and resilient community.
- The UTC (*Urban Tree Canopy*) Study determined that Markham's target of 30% canopy cover cannot be attained and sustained by 2031. The most sustainable and cost-effective means to increase tree cover to 30% is to increase tree cover gradually under the long-term scenario with sustained annual tree planting through time based on an Enhanced Approach.
- Overall, there are 2.8 million trees in the current and future urban areas (Table 7). The most common species in terms of the number of trees are the northern white cedar, European buckthorn (considered an invasive exotic) and Manitoba maple (Table 8). The most dominant species in terms of leaf area are sugar maple, Norway maple and northern white cedar (Table 9). These trees have structural/replacement value around \$1.1 billion (CAD) and conservatively (i.e., not all services are assessed) produce services valued at \$9.1 million/year (Table 10): carbon sequestration, avoided runoff, pollution removal, energy savings and avoided carbon emissions.
- The *Tree Equity Index*, generated by the Plan, will act as a guide for community and City tree planting.
- The challenge of implementing the UFMP is adapting to the pressures of intensified land development, which has created a scarcity of space for large trees and accelerated the Markham's UTC Gap: the difference between the City's target of 30% for UTC and the forecasted UTC based on historical trends, which is 20%.
- The *Urban Forest Management Plan* (UFMP) will be carried out by the City with leadership from the Operations Forestry Department. Collaboration between the Forestry, By-law and Property Unit (Tree Preservation Section), Planning and Engineering departments will be essential to ensure that large urban trees have the space they need to thrive and provide valuable ecological services to people. This will be supported through the development of a new *Streetscape Guidelines* for intensification areas.
- To help achieve *Tree Equity**, Markham needs to follow the City's Sustainability Metrics Program. The Sustainability Metrics must include the specifications for the minimum soil volume quantity and quality needed to grow large trees at the "Tier 1 development application stage".
- Key municipal documents must be harmonized with the UFMP, starting with new urban forest policies in Markham's new *Official Plan*, to realize Markham's Vision for its urban forest.
- Building upon the local community network initiated as part of the UFMP's community engagement efforts, a large-scale community-based tree planting initiative will be essential for achieving the City's Urban Tree Canopy targets.
- The City needs to continue to invest in its green infrastructure by maintaining its *Block Tree Pruning Program*. This Program has effectively encouraged proper structure in the maturing street trees of Markham. If continued over time, it will help achieve the long-term goal of

creating *stability* in the municipal tree population as well as supporting the City's commitment to providing exceptional services.

- A *Strategic Framework* outlines the UFMP's Vision, Guiding Principles, Goals & Objectives and Action Plan.
- The proposed 5-Year Operating Plan for 2026-2030 prioritizes the costs of each *Action Item* in the Action Plan.
- Implementing the UFMP will position the City of Markham among leaders in sustainability and a future-ready community for all.

*Tree Equity refers to "the right number of trees so that all people experience the health, economic, and other benefits that trees provide" (American Forests, 2024)

Background

The *Urban Forest Management Plan* (UFMP) was awarded to Kuntz Forestry Consulting Inc. (KFCI) in the fall of 2023 under the City of Markham's RFP #124-R-23. Our team's mission is to promote a positive relationship between people and trees so as to maximize these benefits for everyone. We have a proven track record of having successfully completed similar projects for many other Ontario-based, municipal clients.

The KFCI team is made up of a diverse group of consultants from Canada and the United States:

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CHAPTER 1

1. Introduction

1.1. About the Urban Forest Management Plan

1.1.1. Purpose

The goal for the City of Markham's *Urban Forest Management Plan* for 2026-2046 is to foster a healthy relationship between the community and urban trees, ensuring that everyone can benefit from this resource. The strategy to maximize the potential of Markham's urban forest on both public and private lands will be to encourage community participation in the development and implementation of this plan. The vision for the plan is based on the belief that a sustainable and resilient Markham relies on its urban forest.

“Urban forestry is a critical element of urban planning. Around the world, cities are actively implementing “nature-based solutions”... [leading to] a rise in the development of strategic and operational plans related to urban forests...[they] are necessary guides to successful urban forestry programs and often reveal the management conditions of urban forestry” (Barona *et al.*, 2024). “The key to advances in urban and peri-urban forestry (UPF) within North America has been the response of remarkable organizations and the coordination of programs that support, monitor, communicate, organize and deliver action through partnerships at all scales” (Borelli, 2023). This level of support has more of a significant presence in the United States than in Canada. Responsibility for urban forestry in Canada falls strictly under the jurisdiction of municipalities. Historically, the lack of provincial and federal government support for urban forestry in Canada has hindered municipal efforts, with “only 20% of municipalities having a comprehensive management plan for their urban forests...The top pressures and obstacles facing urban forests are urban development, lack of funding and lack of planning” (Bardekjian, 2014). However, recognizing this, the Government of Canada, in 2024 launched *Growing Canada's Community Canopies* in partnership with the Federation of Canadian Municipalities and Tree Canada. Matching grants for tree planting and capacity building projects from this seven-year program could assist the City of Markham by funding eligible action items in this UFMS.

Municipalities around the world face a challenging paradox. While the global urban population rises with the earth experiencing record-high daily temperatures (ABC News, 2024), the *urban tree canopy cover* (UTC), which helps to reduce the urban heat island effect, continues to diminish (Nowak, 2018). Municipalities need to address this issue, as it contributes to an increasing gap between the quality of life for urban residents and the urban forest's ability to enhance that quality (Collingwood, 2020). By implementing this *Urban Forest Management Plan* (UFMP), Markham can continue to move towards becoming a future-ready community that successfully bridges this divide.

The *urban forest canopy* (UFC) is crucial because trees significantly benefit both people and the planet. Research clearly demonstrates that trees and urban nature enhance mental and physical health, improve children's attention and test scores, and increase property values in neighbourhoods, among other advantages (Turner-Skoff, 2019). Additionally, trees play a vital role

in cooling urban areas. The primary benefit of urban trees is their ability to lower air temperatures (Nowak, 2015). In the summer, the shade provided by large trees creates cooler environments, which contributes to healthier communities. This is especially important given the increasing impacts of climate change. One effective way to mitigate the urban heat island effect is by expanding the *urban tree canopy* (UTC) in residential, commercial, transportation, and recreational areas (see Figure 1).



Figure 1. Benefits of urban trees. (Nowak, 2015)

The *Urban Forest Management Plan* (UFMP) outlines strategies for managing the City of Markham's urban forest over a 20-year period, 2026 to 2046 and models urban tree canopy levels to 2024. The plan incorporates feedback from the general public of many neighborhoods, promoting a collaborative approach. This Plan includes “The Strategic Framework”, developed with an emphasis on environmental justice and includes five strategic goals, each supported by specific objectives and action items. The UFMP serves as a guide to help achieve a shared community vision for the future of Markham's urban forest, aiming to maximize the potential of urban forests on both public and private lands by engaging a diverse range of interested and affected parties.

1.1.2. How the UFMP was developed

The *Urban Forest Management Plan* (UFMP) generally aligns with the City of Markham's *Strategic Plan* for 2020-2026. When managed sustainably as *green infrastructure* and made accessible to all residents, the urban forest can contribute to Markham's climate leadership goals. This approach will help build a more resilient community in the face of climate change, ultimately leading to an improved quality of life for all residents. The UFMP was developed through these components (Figure 2).

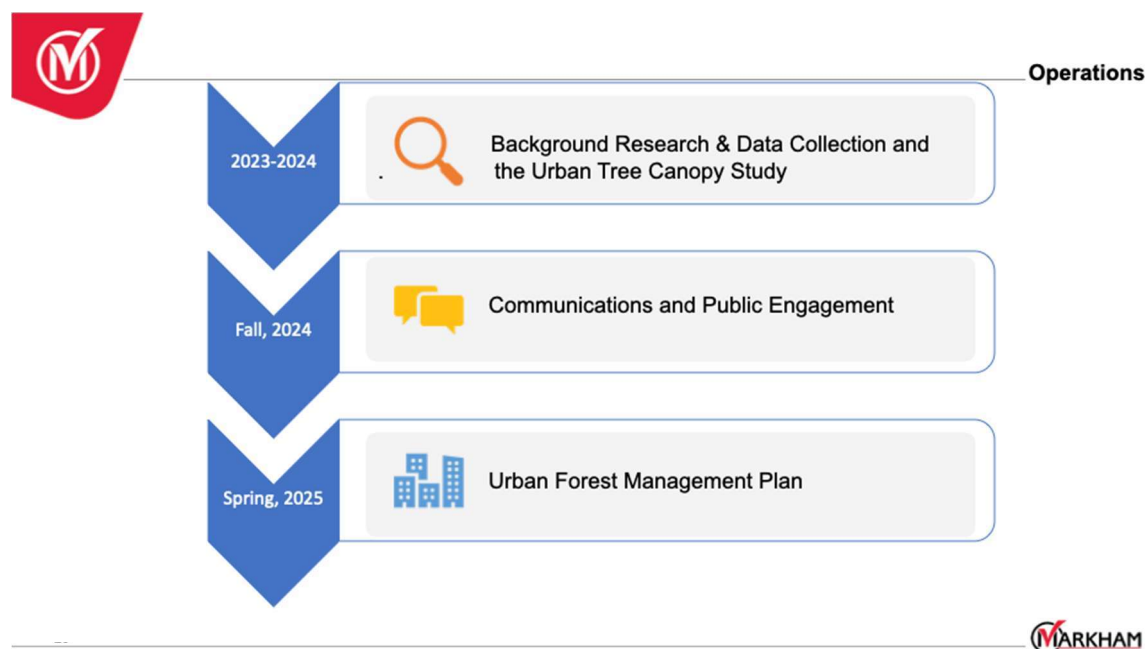


Figure 2. The UFMP Project Components.

1.1.2.1. Background Research and Data Collection Component

The Background Research and Data Collection component of municipal urban forest management involves reviewing relevant planning, engineering, transportation, and forestry documents, in addition to policies, by-laws, and other important documents from both the City and other levels of government. This component includes researching best management practices in arboriculture and urban forestry.

The plan included interviewing staff from various departments whose responsibilities impact the urban forest. These interviews provided insight into the business practices of the City of Markham and how these practices affect the management of the urban forest, thereby assisting in the development of strategies and options. Group discussions with staff considered the current and future needs of the community, as well as available resources and staffing, using a SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis (Chapter 2).

1.1.2.2. Urban Tree Canopy Study Component

The *Urban Tree Canopy Study* (Chapter 2) outlines the findings from historical records, measuring and modelling Markham's past, present, and future *urban tree canopy* (UTC). The 2124 target UTC levels for public and private lands were established to ensure the sustainability of Markham's UTC over the next century. Additionally, the project developed a model to measure *Tree Equity*. *Tree Equity* refers to "the right number of trees so that all people experience the health, economic, and other benefits that trees provide" (American Forests, 2024). However, many Canadian municipalities have not yet evaluated their Tree Equity. The Kuntz Forestry Consulting Inc. (Consulting) team created a *Tree Equity Index* map, which will serve as a guide for future public and community tree-planting initiatives aimed at enhancing tree equity throughout the community.

The land use type specified in the Zoning By-law becomes the habitat for trees. In other words, the extent of tree cover in urban areas is inversely related to the density of the land use type (Oakville, 2006). To support its UTC, including creating space for new trees in high-density development areas, the City of Markham will need new and innovative approaches to urban planning, design, and engineering. This is necessary due to expected changes to the City's Zoning By-law mandated by the province, which will prioritize development intensification. For example, this may involve significantly increasing housing density near major transit hubs, allowing multiplex housing on lots currently limited to single housing only.

1.1.2.3. Communications and Public & Interested & Affected Parties Engagement Component

Engagement through consultation is essential in the development of the *Urban Forest Management Plan* (UFMP) for the City of Markham. The insights gained from this process played a key role in shaping the UFMP.

The goals of this approach are to:

1. Clearly define the current state of Markham's urban forest and its management.
2. Generate ideas for the future management of this forest, including creating a vision of the urban forest, and
3. Use those ideas to create strategies for enhancing the urban forest as Markham continues to grow.

A comprehensive communication strategy was employed to reach out to the general public, residents in neighbourhoods facing tree inequity (as identified by the Tree Planting and Management Committee map), as well as Indigenous and First Nations peoples. This outreach aimed to assess their interests and preferred methods for contributing input on the UFMP. Community feedback is vital for establishing goals and objectives that will support large-scale private tree-planting initiatives aimed at achieving Markham's *Urban Tree Canopy* (UTC) targets.

The City of Markham can be confident that the Urban Forest Management Plan (UFMP) accurately reflects the interests, values, and needs of its residents. This confidence comes from the participation of City staff, political leaders, affected communities, and citizens. Public participation in consultations is most effective when:

- The process is inclusive,
- A diverse range of inputs, ideas, and perspectives are considered, and
- The results are communicated, including how the input was utilized.

The UFMP aims to assess the current state of Markham's urban forest and develop management ideas. Feedback and suggestions gathered during the consultation process were instrumental in shaping the strategy to enhance the urban forest as the City continues to grow.

Four overarching themes guided the messaging for the UFMP Project Engagement Approach on the City's *Your Voice Markham Project* web page (Figure 3):

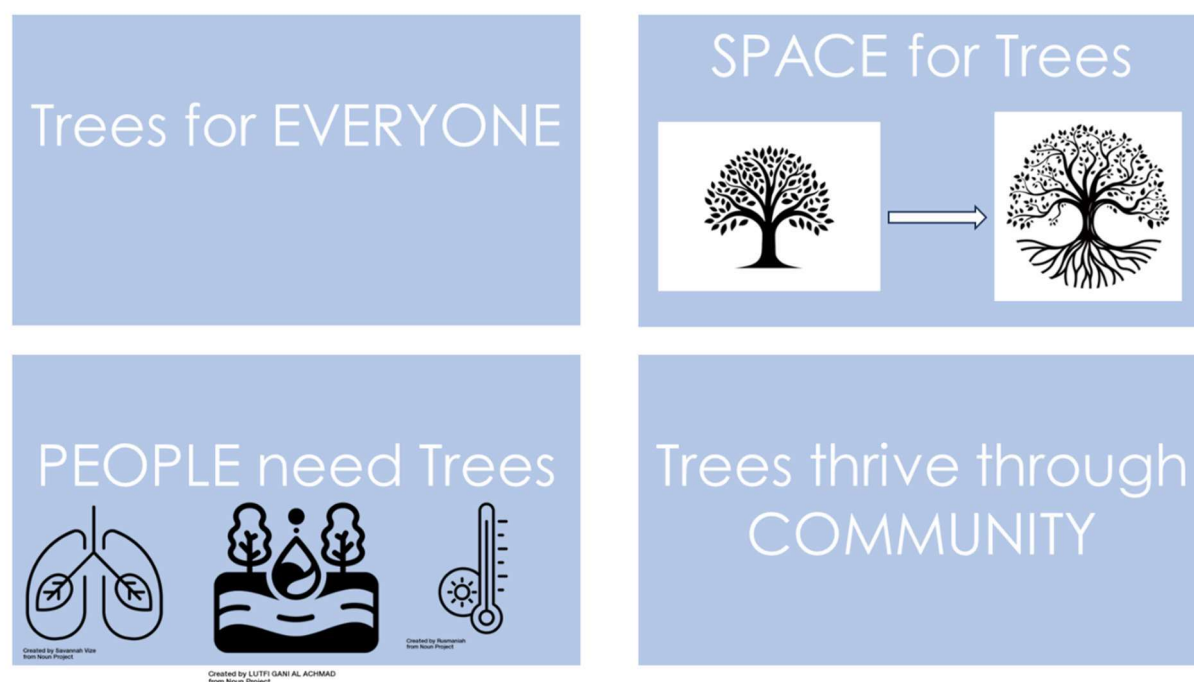


Figure 3. Public Education about trees is an integral part of the UFMPs public engagement.

1. Trees for Everyone.

Our Tree Equity Index map is a tool for all, designed to help ensure that tree benefits are distributed fairly across all neighbourhoods, fostering a sense of inclusivity and equality.

2. Make Space for Trees.

Large shade trees need access to uncompacted soil. Good urban design through planning and engineering can ensure adequate space.

3. People Need Trees

The annual value of the ecological services of Markham's urban forest is approximately \$9 million/year (Markham Forest Study, 2022).

4. Trees thrive through community.

Urban Trees and People Need each other.

Markham is a rapidly growing community dedicated to creating a sustainable and future-oriented environment. One of its strategic priorities is environmental sustainability and climate action. To meet its environmental goals, the City must protect its natural assets, especially its trees.

The communication efforts of the Urban Forest Management Plan (UFMP) have focused on highlighting the importance of trees for the future success of Markham. One key objective is to ensure that underserved communities are actively involved in the development of the UFMP and can benefit from the urban forest. Additionally, these efforts have emphasized the significant physical and mental health benefits that trees and forests offer to the community.

These benefits will be realized through the City's implementation of the strategies outlined in the Strategic Framework of this Plan, which is presented in Chapter 3.

The following is a summary of the Communications/Engagement approach with the public and interested & affected Parties:

1. City of Markham Communications launched the *Your Voice Markham* Project page (Spring, 2024)
2. City of Markham Communications conducted an online public survey (Summer, 2024)
3. The Consulting team prepared a *Tree Equity Index* map, to serve as a guide for future public and community tree-planting initiatives (2024)
4. The City hosted a UFMP Virtual Open House (November 12, 2024)
5. The City hosted a UFMP In-person Open House (November 14, 2024) with approximately 13 people attending.

As indicated above, during the summer of 2024, the Communications Department launched a project survey on the "Your Voice Markham" webpage. This initiative was crucial for the project's success. The City gathered input from residents, students, and local business owners about what matters most to them regarding the urban forest and the forestry services they use and appreciate (Figure 4).

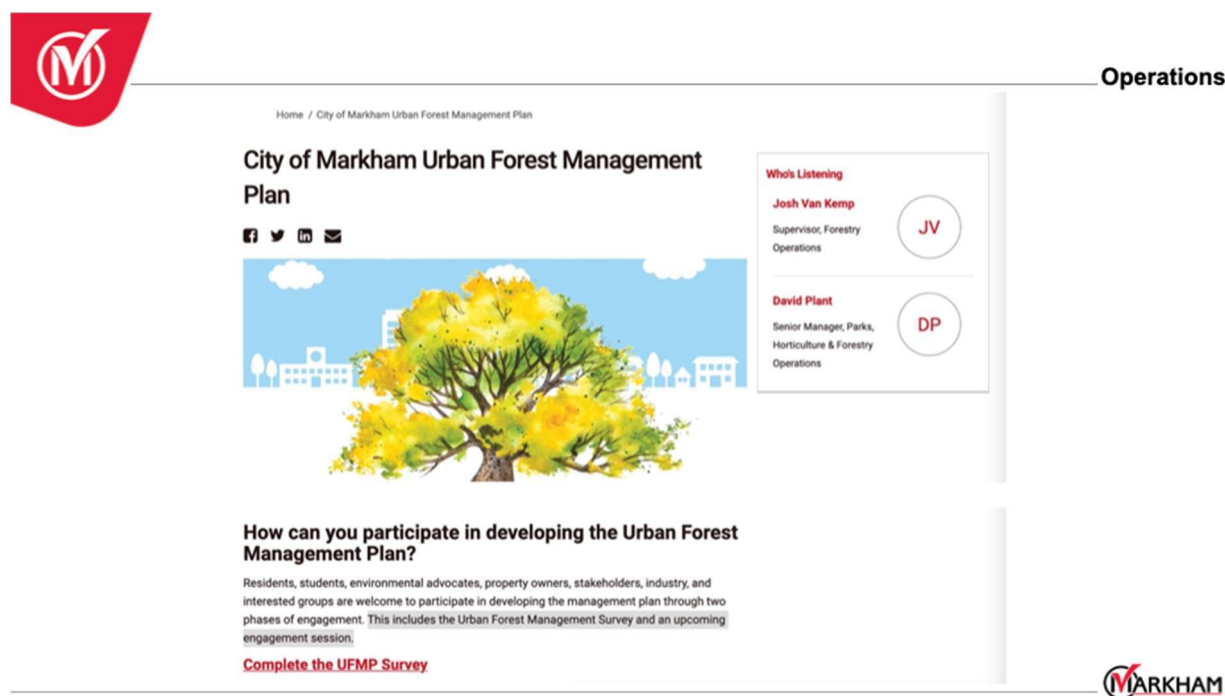


Figure 4. Communications and Community Engagement

A total of 450 respondents completed the *Urban Forest Management Plan Community Survey*, which was available on the City's website and publicized by means of a series of communications via social media. When asked to select from a list of descriptions that applies to them, 338 of 448 respondents indicated that they were residents of Markham (75%) and 81 of 448 respondents

indicated that they are a resident and own land in Markham (18%). Two respondents skipped this question.

Respondents were asked to select a response to a series of questions ranging from strongly disagree, disagree, neutral, agree, to strongly agree. Below are the results:

Table 1. Summary of the Communications and Public & Interested & Affected Parties Engagement Component

Statement:	I believe trees play an important role in human health and wellbeing.				
Respondent Selection:	Strongly Disagree: 21/405	Disagree: 1/405	Neutral: 6/405	Agree: 18/405	Strongly Agree: 359/405

45 respondents skipped this question.

Statement:	I care deeply about urban trees and think this should be a top priority for the City.				
Respondent Selection:	Strongly Disagree: 21/407	Disagree: 14/407	Neutral: 18/407	Agree: 76/407	Strongly Agree: 289/407

43 respondents skipped this question.

Statement:	I believe I have equitable access to urban and community forests, trees, and their associated benefits				
Respondent Selection:	Strongly Disagree: 13/406	Disagree: 20/406	Neutral: 43/406	Agree: 93/406	Strongly Agree: 237/406

44 respondents skipped this question.

Statement:	I feel it is important to ensure residents have easy access to trees and greenspace.				
Respondent Selection:	Strongly Disagree: 11/407	Disagree: 6/407	Neutral: 5/407	Agree: 44/407	Strongly Agree: 341/407

43 respondents skipped this question.

Statement:	I am satisfied with the City's current level of general tree maintenance (i.e. tree pruning)				
Respondent Selection:	Strongly Disagree: 39/405	Disagree: 65/405	Neutral: 124/405	Agree: 121/405	Strongly Agree: 56/405

45 respondents skipped this question.

Statement:	I am satisfied with the City's current level of hazard tree maintenance (i.e. dead tree removal)				
Respondent Selection:	Strongly Disagree: 33/406	Disagree: 45/406	Neutral: 130/406	Agree: 126/406	Strongly Agree: 72/406

44 respondents skipped this question.

Statement:	I am satisfied with the current Markham subsidized tree planting program (LEAF – Local Enhancement and Appreciation of Forests) available for tree planting on privately owned land.				
Respondent Selection:	Strongly Disagree: 17/404	Disagree: 27/404	Neutral: 207/404	Agree: 91/404	Strongly Agree: 62/404

46 respondents skipped this question.

Statement:	I support investment of funds or resources to increase canopy coverage for a greener Markham.				
Respondent Selection:	Strongly Disagree: 7/399	Disagree: 8/399	Neutral: 39/399	Agree: 85/399	Strongly Agree: 260/399

51 respondents skipped this question.

Statement:	Markham Forestry currently prunes each City street tree proactively once every 7-8 years. Pruning includes removing dead branches, cutting branches away from buildings/homes and removing low branches over the road, driveways, or sidewalks. I support a shorter timeframe, meaning City street trees will be pruned more regularly.				
Respondent Selection:	Strongly Disagree: 13/398	Disagree: 23/398	Neutral: 72/398	Agree: 103/398	Strongly Agree: 187/398

52 respondents skipped this question.

Statement:	I support investment of funds or resources to improve the maintenance and care of trees and forests in my community, improving safety, aesthetics, and the overall health of the urban forest.				
Respondent Selection:	Strongly Disagree: 3/397	Disagree: 6/397	Neutral: 46/397	Agree: 98/397	Strongly Agree: 244/397

53 respondents skipped this question.

Statement:	I support the development of rigorous tree protection measures.				
Respondent Selection:	Strongly Disagree: 8/398	Disagree: 12/398	Neutral: 61/398	Agree: 85/398	Strongly Agree: 232/398

52 respondents skipped this question.

Statement:	To attain the City of Markham's tree canopy coverage goal of 30%, it will require more tree planting on privately owned land. I am willing to plant trees on my privately owned property to support the City's tree canopy target.				
Respondent Selection:	Strongly Disagree: 35/394	Disagree: 21/394	Neutral: 89/394	Agree: 65/394	Strongly Agree: 184/394

56 respondents skipped this question.

Statement:	I am aware of the City's approach to urban forest protection, including tree permits and by-laws, as well as urban forest policies.				
Respondent Selection:	Strongly Disagree: 26/384	Disagree: 49/384	Neutral: 90/384	Agree: 105/384	Strongly Agree: 114/384

66 respondents skipped this question.

Statement:	In my opinion, taking care of trees on my property is a nuisance.				
Respondent Selection:	Strongly Disagree: 176/386	Disagree: 93/386	Neutral: 73/386	Agree: 24/386	Strongly Agree: 20/386

64 respondents skipped this question.

Statement:	When it comes to urban forestry, I believe the City includes diverse community values, experiences, and perspectives in planning, management, and educational opportunities.				
Respondent Selection:	Strongly Disagree: 17/384	Disagree: 18/384	Neutral: 239/384	Agree: 56/384	Strongly Agree: 54/384

66 respondents skipped this question.

Statement:	I believe the City makes information about the urban forest easily accessible, while also promoting public engagement.				
Respondent Selection:	Strongly Disagree: 41/382	Disagree: 48/382	Neutral: 185/382	Agree: 68/382	Strongly Agree: 40/382

68 respondents skipped this question.

Statement:	I am interested in participating in city-run programs to support and maintain my community's urban forest and plant care.				
Respondent Selection:	Strongly Disagree: 18/383	Disagree: 18/383	Neutral: 132/383	Agree: 97/383	Strongly Agree: 118/383

67 respondents skipped this question.

1.1.3. Monitoring

The *Urban Forest Management Plan* (UFMP) employs a science-based approach that is anchored in the three pillars of *Criteria and Indicators* for Strategic Urban Forest Planning and Management. Many municipalities in Canada also adopt these pillars to track the progress of their urban forest plans. Markham was assessed using the "*Criteria & Indicators* for Strategic Urban Forest Planning and Management" model (Kenney et al., 2011), with detailed findings presented in Chapter 2. The purpose of this assessment was to evaluate the municipality's urban forest sustainability and identify areas for improvement.

The model should be reapplied to reassess the City's progress after each 5-year Operating Plan period. This ongoing reassessment is crucial for effective monitoring, allowing for necessary adjustments to the UFMP and informing the development of the next 5-Year Operating Plan. This reassessment will serve as a "Progress Report," measuring how well the City has implemented Markham's UFMP.

CHAPTER 2

2. Current Environment

2.1. State of the Urban Forest

2.1.1. Windshield Survey Report: City Tree Maintenance Needs mapping

To assess the condition of public trees in the urban forest, the Consulting Team conducted a “Windshield Survey” of Markham on October 23, 2023, focusing on municipal street trees. A Windshield Survey is a quick and economical method for gathering very general information about trees located on public road allowances, offering insight into the management of City trees. It is also known as a “Limited Visual Assessment” (ISA, 2017). Based on discussions with forestry staff, the survey was organized by municipal ward. To conduct the survey, a sample of each of the eight Wards was collected by driving along representative sections of the public road allowance. The sample categorized the trees into three estimated tree age groups: 0-20 years, 21-40 years, and 41+years. This categorization utilized the City’s *Forestry Block Pruning* map provided by Forestry staff. It was noted that the dominant land use type in the surveyed areas was residential.

During this survey, the following street tree-related variables in each of Markham’s Wards were recorded:

1. Dominant tree species
2. Dominant Age Class: 0-20, 21-40 & 41+
3. Overall, Tree Health & Structure: Good/Fair/Poor
4. Volume of Tree Maintenance Work required to meet generally acceptable arboricultural practices (GAAP): Low, Medium, High.
5. Type of tree maintenance work: raise crown, deadwood removal, tree removal, clearance over sidewalk/daylight triangle/streetlight, stump removal, corrective prune, opportunity for tree planting.
6. Estimated opportunity cost of not undertaking the tree maintenance work: low, medium, high.
7. The relative tree maintenance needs for each Ward was estimated by combining three (3) variables:
 - The type of tree maintenance work (see bullet 5 above);
 - The volume of tree maintenance work required to meet GAAP (see bullet 4 above);
 - The estimated Opportunity Cost (see bullet 6 above).

This method differs from a tree inventory, which systematically collects detailed information and provides recommendations for each tree.

The total estimated distance covered in the Windshield Survey was 21 km. Only roads maintained by the City of Markham were included, and not those maintained by the Region of York.

The amount of maintenance work necessary to meet the tree maintenance standards (below) was recorded by tree “diameter class” (0-20 cm, 21-50 cm, 50 cm+) applying the following criteria:

1. City tree maintenance: a standard of 4.3m (14.5’) clearance over the travelled portion of the road & 2.4m (8’) clearance over the sidewalk
2. GAAP (Generally Acceptable Arboricultural Practice) for the GTA as defined by the Consulting Team which includes:
 - a. Crown raising – establishing a minimum clearance for vehicles and pedestrians
 - b. Deadwood removal - to prevent injury to people or property damage; typically, limbs generally larger than 2.5 cm (1”) in diameter.
 - c. Hazardous tree removal - to prevent injury to people or damage to property
 - d. Clearance - to provide appropriate setback to Hydro lines/ traffic signs/ vehicular site lines; typically, 1m (3.3’) in the case of energized (primary) conductors
 - e. Stump removal - to avoid tripping hazards and to prepare for tree planting after tree removal
 - f. Tree plant - to improve/maintain the desired stocking level of the street and increase tree canopy
 - g. Corrective prune – improving the tree’s health/condition rating and future tree structure, making it more resilient to future severe weather events, thereby reducing future tree maintenance costs during cleanup from wind and ice storms

The volume of work was categorized as ‘Low,’ ‘Moderate,’ or ‘High.’ No *individual Tree Risk Assessment* was conducted during the Windshield Survey. A *Tree Risk Assessment (the process used to identify, analyze, and evaluate tree risk, ISA 2017)* is done on individual trees, often while updating the municipal tree inventor. Consequently, the windshield survey method only generates a very general idea of the volume and urgency of tree maintenance work.

A consistent pattern observed in the eight municipal wards was that areas where the City’s systematic *Block Tree Pruning Program* has been implemented there was a noticeably lower need for tree maintenance. The *Block Tree Pruning Program* has effectively encouraged proper structure in the maturing street trees of Markham. If continued over time, it will help achieve the long-term goal of creating *stability* in the municipal tree population.

Generally, an important management goal of forestry operations is tree *stability*, which is :

“Assuming that the community is interested in a good street tree management program, the overall goal of a program is to provide the highest-value street tree population for the costs incurred. With this objective, three management goals will probably (but not always) emerge:

1. *Maximum stocking of street trees. To provide an optimum-value population, the plan should attempt to achieve a full stocking of street trees in the community at some realistic point in the future*

2. *Low maintenance costs and public safety. Maintenance costs should be balanced against needs for public safety, a high-value tree population, and budgetary constraints. In the short run, cutting maintenance expenses will save money, but in the long run this will result in public hazards and trees that are a liability rather than an asset to the community*
3. *Stability. A stable street tree population is one that is not threatened by catastrophic losses due to poor management. Poor management includes overreliance on a few species, a uniform city-wide age structure, and minimal or no scheduled tree maintenance.”*
(Miller, 1988).

Markham’s municipal urban forest mainly consists of maturing trees, specifically those in the 0-20 year and 21–40-year age classes.

Maturing trees are often prone to developing bark inclusions. Included bark is considered a defect that can make branches more likely to fail prematurely, such as during wind events that would not normally cause limb failure if the tree had been pruned properly. The missed opportunities from not having a well-funded proactive pruning program include (a) increased tree-related risks to public safety and (b) higher costs for forestry operations’ emergency response due to a greater number of storm events. These opportunity costs increase as the trees grow larger.

The outstanding volume of work and type of forestry-related work observed, along with the consequences of failing to perform this work (opportunity cost), served as a proxy for assessing the City’s relative tree maintenance needs in each ward. This assessment was based on a sample of the City’s road network. The City’s street tree population consists of approximately 120,000 trees. To implement an 8-year block pruning cycle, an average of 15,000 street trees must be pruned each year. The Freeman maple, a street tree species commonly found in Markham (11,019 Freeman maple street trees, ~9% of total street tree population), adds extra challenges to transitioning to the 8-year cycle because it “often develops poor structure, and untrained trees are prone to large limb failure, as is silver maple”. (Landscape Ontario, 2013). Freeman maple, known to tolerate many conditions and is disease resistant, was widely planted before the *Block Tree Pruning Program* was introduced around 2020. “An effective tree maintenance program should include corrective pruning within the first 5 to 10 years after planting. If maintenance is delayed beyond this period, the cost for each tree becomes significantly higher. Additionally, it may take at least two successive pruning cycles to adequately address the tree’s malformed structure, particularly for fast-growing species like Freeman maples. The City estimates that there are many trees in this situation and must account for this extra transition cost.

The results of the Windshield Survey are illustrated in Figure 5.

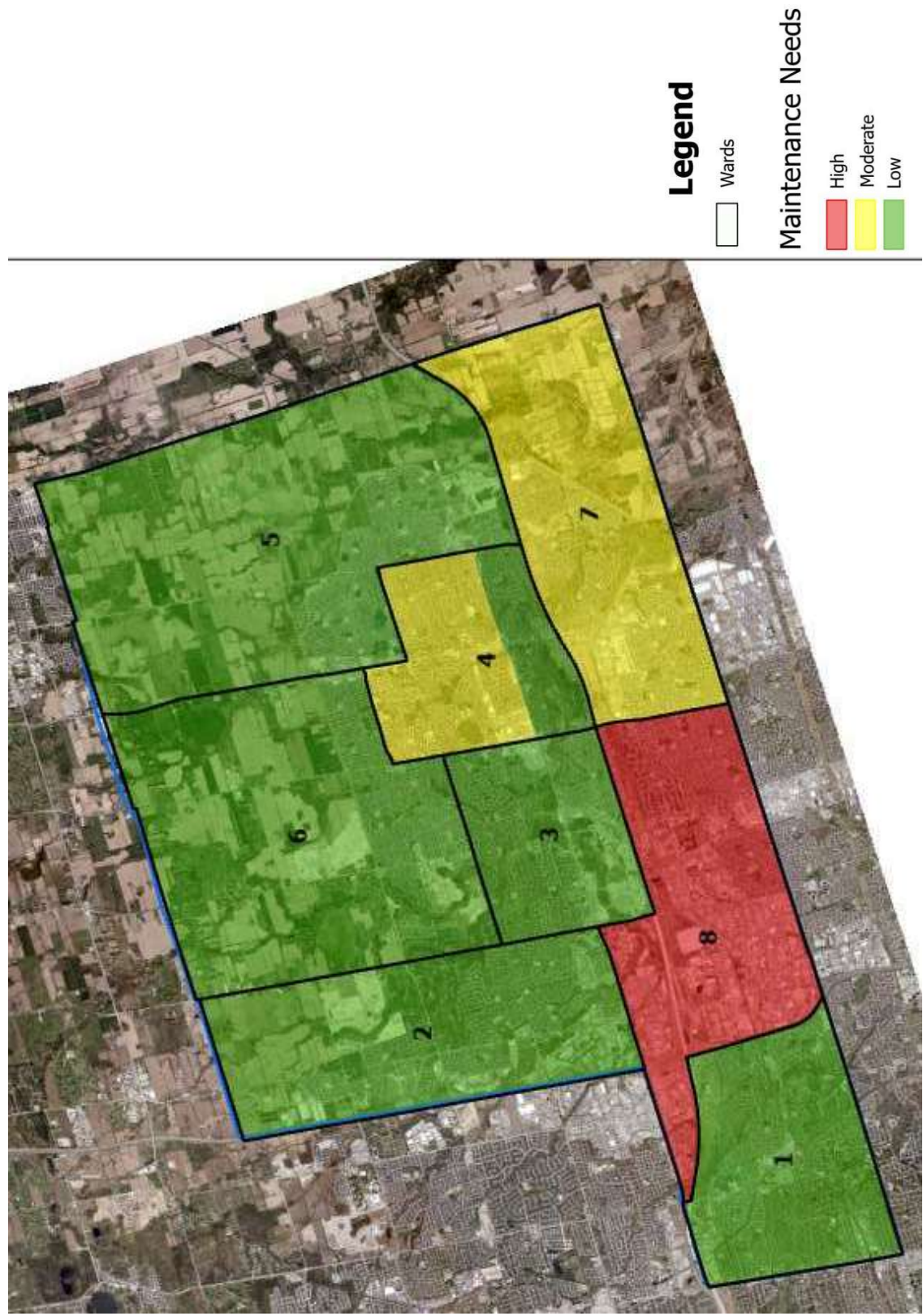


Figure 5. City of Markham Windshield Survey. Relative Tree Maintenance Needs in each Ward
(Source: <https://maps.markham.ca/html5viewer/?viewer=wards>)

2.1.2. Background Research & Data Collection

2.1.2.1. City Policy Review

Staff interviews were conducted in 2024 as part of the background research phase for the *Urban Forest Management Plan*. These interviews involved departments that influence urban trees. The purpose was to better understand how the *Urban Forest Management Plan* (UFMP) could assist staff in their work, comprehend how the activities of various City departments impact urban trees, and evaluate existing City policies and documents concerning Markham's urban forest.

TD Economics (2014a) shows that investing in the urban forest benefits both the economy and the environment: “For every dollar spent on annual maintenance, the City of Toronto’s urban forest returns \$1.35 – \$3.20 worth of benefits and cost savings each year.” In other words, “The cost savings produced by our urban forests make it clear that keeping the green on our streets keeps the green in our wallets” (TD Economics, 2014b). The City of Markham’s Neighbourhood Block Tree Pruning Program represents a vital and positive investment in the community’s environment and beauty.

From an analysis of the available data, several “themes” have emerged regarding Markham’s urban forest:

Theme 1. Staffing and resource levels are insufficient to support Markham’s public tree care management needs.

1. Impacts of falling behind with City tree maintenance.

In 2020, the City launched its *Neighbourhood Block Tree Maintenance Program* to prune street trees on a cyclical basis every 8 years across all eight Wards. To catch-up on the backlog, the program was allocated a budget of \$3 million (capital budget) over the first three years for the City's (approx.) 121,263 street trees.. In the first 3-4 years, the program pruned 72,400 trees, averaging 24,133 trees per year. This represents about 75% of the City's land area and about 60% of the street trees. The aim is to complete the balance over the remaining three years of the Program, based on an average cycle of eight years. Operations is selective when implementing the program, focusing on specific fast-growing tree species such as the Freeman Maple, which when pruned in the first three years will need additional pruning before Year 8 to comply with road clearance standards.

“In the short run, cutting maintenance expenses will save money, but in the long run this will result in public hazards and trees that are a liability rather than an asset to the community.” (Miller 1988)

This creates potential risk and liability management issues for the City.

In a Municipal Pruning Benchmarking Survey (Urban Forest Innovations 2024) the following data was collected:

- Full-time staff. The number of full-time tree workers employed by the City of Markham (6 workers) is below the average (9 workers).

- ISA Certified Arborists. The number of ISA Certified Arborists on-staff at the City of Markham (9 arborists) is below the average (10 arborists)
- Annual Street Tree Pruning Budget: The City of Markham spends \$14.84/ street tree; this is below the average of \$24.53/street tree.
- Actual Street Tree Pruning Frequency: The City of Markham's 8-year cycle is on par with the average cycle (8.5 years).

A ten-year forecast based on extrapolating the Windshield Survey results from 2028 to 2038 outlines two potential scenarios for tree maintenance needs across Markham's Wards by 2038. This forecast serves to reinforce the findings of the Benchmark Survey, which underscored the critical importance of the City of Markham maintaining its Neighborhood Block Tree Pruning Program and enhancing its Forestry Operations by allocating additional funds for Forestry Operations, as outlined in the 5-Year Operating Plan for 2026-2030 presented in Chapter 4.

As urban forestry plays a vital role in enhancing community aesthetics, improving air quality, and promoting biodiversity, it is essential for the city to invest adequately in this initiative to ensure healthy tree growth and maintenance in residential areas. Additionally, the forecast highlights the urgent need for the allocation of tree-specific funding for Forestry Operations. These additional resources are necessary to meet the demands outlined in the 5-Year Operating Plan for 2026-2030, discussed in Chapter 4, which specifies strategies for managing the city's urban forestry efficiently and sustainably. Investing in these programs will help ensure that tree maintenance aligns with community needs and environmental standards over the next decade.

Scenario 1. Not Recommended. Eliminate the current funding for the *Block Tree Pruning Program* (Figure 6).

In this scenario, the Forestry Section would stop proactively pruning City trees, resulting in high maintenance needs across all Wards, as depicted in Figure 6. As a result, any structural issues with the trees will only be addressed reactively as reports are received. This approach is likely to worsen the existing backlog of Action Completion Requests (ACRs), especially after tree damage due to extreme weather events because street trees will be more prone to breakage if not properly pruned.

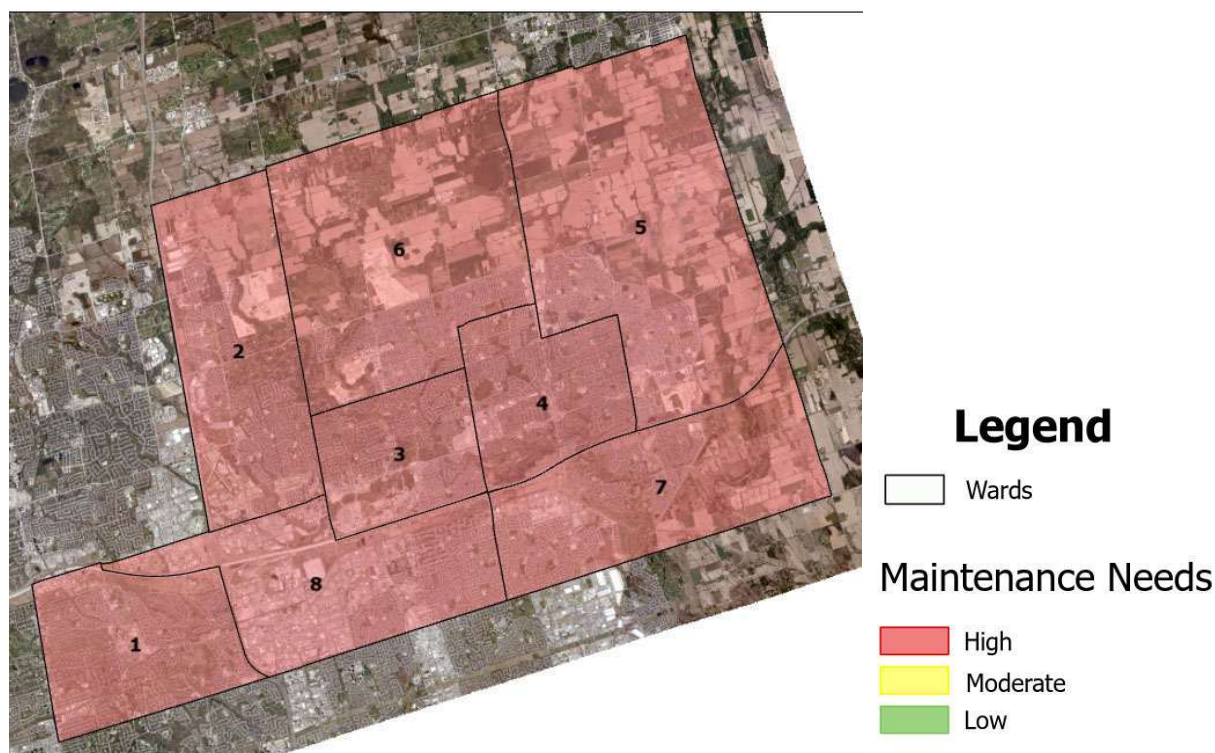


Figure 6. City of Markham Windshield Survey. Relative Tree Maintenance Needs in each Ward- Scenario 1

Scenario 2. Recommended. Maintain current funding for the Block Tree Pruning Program (Figure 7).

In this scenario, City trees would continue to be proactively pruned on a scheduled basis, averaging every 8 years, resulting in low maintenance needs across all Wards, as depicted in Figure 7. Structural tree issues would be addressed before they are reported.

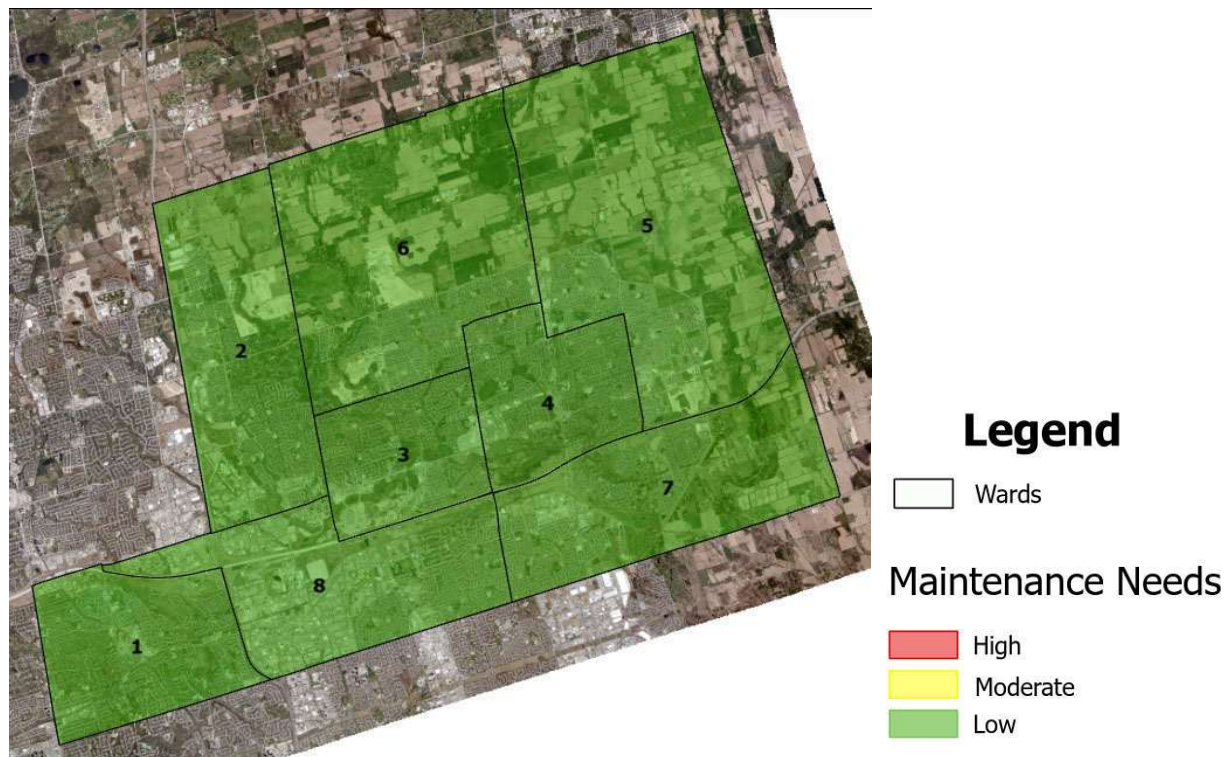
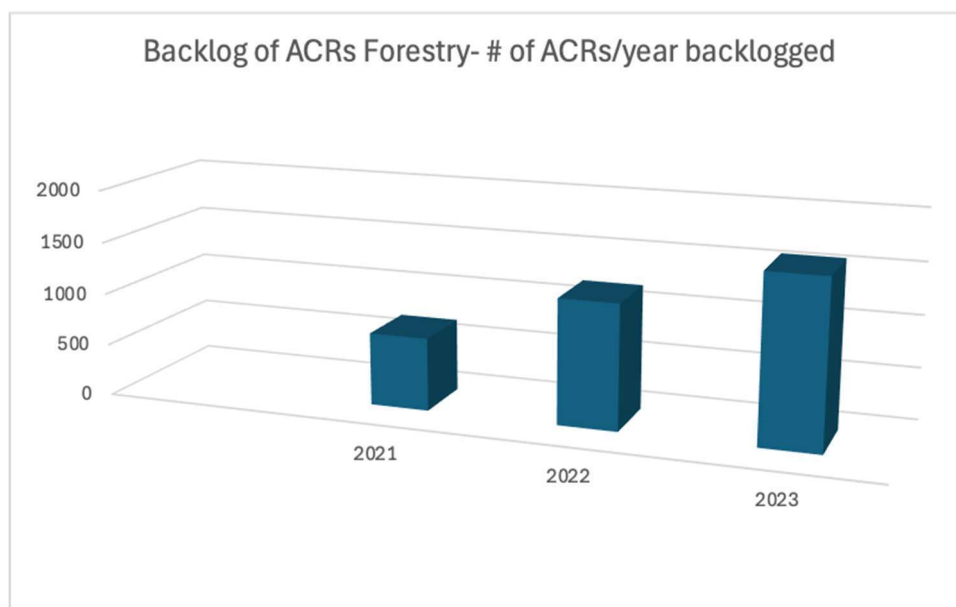


Figure 7. City of Markham Windshield Survey. Relative Tree Maintenance Needs in each Ward- Scenario 2

2. Impacts of a growing backlog of citizen requests for City tree work.

The current staff complement is unable to manage the rising number of Action Completion Requests (ACRs) for Forestry. As a result, the annual backlog has more than doubled between 2021 and 2023, with the number of ACRs increasing from 700 to 1,600 (Graph 1). Up to 2024, limited resources were available to handle these duties, which involves inspections and generating Work Orders for Operations Forestry staff. The personnel available to perform this work were not full-time Forestry Inspectors, so addressing the requests had to be integrated into their existing responsibilities. In 2024, a new Full-time Forestry Inspector position was created.



Graph 1. Backlog of Action Completion Requests (ACRs) for Forestry.

3: Impacts of Citywide Construction. - There is a lag in the City’s permit process that regulates construction on the public road allowance. This lag poses a risk of unintended damage to City trees caused by third-party contractors during construction activities on the public road allowance covered by Municipal Access Agreements (MAA).

Markham’s By-law 2023-164, a Tree Preservation By-law is an individual tree by-law applying to trees located on both public lands and private lands with a DBH of 20 cm and greater. It contains four ‘exemptions:’ (1) the by-law does not apply to woodlots; (2) it does not apply to any activities under the *Municipal Act*; (3) it does not apply to properties covered by the Site Plan & Subdivision approval processes; (4) construction work that is regulated by an Municipal Access Agreement negotiated by Operations-Utility & Right of Way. These agreements are required when third-party utilities wish to work in the municipal right of way and require a Municipal Consent permit. Under the Municipal Access Agreement, utilities are required to apply for an Municipal Consent permit. There are three tiers of Municipal Consent permits with increasing complexity and slightly different requirements for the utility submission and drawings depending on the scope of work. Some require pre-inspection and some post-inspection including confirmation of satisfactory restorations. The Municipal Access Agreement covers a period of 5 years and outlines the roles and responsibilities of the utility and the city. Currently, the City has 9 of these agreements with telecoms that operate within the city.

Operations-Utility & Right-of-Way enforces regulations related to Forestry’s *Tree Protection Zones* using a standard drawing to render it without making any reference to the municipal tree inventory. In the case of the design consultant, the Engineering Services department provides the utility with all the necessary design criteria to comply with regulations. Many Municipal Access Agreements have a clause that mandates the presence of a certified arborist during any tree pruning within a

Tree Protection Zone. However, on bigger projects, it may be difficult for the Utility Inspector to ensure that the certified arborist's work complies with good arboriculture practices.

Operations-Utility & Right-of-Way does not have the resources to conduct inspections during utility construction, only during pre- and post-construction. This is a gap in the quality control for the City's permit process creating a risk of unintended construction damage to City trees caused by third-party utilities during construction activities on the public road allowance covered by *Municipal Access Agreements*).

The Municipal Consent (MC) process does not include a 'checks-and-balances' inspection process to ensure City tree protection. Implementing these measures will reduce costs by reducing the complaints that Forestry receives about construction damage in the form of Action Completion Requests concerning tree die-back post-construction that can be linked back to construction activity by third-party utilities. By establishing this checks-and-balances process, the City can reduce the necessity for remedial tree pruning work by minimizing construction damage to City street trees. This will save taxpayers money and improve customer service by reducing the backlog of Action Completion Requests directed at Forestry.

The Supervisor of Forestry is currently not an active member of the Markham Utilities Coordinating Committee. Inclusion will allow the City to build better relationships with utilities about trees, explain the City's tree protection specifications, and work together to develop new specifications to guide utilities when operating within the Tree Protection Zone and ensure compliance with Markham's Streetscape Manual.

Theme 2. There are strengths to build upon.

Markham is recognized as an Arbor Day Foundation *Tree City of the World*. The City has a proactive *Neighbourhood Block Tree Pruning Program* for its 120,000 street trees. City staff have demonstrated excellent interdepartmental and outside agency collaboration and teamwork in their efforts to preserve and protect trees. Forestry Operations staff have established good customer relations with the public, and their knowledge and expertise are highly appreciated. The staff who were interviewed expressed optimism about the potential of the *Urban Forest Management Plan*.

Theme 3. Urban tree canopy (UTC) cover is important to the City of Markham.

The City has developed urban forest policies and technical specifications for the 'space' for trees in the public realm which include:

1. Markham's Official Plan Section 6.1.4.4 – Streetscapes and Sustainable Development: "To ensure soil quality and increase soil volumes and minimize soil compaction in boulevards to provide maximum growing conditions."
2. The current City of Markham goal is an *Urban Tree Canopy* (UTC) Target of 30% by 2031 which was adopted by Council following the *York Region Forestry Management Plan* in 2016. The Region of York's *Markham's Forest Study 2022* indicates Markham had an UTC of 21% within its municipal boundary The Urban Tree Canopy study done for this plan shows

that Markham had a UTC of 18.6 % in 2023 within its current urban boundary. Both studies are correct; they differ because the Study Area boundaries are different. The City will continue to use and report the information gathered by the Region of York as the official data.

3. Markham's current *Streetscape Manual* demonstrates a thorough understanding of what trees require to thrive. It specifies a minimum soil volume requirement of 30m³ of uncompacted soil per tree; however, this condition is rarely provided, particularly in higher-density projects. This can be achieved in a number of ways through the employment of various approaches to reduce soil compaction. This is not to say that trees need to be given more priority than the other aspects of the municipal right-of-way. A city street is a complex assembly of components and requirements that can often conflict. More cooperation and coordination are required to successfully include trees as part of the city's infrastructure. Without it, for example, the clearance requirements as outlined in the *Streetscape Manual* can result in conflicts to provide trees with sufficient soil and space as expressed in the same document.



Figure 8. Photo of mature tree near hydrant



Figure 9. Photo of small trees near hydrant

These conflicts can be avoided through coordination and collaboration. For example, Figure 8 shows a 100-year-old tree with only 1m clearance between the trunk and a hydrant. In older neighbourhoods with an expansive tree canopy, we would find many trees to be non-compliant with the existing tree siting requirements. The 100-year-old tree would not have been planted if a 3m clearance, as required by Markham's *Streetscape Manual*, had been strictly enforced.

Another example can be seen in Figure 9. If the hydrant had been better located, off to one side, it would be perfectly located to support one tree instead of the two trees, each having only half the amount of soil they need with both trees positioned closer to a paved driveway, further restricting their root space.

Improved coordination between tree planting and utilities is required to reduce tree canopy impacts in residential neighbourhoods.



Figure 10. Existing condition

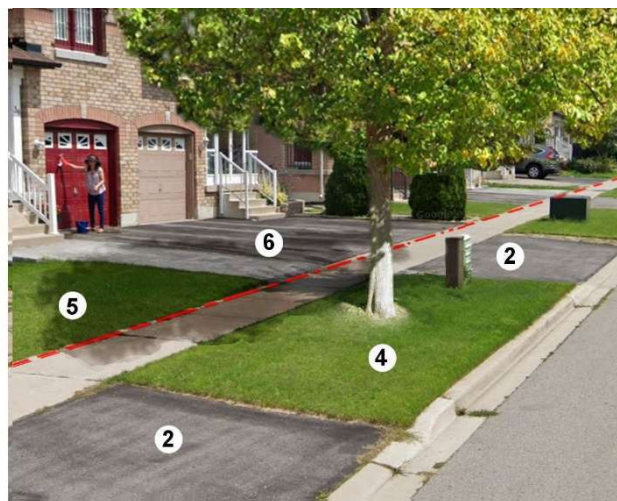


Figure 11. Potential condition with coordination

1. Utilities and their offsets are often sited in locations that negatively impact/preclude trees. Utilities and trees can coexist if designed appropriately.
2. The pavement area within the public right-of-way presents challenges to supporting tree growth.
3. Priority should be given to the space to plant a tree between the sidewalk and the street line.
4. The soil depth in the boulevard is often shallow. Programs may be needed to enhance soil conditions with aeration, vertical mulching or soil replacement.
5. Programs to plant large shade trees on private front yards should be considered.
6. In order to advance Markham's tree canopy objectives, the driveways and sidewalks should be constructed in a manner that provides adequate space and soil volume and which supports healthy and sustainable tree growth.

Planting trees only in the space between the sidewalk and the curb significantly limits the amount of tree canopy that can be achieved. Providing sufficient space to plant a tree between the sidewalk and the property and between driveways is crucial to growing successful street trees. Planting a tree on public land while providing its roots access to soil on the adjacent private land is fundamental to achieving a meaningful tree canopy. The design and location of the sidewalk is a multi-department issue that requires further study and collaboration.



Illustration by Peter Simon

Figure 12. A minimum soil volume of 30m³ is required to grow a meaningful sized tree.

Another reason why providing a minimum of 30 m³ of soil might be challenging has to do with something that often happens at the earliest stage of the approvals process - site preparation (see Figure 13). The vast tracts of land now occupied by many subdivisions were once covered by forest, then farmland. The soil that once supported a forest is typically removed, resulting in a lack of nutrients for new trees.



Figure 13. Soil is removed to standardize the relationship of houses to grade, speeding up construction and centralizing stormwater management.



Figure 14. Source (Google Earth)

Figure 14 (right) shows a mound of topsoil that has been removed and stockpiled. Some of the soil is then spread on front yards, in the boulevard and in backyards as shown in the photo on the left. The depth of soil is often only sufficient to grow grass and shrubs but insufficient to grow mature trees.



Illustration by Peter Simon

Figure 15. This is a plan of a typical subdivision constructed around 2013.

The plan in Figure 15 above illustrates the potential area for tree planting. The area in green is public land representing approximately one-third of the plantable area while the area in brown is private land representing the remaining two-thirds. The existing canopy shown is approximately 4%. With limited soil available within the public lands, the maximum tree canopy potential of this development is around 10% to 12%. To achieve a tree canopy of 30% or more in this or similar development, two requirements would be necessary:

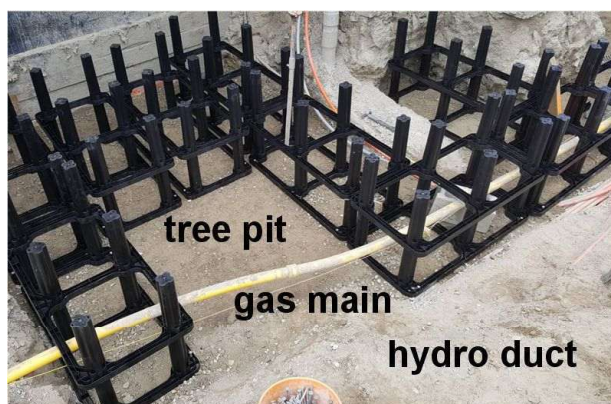
- a. new design considerations along with, specifications and construction methods for sidewalks and driveways.
- b. a community/ City collaboration to consider planting trees on private land that includes the provision of sufficient soil to support a healthy, mature tree.

The City's Trees for Tomorrow Program has planted over half a million trees since 2006. The Program has had different 'thematic' focus' over the years. In the last decade, its focus has been to recognize and promote partnerships with the community, NGOs, and corporations to promote education and tree planting on public and private lands. In addition, the annual boulevard and park planting that Operations administers consists of 1,900 trees: 50 (*Trees*

for Tomorrow), 450 (tax levy funded), 1150 (*Annual Boulevard Tree Replacement Program*, tax levy funded), 300 (Windstorm Recovery fund from 2022 Storm). Generally, these Programs do not have a scheduled watering component outside the tree planting tender. It is widely recognized that extending the watering program beyond two years, up to 3-5 years is now required because of the hotter and longer dry periods during the summer due to climate change, which has already led to the loss of many young trees throughout the GTA.

4. A new Streetscape Guidelines For Intensifications Areas is slated to be developed by the City's Urban Design Group. It will consider a variety of methods to provide adequate soil volume and tree planting locations for trees within the street ROW. Soil Cells, noted as one of the most expensive options, have successfully provided soil volume for trees under concrete or paved areas while also accommodating utilities. The City of Toronto (and other municipalities) have implemented many such projects. The use of soil cells, based on total cost of ownership, is not the only available option, but simply one of the tools available for enhanced soil conditions.

It is difficult, if not impossible, to grow an urban forest without effectively coordinating trees and utilities. We cannot provide separate zones and clearance requirements between trees and utilities and successfully grow a tree canopy.



The above photo shows SilvaCells under the front porch area of a downtown Toronto housing project with gas main and service connection integrated within a tree planting area.

The SilvaCells extend over a hydro duct located under the sidewalk shown in the photo on the right providing the tree with access to approximately 30m³ of soil.



Figure 16 photos by Peter Simon.

Figure 16 illustrates a project that uses SilvaCell technology to integrate utilities and trees to grow an urban forest with restricted space. If soil cells are being used, it is important to recognize that:

- Utilities existing below grade must also co-exist with the roots of mature trees.
- Workshops with utilities and City staff are needed to develop the designs, specifications and maintenance protocols necessary to sustain the coexistence of utilities and trees

Theme 4. Citywide policies and processes are required to protect and make space for trees.

The importance of City trees and the goal of achieving a 30% canopy needs to be shared with and acknowledged by all City departments. The current corporate policies and processes for development applications need to be reviewed to support the City's urban tree canopy target. It is important to understand the rationale for reviewing current policies and processes to protect and create space for trees.

Additionally, it is critical to develop and propose improved specifications and standards for planting trees and designing sidewalks, especially in the City's most challenging and densely populated areas, including commercial and multi-family residential districts. The impacts of adding a sidewalk to an existing neighborhood should be considered, as this typically results in the loss of mature trees and important neighborhood canopy. Tree compensation for these kinds of projects should consider a higher ratio of new trees planted when added sidewalks result in mature tree removal.

The Official Plan (OP) of Markham includes guidelines to ensure that the conditions for growth of street trees are optimal. These guidelines include ensuring adequate soil volume for trees, as outlined in Section 3.2.1, and promoting sustainable development practices to increase soil quality and volumes while minimizing soil compaction in boulevards, as stated in Section 6.1.4.4. It has proven to be a challenge to apply these provisions consistently in the City's physical infrastructure. Specifically, during Phase 2 of the City's OP Review, the City should consider including more enforceable requirements for the provision of adequate volumes of uncompacted soil through the approvals process to support the UFMP's Strategic Framework, as detailed in Chapter 4, Action Items.

By utilizing a range of useful tools, the "enhanced approach" as described below supports the well-being of large trees and helps guide the City toward successfully reaching and maintaining Markham's UTC Target.

Proposed “Enhancing Approach” - soil and site conditions for growing large trees to attain and sustain Markham’s UTC Target:

- Design and installation specifications for all new tree plantings should ensure adequate soil and planting conditions that promote tree growth and health.
- Design and construction methods must provide each tree with at least 30 m³ of growing medium, especially in high-density urban areas such as sidewalks, parking lots, and plazas. For low-rise residential and employment areas, similar methods should be used, including soil amendments or replacing existing soil, along with appropriate sidewalk and driveway designs.
- Specifications and protocols are required for construction activities near trees, including details on utility and infrastructure repairs. Programs* and bylaws** should be established for tree planting and protection on private property.
- Remediation of existing tree habitats, such as restoring street tree locations, can be achieved using arboricultural tools, including air spading to address soil compaction and vertical trenching to add mulch. This approach is a cost-effective way to retrofit areas with street trees.
- New City Programs* include supporting community tree-planting initiatives on private land, such as backyards, through organizations like Leaf. These initiatives could encourage neighbourhood groups to fundraise for tree planting and removal, share knowledge about landscape treatments for driveways and walkways that support and protect trees, and provide forums for homeowners planning additions that may impact trees to collaborate on solutions that safeguard and enhance the local tree canopy.
- Tree Preservation By-law 2023-164** for trees on private properties, including measures that support the ongoing protection and enhancement of the tree canopy. These measures should be constructive, not only punitive, and backed by incentive Programs.*

Theme 5. Interdepartmental collaboration is critical to growing the urban tree canopy and reducing the impacts of climate change for Markham.

“For people to receive their benefits, the urban forest needs to be healthy and diverse to create the most sustainable and livable communities possible” (Turner-Skoff, 2019). “The built environment as it currently exists is not conducive to most trees” (Watson & Himelick, 2013). “Many of the conditions that we seek to improve in our landscapes by planting trees are the same conditions that make tree establishment and growth so difficult” (Watson, 1994).

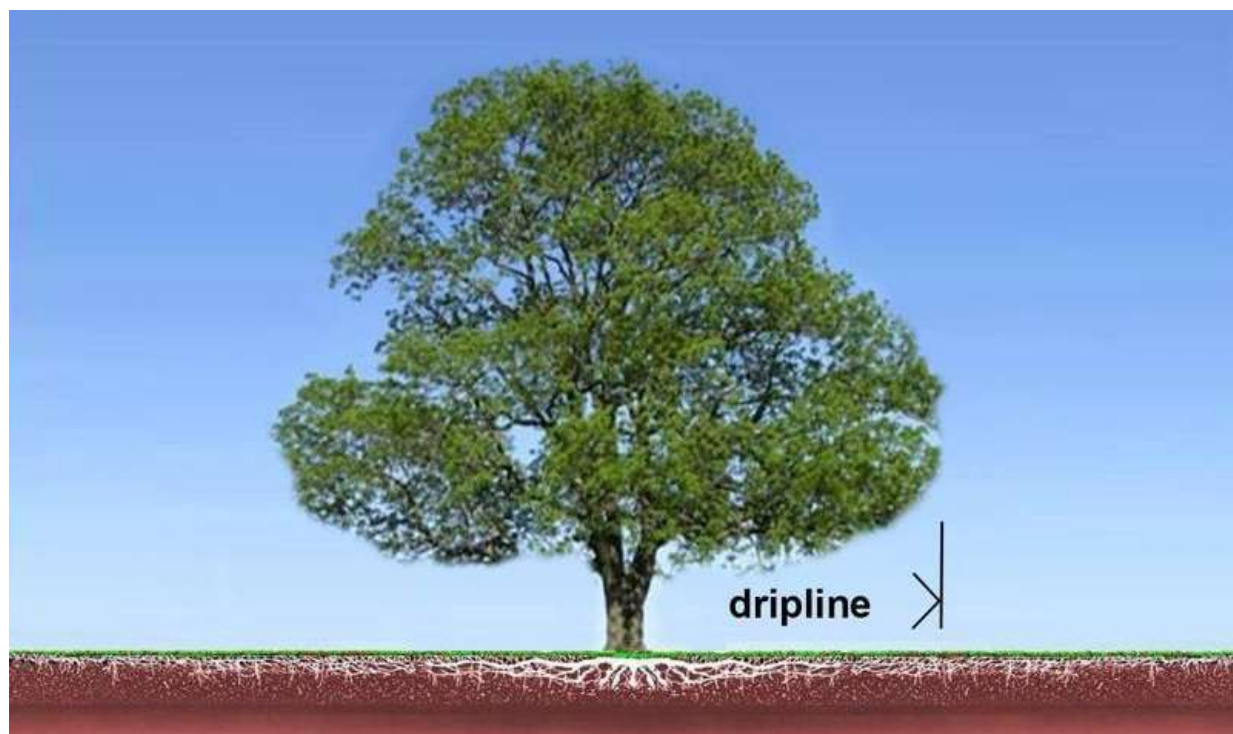


illustration by Peter Simon

Figure 17. The roots of a tree can extend to more than twice its dripline.

Trees have horizontal root structures. Urban (2008) suggests that a tree is structurally like a wine glass on a dinner plate, analogous to the proportion of glass height to plate size that closely resembles the natural model for forest trees. Good soils are quite fragile and can easily be degraded if not given priority in the design process and protected during construction and tree growth is directly related to the volume of soil available for root growth (Urban, 2008). “Soil volume requirements for good tree growth must be factored into the many compromises that represent the urban design process, a process that determines space and budgets for roads, sidewalks, utilities, grading, stormwater systems- and trees (Urban, 2008). The technology is available to create space for urban trees, allowing large, healthy shade trees to grow in residential, commercial, recreational, and transportation areas. *This deliberate allocation of space for trees in urban areas requires meticulous planning, engineering, and urban design. It also requires budgetary considerations.*

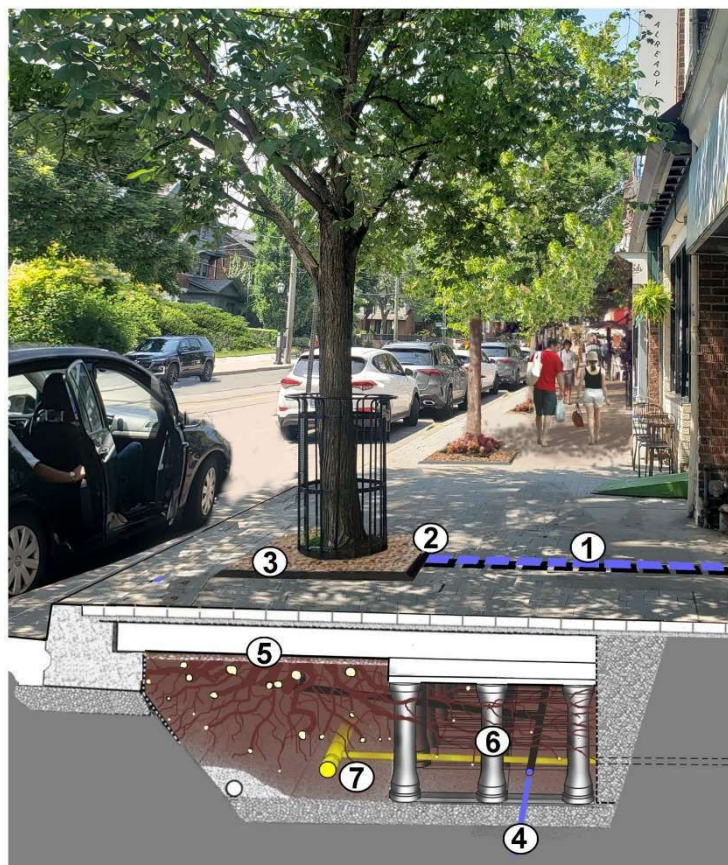


illustration by Peter Simon

1. Rainwater that sheets off the sidewalk drains into a tree planter designed to collect the water at the perimeter.
2. The robust metal curb detail is sloped and designed to not be an obstacle for a snowplow.
3. There are many options for the surface treatment of the planting area. Fundamental to any solution is that water must drain away from the tree. This will prevent perched, salty water, freezing, keeping young roots in frozen soil, undermining the root growth that naturally occurs in late winter/early spring.
4. Passive irrigation pipe connected to the tree planter acting as an area drain, made of 60mm PVC pipe, it also serves as a way for providing oxygen into the soil trench as well as a means for delivering compost tea fertilizer.
- 5/6. A concrete panel resting on a footing at the curb and a Silva Cell opposite, creates a continuous soil trench of 30m³ of the uncompacted soil needed to support a healthy tree.
7. The continuous soil trench can provide a utility corridor for hydro, telecoms or gas main as shown here.

Figure 18. The City of Toronto has implemented sidewalk designs, soil volume requirements and stormwater reduction requirements as part of the approvals process through a Green Standard policy.

The detail illustrated in Figure 18 above is one of several solutions that can provide street trees with access to 30m³ of soil, capture rainwater to water trees, reduce stormwater while integrating utilities.

During Phase 2 of the City's Official Plan Review, the City should consider reviewing road cross-section designs as recommended in Chapter 4, Action Items, that prioritize soil and space for trees.

An important first step to address this would be to leverage the collaboration amongst City staff to have the appropriate City departments review corporate policies/technical specifications and a new development application process that provides for adequate space for trees.

The *Urban Forest Management Plan* (UFMP) should not stand alone as the sole document needed by Markham to attain and sustain its urban tree canopy target. Instead, it should act as a catalyst, consisting of at least the UFMP, the Sustainable Metrics Program, the Trees for Tomorrow Streetscape Manual, and a new City *Enhanced Streetscape Manual*. In other words, this task is not straightforward; it is complex and highlights the importance of collaboration among various City departments and of using specialized knowledge to create more urban tree canopy.

Designing and building adequate space for the urban tree in city projects and city-approved projects also aligns with the *Sustainable Forest Initiative's* Sustainability Standard, Performance Measure 4.3 Strategy to protect soil quantity, soil quality, and soil health: the space for trees (Sustainable Forestry Initiative, 2024). Leveraging the City's Sustainability Metrics Program to guide urban design elements that support Markham's Urban Tree Canopy Target will help build a more livable and sustainable environment.

The City of Toronto's *Toronto Green Standard* is an example for Markham of a policy that is delivering the minimum soil volume required to support urban tree canopy targets in Toronto (Toronto, 2025).

The Markham Planning Department plays a crucial role in achieving urban tree canopy targets. Although the City already has guidelines for adequate soil volume for trees (Official Plan Section 3.2.1 b), these guidelines are not properly linked to the development application process, and does not clearly advise applicants of requirements. As part of the OP Review in Markham, new tree policies should explain why developers are encouraged to meet these guidelines in case of an appeal. It should clearly outline the various ways to achieve recommended soil volume requirements and include proposed setbacks in cross section drawings to support an urban tree canopy target. Opportunity exists to communicate minimum specifications for uncompacted soil volume for trees in the development application process, particularly in medium-density and high-density development sites. This will be especially important as Markham moves towards a more intensified form of growth.

The City has resourcing gaps that present barriers to the establishment and maintenance of recognition of trees as green infrastructure. As a result, a lack of clarity exists regarding the roles of utilities and trees, making it challenging to prioritize public trees in the standard engineering road cross-section of the City. As a result, the public road allowance in Markham is falling short of equally serving the needs of both green and grey infrastructure services.

Prior to the development of the UFMP, trees have not been given the same recognition as other assets with the ROW. Through cross-commission collaboration, efforts are now being made to change this perspective and acknowledge that city infrastructure encompasses more than grey infrastructure. In this regard, the *Urban Forest Management Plan* plays a critical role in promoting this new narrative as well as tree equity within the community; for example, aligning the *Urban Forest Management Plan* Project with the City's *Greenprint Sustainability Plan*. There are ongoing concerns regarding conflicts between raised planters and sidewalk plowing on 1.5m AODA (Accessibility for Ontarians with Disabilities Act) sidewalks. Tree grates, which are seen as a solution, can worsen issues related to road salt and poor drainage, which can lead to unhealthy tree conditions and high maintenance costs over time. Operations Forestry supports the use of raised planters instead of tree grates as the results seen over time have proven these to be a better option. Utility and Right of Way staff lead the City *Public Utilities Coordination Committee* in which some staff (but not Forestry) from other city departments are invited to an annual fall meeting to share their capital project plans for the coming year. By adding Forestry to the departmental invitation list and sharing upcoming Forestry capital work and projects, such as street tree planting locations, a dialogue can begin about street tree/utility conflicts and how best to resolve them.

Currently, the City has 9 *Municipal Access Agreements* with telecoms that operate within Markham. Under the *Municipal Access Agreement*, utilities are required to apply for a *Municipal Consent*. There are three tiers of *Municipal Consent* permits with increasing complexity and slightly different requirements depending on the scope of work. Some of the *Municipal Consent* permits required pre-inspection and some post-inspection on a specific project including confirmation of satisfactory restorations. It would be beneficial to have Operations Forestry review the *Municipal Access Agreement* to ensure that tree protection is taking place, including specified clearances and when open trench and directional boring are required. This discussion will help confirm necessary measures to protect municipal trees during third-party utility construction projects. Implementing these measures will reduce the costs as Forestry receives complaints about tree die-back that can be linked back to construction activity by third-party utilities. By doing so, Forestry can prevent the need for remedial tree pruning work on construction-damaged street trees after the *Municipal Consent* file is closed, which will save the taxpayer money and improve customer service by reducing the backlog of Forestry Action Completion Requests.

Utility & Right-of-Way enforces regulations related to *Tree Protection Zones* by delineating the Zone in writing, but do not reference the municipal tree inventory. When a design consultant is involved, it is unclear how they would determine the appropriate Tree Protection Zone. Currently it is Engineering Services that provides the utility with all the design criteria necessary to comply with regulations. Many *Municipal Access Agreements* include a clause that requires the presence of a certified arborist during any tree pruning within a Tree Protection Zone. It is also unclear how the Utility Inspector can ensure that the certified arborist's work adheres to proper arboricultural practices on larger projects. The Operations Department of Utility & Right-of-Way does not have the resources to conduct inspections during utility construction; they can only perform pre- and post-construction inspections. The lack of proper quality control can pose a significant risk of damage to city trees during construction. To address this issue, the Forestry and Utility & Right of Way staff should ideally collaborate to develop an SOP aimed at protecting municipal trees during construction, not just during the pre- and post-construction stages. This SOP could be called the "Tree Protection During Construction Policy" and would introduce a new permit known as the *Tree Protection Permit*. The TPP could be linked to the issuance of a *Municipal Consent*. The primary goal of this new policy is to ensure the safety and protection of city trees during construction

activities conducted by third parties. Implementing this policy may involve additional staff or consulting arborist fees, which could be balanced with a fee schedule associated with the permit.

These are all examples of important considerations for staff as they work to balance the needs of future infrastructure management.

In addition, this UFMP Project includes the creation of a *Woodland Management Plan* for all municipal properties, prepared as a separate document. Currently, Markham does not have a City Forester position, which could offer the necessary leadership for the overall forestry program and participate in inter- departmental discussions.

2.1.2.2. Criteria & Indicators for Strategic Urban Forest Planning and Management

The *Urban Forestry Management Plan*'s Technical Advisory Committee (the Kuntz forestry team) in consultation with the City of Markham's Consulting Team completed a self-assessment exercise on November 30, 2023, based on the *Criteria and Indicators for Sustainable Urban Forest Management* (C&I) (Kenney et al. 2011).

The criteria and indicators process serves as a method to assess a municipality's position within a model of urban forest sustainability. The process provides a snapshot of a city's performance based on 25 performance indicators and identifies areas where the city is performing well and areas that require improvement. It is recommended that this exercise be conducted regularly as part of the urban forest management plan for the community, updated every five years.

Three broad categories of Criteria & Indicators called "Frameworks" are measured (Figure 19):

- (a) the Vegetation Resource,
- (b) the Community Cooperation Around Sustainability of the Resource and
- (c) the Resource Management Approach.



Criteria & Indicators for Strategic Urban Forest Planning and Management



Figure 19 Criteria and Indicators for Strategic Urban Forest Planning and Management

The Performance Indicators measure progress towards the achievement of key objectives for each criterion used to assess each Framework. In general, a rating at the 'Good' or 'Optimal' level of performance is considered desirable.

A summary of the results from the Criteria and Indicators Analysis is presented in Tables 2-5, with pink highlighting indicating the current performance indicator for the City of Markham.

Table 2. Criteria and performance indicators for the Resource Management Approach.

Resource Management Approach – Highlights Indicate Current State

Criteria	Performance Indicators				Key Objectives
	Low	Moderate	Good	Optimal	
Tree Inventory	No inventory.	Complete or sample-based inventory of publicly-owned trees	Complete inventory of publicly-owned trees AND sample-based inventory of privately-owned trees.	Complete inventory of publicly-owned trees AND sample-based inventory of privately-owned trees included in city-wide GIS	Complete inventory of the tree resource to direct its management. This includes age distribution, species mix, tree condition, risk assessment.
Canopy Cover Inventory	No inventory.	Visual assessment.	Sampling of tree cover using aerial photographs or satellite imagery.	Sampling of tree cover using aerial photographs or satellite imagery included in city-wide GIS.	High resolution assessments of the existing and potential canopy cover for the entire community.
City-wide management plan (PLAN IN DEVELOPMENT)	Plan in Development/No plan.	Existing plan limited in scope and implementation.	Comprehensive plan for publicly-owned intensively and extensively managed forest resources accepted and implemented.	Strategic multi-tiered plan for public and private intensively and extensively managed forest resources accepted and implemented with adaptive management mechanisms.	Develop and implement a comprehensive urban forest management plan for private and public property.
Municipality-wide funding	Funding for reactive management.	Funding to optimize existing urban forest.	Funding to provide net increase in urban forest benefits.	Adequate private and public funding to sustain maximum urban forest benefits.	Develop and maintain adequate funding to implement a city-wide urban forest management plan.
City staffing	No staff.	No training of existing staff.	Certified arborists and professional foresters on staff with regular professional development.	Multi-disciplinary team within the urban forestry unit.	Employ and train adequate staff to implement city-wide urban forestry plan.

Criteria	Performance Indicators				Key Objectives
	Low	Moderate	Good	Optimal	
Tree establishment planning and implementation	Tree establishment is <i>ad hoc</i> .	Tree establishment occurs on an annual basis.	Tree establishment is directed by needs derived from a tree inventory.	Tree establishment is directed by needs derived from a tree inventory and is sufficient to meet canopy cover objectives (see Canopy Cover criterion in Table 2).	Urban Forest renewal is ensured through a comprehensive tree establishment program driven by canopy cover, species diversity, and species distribution objectives.
Tree habitat suitability	Trees planted without consideration of site conditions.	Tree species are considered in planting site selection.	Community-wide guidelines are in place for the improvement of planting sites and the selection of suitable species.	All trees planted in sites with adequate soil quality and quantity, and growing space to achieve their genetic potential.	All publicly-owned trees are planted in habitats which will maximize current and future benefits provided to the site.
Maintenance of publicly-owned, intensively managed trees	No maintenance of publicly-owned trees.	Publicly-owned trees are maintained on a request/reactive basis. No systematic (block) pruning.	All publicly-owned trees are systematically maintained on a cycle longer than five years.	All mature publicly-owned trees are maintained on a 5-year cycle. All immature trees are structurally pruned.	All publicly-owned trees are maintained to maximize current and future benefits. Tree health and condition ensure maximum longevity.
Tree Risk Management	No tree risk assessment/ remediation program. Request based/reactive system. The condition of the urban forest is unknown.	Sample-based tree inventory which includes general tree risk information; Request based/reactive risk abatement program system.	Complete tree inventory which includes detailed tree failure risk ratings; risk abatement program is in effect eliminating hazards within a maximum of one month from confirmation of hazard potential.	Complete tree inventory which includes detailed tree failure risk ratings; risk abatement program is in effect eliminating hazards within a maximum of one week from confirmation of hazard potential.	All publicly owned trees are safe.
Tree Protection Policy Development and Enforcement	No tree protection policy.	Policies in place to protect public trees.	Policies in place to protect public and private trees with enforcement.	Integrated municipal wide policies that ensure the protection of trees on public and private land are consistently enforced and supported by significant deterrents.	The benefits derived from large-stature trees are ensured by the enforcement of municipal wide policies.

Criteria	Performance Indicators				Key Objectives
	Low	Moderate	Good	Optimal	
Publicly-owned natural areas management planning and implementation	No stewardship plans or implementation in effect.	Reactionary stewardship in effect to facilitate public use (e.g. hazard abatement, trail maintenance, etc.)	Stewardship plan in effect for each publicly-owned natural area to facilitate public use (e.g. hazard abatement, trail maintenance, etc.)	Stewardship plan in effect for each publicly-owned natural area focused on sustaining the ecological structure and function of the feature.	The ecological structure and function of all publicly-owned natural areas are protected and, where appropriate, enhanced.

Table 3. Criteria and performance indicators for Community Framework.

Community Framework

Criteria	Performance Indicators				Key Objectives
	Low	Moderate	Good	Optimal	
Public agency cooperation	Conflicting goals among departments and/or agencies.	Common goals but no cooperation among departments and/or agencies.	Informal teams among departments and or agencies are functioning and implementing common goals on a project-specific basis.	Municipal policy implemented by formal interdepartmental/ interagency working teams on ALL municipal projects.	Ensure all city departments cooperate with common goals and objectives
Involvement of large private and institutional land holders	Ignorance of issues.	Educational materials and advice available to landholders.	Clear goals for tree resource by landholders. Incentives for preservation of private trees.	Landholders develop comprehensive tree management plans (including funding).	Large private landholders embrace city-wide goals and objectives through specific resource management plans.
Green industry cooperation	No cooperation among segments of the green industry (nurseries, tree care companies, etc.) No adherence to industry standards.	General cooperation among nurseries, tree care companies, etc.	Specific cooperative arrangements such as purchase certificates for “right tree in the right place.”	Shared vision and goals including the use of professional standards.	The green industry operates with high professional standards and commits to city-wide goals and objectives.
Neighbourhood action	No action.	Isolated or limited number of active groups.	City-wide coverage and interaction.	All neighbourhoods organized and cooperating.	At the neighbourhood level, citizens understand and cooperate in urban forest management.
Citizen-municipality-business interaction	Conflicting goals among constituencies.	No interaction among constituencies.	Informal and/or general cooperation.	Formal interaction e.g. Tree board with staff coordination.	All constituencies in the community interact for the benefit of the urban forest.

Criteria	Performance Indicators				Key Objectives
	Low	Moderate	Good	Optimal	
General awareness of trees as a community resource	Trees seen as a problem, a drain on budgets.	Trees seen as important to the community.	Trees acknowledged as providing environmental, social, and economic services.	Urban forest recognized as vital to the communities environmental, social, and economic well-being.	The general public has an understanding of the role of the urban forest.
Regional cooperation	Communities cooperate independently.	Communities share similar policy vehicles.	Regional planning is in effect.	Regional planning, coordination and /or management plans.	

Table 4. Criteria and performance indicators for the Vegetation Resource.

Vegetation Resource

Criteria	Performance Indicators				Key Objectives
	Low	Moderate	Good	Optimal	
Relative canopy cover	The existing canopy cover equals 0-25% of the potential.	The existing canopy cover equals 25-50% of the potential.	The existing canopy cover equals 50-75% of the potential.	The existing canopy cover equals 75-100% of the potential.	Achieve climate-appropriate degree of tree cover, community-wide
Age distribution of trees in the community	Any Relative dbh (RDBH) class (0-25% RDBH, 26-50% RDBH, etc.) represents more than 75% of the tree population.	Any RDBH class represents between 50% and 75% of the tree population	No RDBH class represents more than 50% of the tree population	25% of the tree population is in each of four RDBH classes.	Provide for uneven-aged distribution city-wide as well as at the neighbourhood level.
Species suitability	Less than 50% of trees are of species considered suitable for the area.	50% to 75% of trees are of species considered suitable for the area.	More than 75% of trees are of species considered suitable for the area.	All trees are of species considered suitable for the area.	Establish a tree population suitable for the urban environment and adapted to the regional environment.
Species distribution	Fewer than 5 species dominate the entire tree population city-wide.	No species represents more than 20% of the entire tree population city-wide.	No species represents more than 10% of the entire tree population city-wide.	No species represents more than 10% of the entire tree population at the neighbourhood level.	Establish a genetically diverse tree population city-wide as well as at the neighbourhood level.
Condition of Publicly-owned Trees (trees managed intensively)	No tree maintenance or risk assessment. Request based/reactive system. The condition of the urban forest is unknown.	Sample-based inventory indicating tree condition and risk level is in place.	Complete tree inventory which includes detailed tree condition ratings.	Complete tree inventory which includes detailed tree condition and risk ratings.	Detailed understanding of the condition and risk potential of all publicly- owned trees

Criteria	Performance Indicators				Key Objectives
	Low	Moderate	Good	Optimal	
Publicly-owned natural areas (trees managed extensively, e.g. woodlands, ravine lands)	No information about publicly-owned natural areas.	Publicly-owned natural areas identified in a “natural areas survey” or similar document.	The level and type of public use in publicly-owned natural areas is documented	The ecological structure and function of all publicly owned natural areas are documented and included in the city-wide GIS	Detailed understanding of the ecological structure and function of all publicly-owned natural areas.
Native vegetation	No program of integration	Voluntary use of native species on publicly and privately- owned lands; invasive species are recognized.	The use of native species is encouraged on a project-appropriate basis in both intensively and extensively managed areas; invasive species are recognized, and their use is discouraged.	The use of native species is required on a project-appropriate basis in both intensively and extensively managed areas; invasive species are recognized and prohibited.	Preservation and enhancement of local natural biodiversity

Table 5. Summary of results of the ratings for all 25 Criteria and Indicators

Criteria & Indicators						
Performance Indicator						
Criteria	Total	Low	Moderate	Good	Optimal	No Data
Vegetation Resource	7	1	2	3	1	0
Community Framework	7	2	3	2	0	0
Resource Management Approach	11	2	4	3	2	0
Total	25	5	9	8	3	0

Overall, 56% of the 25 Performance Indicators are either 'Low' or 'Moderate' and 44% of the Performance Indicators are in the desired category of either "Good" or "Optimal." This rating shows room for improvement over time and provides direction to the City on where it can focus resources to move towards achieving more sustainable urban forest management in the future. For example, many of the 'Low' Performance Indicators are in the *Community* framework; this suggests the City can improve its overall rating by focusing work over the next 5-Year Operating Plan on attaining a 'Good' performance indicator rating by working towards these objectives:

1. Neighbourhood Action: At the neighbourhood level, citizens understand and cooperate in urban forest management.
2. Citizen-municipality-business interaction: All constituencies in the community interact for the benefit of the urban forest.
3. General awareness of trees as a community resource: The general public understands the role of the urban forest.

By the end of this planning period in 2045, most of the 25 Criteria and Indicators for Strategic Urban Forest Planning and Management should reach the 'good' or 'optimum' indicator level. This will require the investment of resources based on a hierarchy of needs.

2.1.2.3. SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis

It is a crucial part of any plan to undertake a Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis.

Table 6. SWOT Analysis of Urban Forest Management in the City of Markham

City of Markham Urban Forest SWOT Analysis	
Strengths	Weaknesses
- Urban forest canopy cover is important to Markham with Council endorsing a 30% canopy goal aligning with the Region of York Urban Forest recommendations. - Worker safety. Staff have good equipment and training. - Good relations with the public. The public has confidence in the staff's arboricultural knowledge - Utilizing a mix of staff and contracted services to leverage existing budgets and maximize results. - Providing cross-departmental training about trees, tree protection and appropriate compensation when necessary to remove trees. - Providing timely updates to senior staff and elected officials regarding current and emerging issues which affect the urban forest. - Forestry Operations efficiency was improved in 2024 with the creation of a new Full-time Forestry Inspector position (<i>Block Pruning Program</i>, tree planting & stump removal duties) which permitted the Full-time Forestry Working Supervisor position to remain full time with the maintenance crews. - Responding quickly and effectively to urban forestry related events either weather or pest related employing corporate messaging and resident engagement during and after the event. - Actual Street Tree Pruning Frequency: The City of Markham's 8-year cycle is on par with the average cycle (8.5 years) from a Benchmarking Survey provided by the City of Markham.	Staffing and resource levels are not sufficient to support Markham's public tree care management needs. The gaps for effective service delivery in Forestry are: An Operations Manual with written SOPs including Tree Maintenance Standards that reflect industry BMPs Accelerate the frequency and required funding for the Neighborhood Block Tree Pruning Program as a primary service delivery tool for 2026 and beyond. Current modelling suggests that a seven year cycle would be more effective in addressing the growth of the younger trees in the urban forest. Over the next 5-Year Operating Plan period (2026-2030) the following resources are recommended to improve service delivery and departmental efficiency. A second Full-time Inspector position is required to stay current with the volume of resident requests and determine what action is required.. This additional inspector would allow Operations Parks Forestry to improve service delivery through creating an "Operations West" and "Operations East" organizational model - each staffed with a Full-time Forestry Inspector and a Full-time Forestry Working Supervisor. This model would yield the most effective productivity and service given the current and short-term growth of the City. A Contracted Arboricultural Inspector is required every two years to be responsible for Woodlot assessment/coordination across the whole City. The current Operations Parks Forestry complement of 6 Full-time in-house Arborists (3 crews of 2 Arborists/crew) and 1 should be increased to 8 Full-time in-house Arborists (4 crews of 2 Arborists/crew). The current Operations complement of 1 Arborist Contract Crew should be increased to 3 to keep up with the volume of resident requests

○ Markham is recognized as an Arbor Day Foundation <i>Tree City of the World</i>. ○ The City has a proactive <i>Neighbourhood Block Tree Pruning Program</i> for its 120,000 street trees.	for tree work due to Markham's growing urban forest. The Operations Parks Forestry department requires a manager to oversee the administrative, financial, planning, strategic initiatives and departmental liaison responsibilities. This will allow the Supervisor to oversee daily operations of staff and contractors focusing on improved productivity and service delivery. The current model requires the Supervisor to spend a disproportionate amount of their time on administrative tasks.
Opportunities	Threats
○ Planning staff incorporate direction from the Urban Forest Management Plan into their work on Phase 2 of OP Review. Leverage collaboration among City staff to ensure adequate space for trees in the development application process through the creation of a City Green Standard Document* to provide approved guidelines and urban design elements that support Markham's Urban Tree Canopy Targets. This document should be prepared with the collaboration of Urban Design. ○ Urban Design staff incorporate direction from the Urban Forest Management Plan into their work on Markham's new 'Enhanced Streetscape Manual' for intensification areas that recognizes and reflects that the public tree is an integral part of the public road allowance ○ Recognize City trees as Green Infrastructure and with direction from the UFMP treat and value this asset in the same way we treat static assets understanding that the City cannot replace mature trees on a like for like basis and when a mature tree is removed the replacement is fractionally equivalent to the original asset. ○ Planning staff incorporate direction from the Urban Forest Management Plan into their work on Phase 2 of OP Review. Leverage collaboration among City staff to ensure adequate space for trees in the development application process through the creation of a City Green Standard* to guide urban design elements that support Markham's Urban Tree Canopy Targets. Engineering staff incorporate direction from the Urban Forest Management Plan into their work on Markham's new 'Enhanced Streetscape Manual' for intensification areas	○ There are insufficient well-defined corporate processes in place to preserve and protect trees. While the City has a Council endorsed canopy cover goal of 30% by 2031 programs such as sidewalk infill in mature neighborhoods resulting in mature trees being removed and valuable canopy being lost. As another example, the City does not currently review utility construction plans for City tree protection concerns. ○ Cyclical pests such as Spongy Moth present an ongoing threat to the urban forest and have the potential to result in tree mortality depending on the severity of the infestation. Healthy trees are better equipped to survive the effects of such pests and as such tree maintenance becomes a critical requirement. ○ Windstorms and microbursts which seem to occur almost yearly have the potential to severely damage the urban forest, often resulting in the removal of mature trees in older neighborhoods. The Neighborhood Block Tree Pruning program is the first line of defense to prune street trees and eliminate structural defects and lighten the canopy of the tree.

that recognizes and reflects that the public tree is an integral part of the public road allowance.	
*or an equivalent mechanism to ensure trees are considered early in the planning and design process to guarantee minimum soil volume and adequate space for trees during the development application process	

The weaknesses, opportunities, and threats have been addressed in Chapter 4 - action items.

2.1.3. Urban Tree Canopy Study

The urban forest is an essential component of cities. It is defined as “trees, forests, greenspace and relative abiotic, biotic and cultural components in and around cities and communities” (OPFA, 2024). The view from the air provides a better understanding of an urban forest. A pattern appears: the density of the urban forest varies with land use patterns in urban areas. “Tree canopy is the layer of branches, stems, and leaves of trees that cover the ground when viewed from above” (The City of Kitchener, 2016). The existing urban tree canopy (UTC) is the amount of tree cover when viewed from above using aerial or satellite imagery.

In addition to tree cover, measurements of trees within Markham based on randomly located field plots collected in 2022 (York, Region of, 2023) were also assessed to better understand tree composition and benefits derived from Markham’s urban forest. In assessing Markham’s urban forest, two areas within the municipality of Markham were analyzed (Figure 20): 1 - Current urban area and 2 - Future development area.

The current urban area was subdivided into the following land uses:

Commercial – private commercial, right-of-way/transportation/utility and future development land uses within the urban area.

Public parks - City-owned parklands

Public other – public land not in parks or woodlots.

Residential – private residential land.

Woodlots – includes public and private ravines and greenways; and private open space.

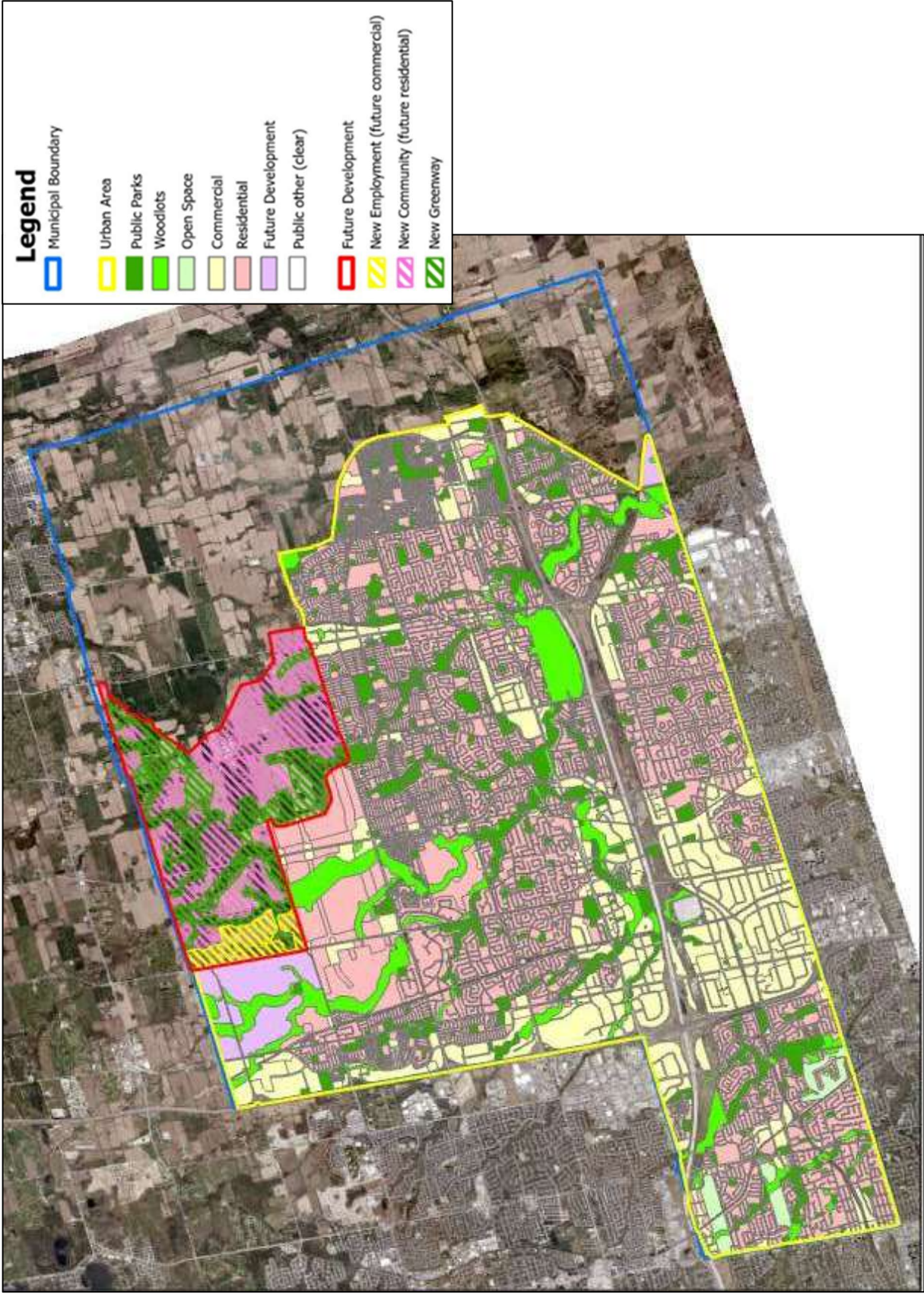


Figure 20. Urban Tree Canopy Study area in Markham. Yellow boundary encompassed the urban area; red boundary = future development area.

2.1.3.1. Forest Composition and Benefits with the Current and Future Urban Boundary

The field plots from the 2022 Markham urban forest study (York, Region of, 2023) were used to analyze the forest composition and values with the current and future urban areas using the i-Tree model. These results represent current conditions within the study area. Overall, there are 2.8 million trees in the current and future urban areas (Table 7). The most common species in terms of the number of trees are the northern white cedar, European buckthorn (considered an invasive exotic) and Manitoba maple (Table 8). The most dominant species in terms of leaf area are sugar maple, Norway maple and northern white cedar (Table 9). These trees have structural/replacement value around \$1.1 billion (CAD) and conservatively (i.e., not all services are assessed) produce services valued at \$9.1 million/year (Table 10).

Table 7. 2022 urban forest results within current and future urban areas.

Land Use	Area (ha)	Number of Trees	Percent of Population
Commercial	3,077.3	98,854	3.6%
Future Development	1,905.0	34,686	1.3%
Public other	3,099.7	212,764	7.7%
Public parks	1,473.8	677,942	24.5%
Residential	7,229.6	1,596,183	57.7%
Woodlots	990.0	146,780	5.3%
Current & Future Urban	17,775.4	2,767,210	100.0%

Table 8. Top 3 species in terms of number of trees by land use in current and future urban areas.

Land Use	Species 1	%	Species 2	%	Species 3	%
Commercial	Black walnut	23.1	Amur maple	19.2	Norway maple	11.5
Future Development	Black locust	35.7	White spruce	21.4	Amer. basswood	14.3
Public other	N. white cedar	20.0	Sugar maple	12.0	White ash	8.8
Public parks	Manitoba Maple	18.2	N. white cedar	16.1	Sugar maple	11.6
Residential	N. white cedar	65.3	Norway maple	4.1	Euro. buckthorn	3.5
Woodlots	Euro. buckthorn	44.4	Sugar maple	16.7	Red pine	13.0
Study Area	N. white cedar	43.2	Euro. buckthorn	6.8	Manitoba Maple	6.2

Table 9. Top 3 species in terms of leaf area by land use in current and future urban areas.

Land Use	Species 1	%	Species 2	%	Species 3	%
Commercial	Norway maple	30.6	Honey locust	23.1	Blue spruce	21.9
Future Development	Black locust	47.8	White spruce	15.7	Paradise apple	14.8
Public other	Sugar maple	30.0	Norway maple	13.0	Littleleaf linden	10.7
Public parks	Sugar maple	33.4	Eastern hemlock	22.1	N. white cedar	19.9
Residential	Norway maple	21.0	Norway spruce	19.4	N. white cedar	14.4
Woodlots	Sugar maple	44.2	Manitoba Maple	19.7	White spruce	14.2
Study Area	Sugar maple	16.4	Norway maple	13.5	N. white cedar	12.7

Table 10. Estimate annual values of services provided by trees in the current and future urban area.

Service / Benefit	Value (\$/year (CAD))
Carbon sequestration	\$590,000
Avoided runoff	\$1.6 million
Pollution removal	\$2.6 million
Energy savings	\$3.5 million
Avoided carbon emissions	\$811,000
Total	\$9.1 million

2.1.3.2. Present UTC

Kuntz Forestry utilized i-Tree Canopy to estimate the current Urban Tree Canopy. Using 2023 aerial photography, 3000 points were randomly generated by the model using the cover types as outlined in Table 11. Refer to Figure 21 for the points and cover types.

Table 11. Land Cover Classes utilized in i-Tree Canopy

Cover Classes	Description
Trees	Woodlots, single or small groups of trees on residential lots, street trees and middle of field
Impervious	Buildings, roads, sidewalks, driveways, concrete, structures
Plantable	Residential lawns, open park, open space, municipal right-of-way, schools, hospitals, regenerating meadow, grassy strips in parking lots or right-of-way, gravel boulevards
Permeable	Cultivated agriculture, active sports fields, cemetery, golf courses, wetlands, gravel parking, waste management, quarry, other areas devoid of trees
Water	Open water

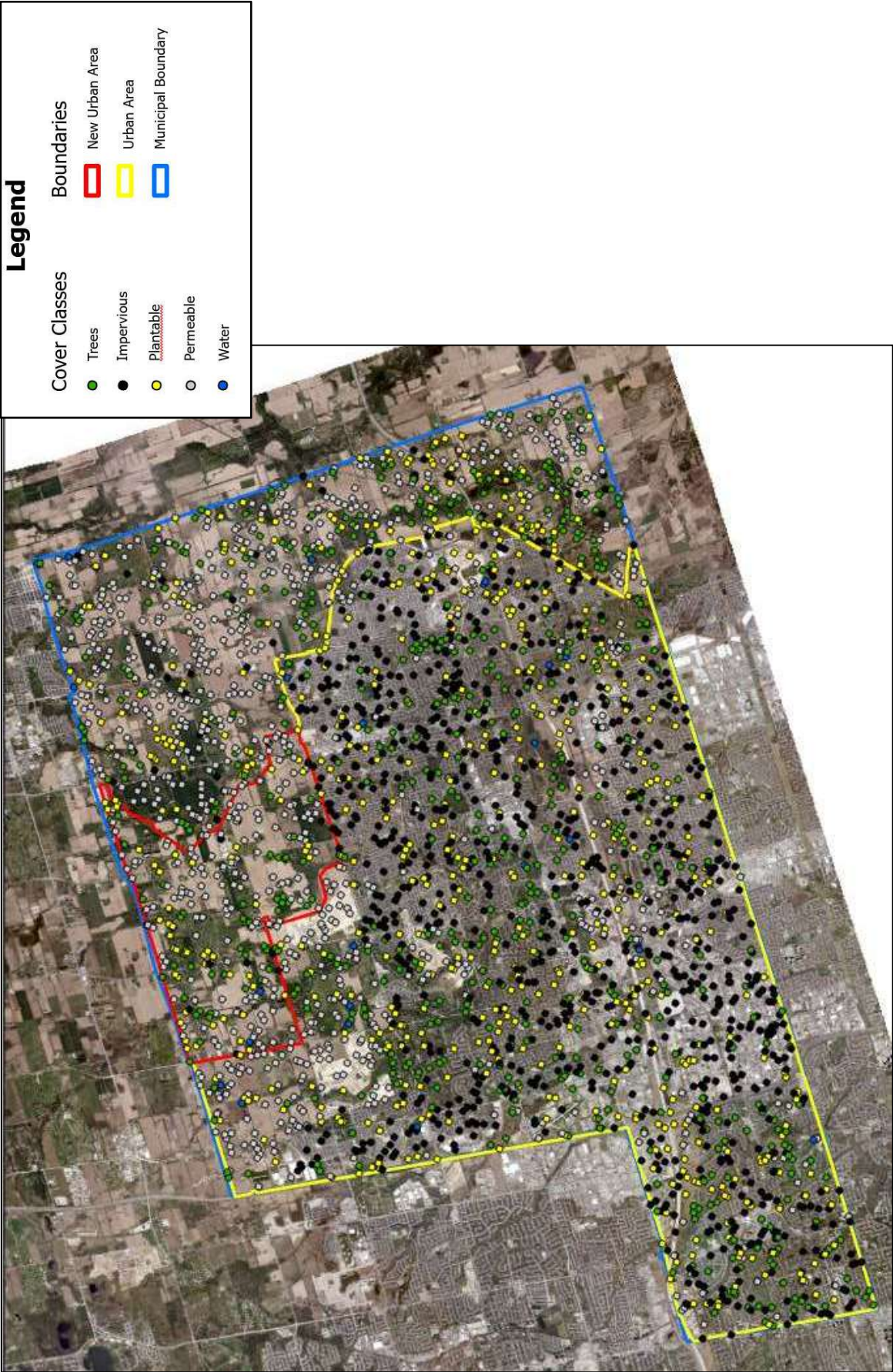


Figure 21. 2023 i-Tree Canopy Analysis

The results were translated to cover types as outlined in Table 11. Current tree cover in the study area is 18.5 % for the Current Urban Area and 18.6% for the Current & Future Urban Area (Table 12).

Table 12. Land cover estimates within study area (2023):

Land Use	% Cover				
	Tree	Impervious	Plantable	Permeable ^a	Water
Commercial	10.5%	47.1%	16.9%	25.2%	0.2%
Future Development	19.7%	3.0%	18.7%	57.4%	1.2%
Public other	11.4%	60.5%	21.8%	6.3%	0.0%
Public parks	43.6%	11.9%	30.2%	8.9%	5.4%
Residential	16.4%	49.4%	19.5%	14.5%	0.3%
Woodlots	43.9%	3.8%	24.7%	25.0%	2.6%
Current & Future Urban Area	18.6%	40.3%	20.5%	19.6%	0.9%
Current Urban Area Only	18.5%	44.8%	20.8%	15.1%	0.8%

^a grass/herbaceous/soils areas were current land use practices likely limiting tree planting (e.g., active sport fields, agriculture).

2.1.3.3. Historical UTC: 10-Year Change Analysis within the Current Urban Area

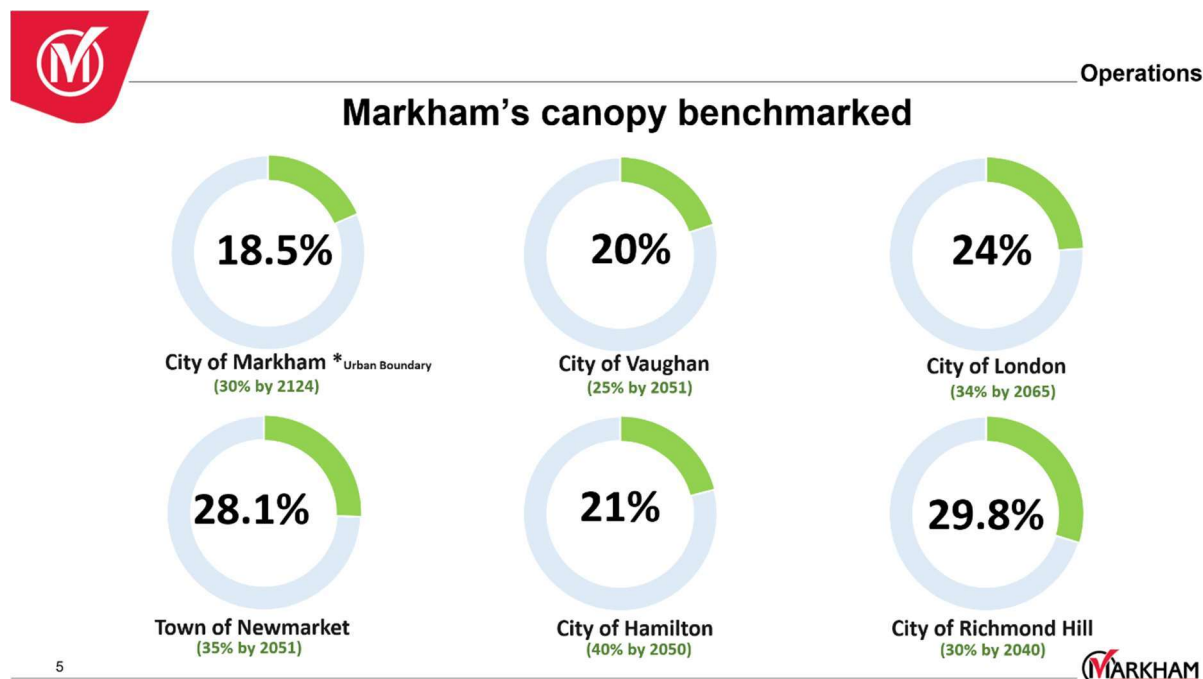
The study area corresponds to the current urban area only (Figure 20). In 2013, the City's urban tree canopy coverage was 18.1%. Based on aerial imagery from 2023, the tree canopy coverage in the urban area increased to 18.5% over the decade. This is a change of 0.4% per decade (see Table 3).

Table 13. 10-Year UTC Coverage Change in Markham

Tree Cover	2013	2023
Canopy (UTC) - Tree, Shrub, Forests	18.1%	18.5%

The 2022 Markham Forest Study, conducted by the Toronto and Region Conservation Authority (TRCA) for the Region of York (York, Region of, 2023), reported a tree canopy coverage (UTC) of 21% for that year. While both the TRCA report and the Kuntz Forestry assessment are accurate, they differ mainly due to the different areas they examine and the means of assessing tree cover. The TRCA report considers the entire city, known as the municipal boundary, as its study area. In contrast, Kuntz Forestry's assessment focuses specifically on the urban boundary, which is smaller than the entire municipal boundary. The urban boundary is deemed the appropriate study area to support the urban forest management plan. Both of the studies (York and Kuntz) reported

urban tree canopy values for Markham as lower than those of seven other sampled municipalities (Graph 2).



Graph 2. Urban Tree Cover (UTC) for various Ontario Municipalities

2.1.4. Markham's Urban Tree Canopy Gap

We utilized the i-Tree Canopy model developed by the U.S. Forest Service because it offers a high degree of precision. It employs a robust methodology, combining remote sensing, GIS tools, and satellite-based surveys. Using 1,909 sampling points, this comprehensive approach characterizes the forest across the City, examining factors that may impact its health and function, such as land use and surface conditions.

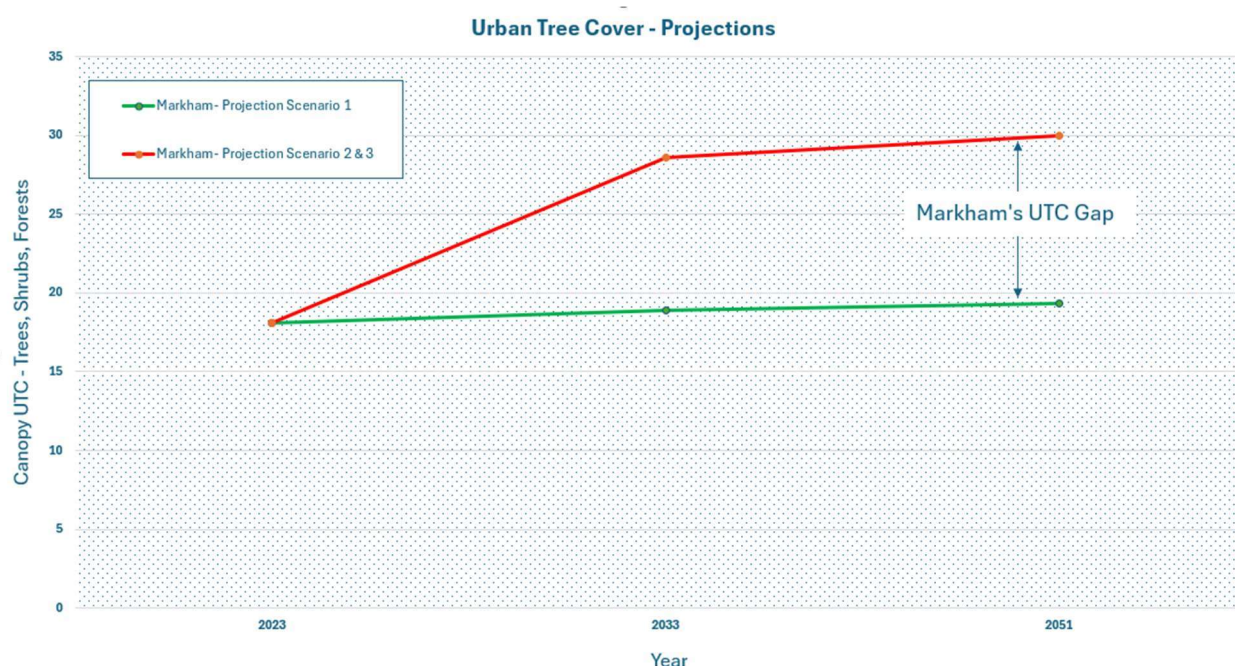
In 2022, City Council received a staff report on the *2022 Markham Forest Study* prepared York Region. That document stated the UTC in 2022 was 21%. Both numbers (21% and 18.5%) are correct. They differ because the Study Area Boundaries differ.

1. The Study Area for the York Region report is the City-wide Boundary.
2. The Study Area for our Project Team assessment is the Urban Boundary as defined in Markham's Official Plan.

The data analyzed from the *Urban Tree Canopy Change Analysis*, conducted by Kuntz Forestry between 2013 and 2023 as part of their 2024 UTC Study, indicates that Markham's urban tree canopy (UTC) increased by 0.4% during this ten-year period. Based on this trend, Markham is expected to increase its urban tree canopy by approximately 1.2% over the next approximately 30 years at current management levels: from 18.5% to 19.7% in 2051 based on three key factors: 1-the annual influx of new trees (such as planting or natural regeneration), 2- annual tree growth, and 3- annual mortality rates. This is called Markham's "projected UTC."

This modest upward trend in urban tree canopy, reflecting a positive change based on a historical ten-year pattern, is noteworthy considering the general downward trend in urban tree canopy observed in North American cities.” The percentage of tree cover in urban areas, throughout North America, has been on the decline...this decrease in urban tree cover is directly related to the increase in impervious surfaces” (Nowak and Greenfield, 2018).

Markham’s current 30% urban tree canopy goal by 2031 was adopted by City Council following the York Region Forest Management Plan (2016). It is important to point out that the modest positive UTC trend of the status quo conditions will not be sufficient in attaining Markham’s current UTC goal of 30% ; this is called “Markham’s Urban Tree Canopy Gap” see Graph 3).



Graph 3. Markham’s Urban Tree Canopy Gap

Chapters 3 and 4 of this UFMP outline the strategies, objectives, and action items needed to close Markham’s *Urban Tree Canopy Gap* and achieve the UTC Target.

2.1.4.1. Attaining 30% Tree Cover within the Current Urban and Future Development Areas

A crucial component of the *Urban Forest Management Plan* is to evaluate the feasibility of the 30% tree cover goal and to establish a tree canopy coverage target for both the current urban area plus the future development zone as outlined in Markham’s updated Official Plan (see Figure 20). Establishing a new timeline to the year 2051 ideally aligns with the City’s planning horizon for Markham’s updated Official Plan.

2.1.4.2. Markham Planting Estimates to Attain 30% Tree Cover

To attain 30% tree cover, three planting scenarios were projected to obtain:

- 1) 30% tree cover by 2031
- 2) 30% tree cover by 2051
- 3) 30% tree cover by 2124 (long-term scenario of 100 years).

The methods used to make these projections and rationale for long-term sustainability goals are detailed in Appendix 1.

Objective: Determine how many trees need to be planted among land uses in Markham to attain 30% tree cover in 2031, 2051 and with a more long-term, 100-year goal (2124).

Issue: The goal of sustainable forestry is to sustain tree cover at a desired level with minimal perturbations. It's like sailing on the ocean, calm seas are good, and large waves can create havoc; however, as you will see, creating short-term goals (e.g. 2031), particularly with large tree cover changes, can create large waves that future generations will have to address. The shorter the time frame and the larger the tree cover change, the greater the wave.

Having said that, there is an advantage of a large tree cover change in a short time frame. That is, more benefits will be derived from the forest in the short term as tree cover will increase rapidly; however, there are also disadvantages:

- More trees will need to be planted at greater cost
- Tree cover will exceed the desired goal as the trees will continue to grow
- It is less sustainable in the long run (cover will go up and then down; wave function). The large population planted in a short time frame will grow old together and lead to relatively large tree cover loss in the future. This future loss will necessitate more large-scale plantings in the future to offset canopy losses.

Basically, slow and steady wins the race. A long-term steadily increasing planting rate can lead to a sustainable forest with minimal perturbations in tree cover.

Findings: The estimated number of trees needing to be planted annually until the goal date (2031, 2051 and 2124 respectively) to attain 30% tree cover under current conditions (3% mortality rate) will be:

2031 Goal – Not Attainable = 1,526,000 trees/year (private trees = 1,203,000 million; public trees = 323,000).

2051 Goal – Not attainable= 141,000 trees/year (private trees = 110,000; public trees = 31,000).

Long-term (2124) Goal - Attainable = 50,800 trees/year (private trees = 39,600; public trees = 11,200).

“Enhanced management” (which includes such things as a Markham Sustainability Metrics Program for the Development Application Process that specifies new design and build space for large canopy trees with a minimum of 30 cubic metres of uncompacted soil, increased watering, fertilization and pruning, using improved nursery stock etc.) can increase tree growth rates and reduce tree mortality (assumed to be 2.5% per year). With enhanced management (with no additional tree planting in woodlots), the planting rate decreases to:

2031 Goal = 1,124,000 million trees/year (private trees = 890,000; public trees = 234,000).

2051 Goal = 55,900 trees/year (private trees = 41,100; public trees = 14,800).

Long-term (2124) Goal = 18,700 trees/year (private trees = 14,600; public trees = 4,100).

Enhanced management can increase tree growth rates and reduce tree mortality (assumed to be 2.5% per year). With enhanced management (with tree planting in woodlots), the planting rate decreases to:

2031 Goal = 1,095,500 million trees/year (private trees = 867,700; public trees = 227,800).

2051 Goal = 54,500 trees/year (private trees = 40,100; public trees = 14,400).

Long-term (2124) Goal = 18,200 trees/year (private trees = 14,200; public trees = 4,000).

The City currently plants an average of 3,336 Street trees annually: 1,396 trees in new developments and 1,950 planted by Forestry as replacement trees. This leaves a deficit of 664 trees. The 664 trees/year deficit could be overcome in a few ways:

- 1) Increase the tree planting budget. This requires available planting sites.
- 2) Shift funds from the natural regeneration program to other public land tree planting after the public greenways reach the maximum capacity for tree cover. There are currently 51.2 ha of available space within public greenway areas in Markham's urban areas. Given that 12.2 ha of natural regeneration will be established annually by the City, the greenway available space will be filled with trees in 5 years. After that time, only about 2.7 ha of new land will need to be established annually to sustain the greenway tree cover. Savings from the reduction in tree planting in public greenway areas could be used to help cover the tree deficit. Funds from the Landscape Recovery Fund can be utilized here.
- 3) Establish regeneration within greenway areas in the future development area. It is unknown how much of this greenway area is public land, but there is currently 383 ha of available space for trees. If the public tree regeneration program focused on regenerating this area, the annual public tree planting goal would drop from 4,000 to 3,200 trees per year. This reduction in 800 trees planted per

year would more than cover the current deficit of 664 trees. However, the greenway areas in the future development zone may not be public land and planting would thus occur on private land.

Option 2 is recommended.

2.1.4.2.1. SUMMARY OF RESULTS

Below are the results of tree planting estimates by land use for various years (2031, 2051, long-term [2124]) desired to attain 30% tree cover. The woodland land use was assumed to sustain current tree cover via natural regeneration (no tree planting needed). For 2051 and 2031 30% tree cover goals, the tree cover was exceeded after the goal year. In these cases, tree cover would still increase after the goal year even if no trees were planted due to the growth of existing trees. However, by not establishing trees after 2051 or 2031, the population would be headed for a crash in future. Thus, trees were also established after the goal year to help sustain the tree cover through time.

For the long-term (**2124**) goal under current conditions (3% annual mortality), 30% tree cover would be attained near the end of the 100 years in a sustainable fashion (See Appendix 1) with the total number of trees planted over the 100 years estimated at **5.1 million trees or 50,800 trees per year** (11,200 public trees, 39,600 private trees).

Shortening the 30% goal to **2051** increases the total number of trees planted over the 100 years to **6.3 million trees with a starting annual planting number of 141,000 trees/year** (31,000 public trees, 110,000 private trees). This would require a new program and dedicated resources to administer it.

Shortening the goal even more to **2031** increases the total number of trees planted over the 100 years to **15.6 million trees with a starting annual planting number of 1.5 million trees/year** (300,000 public trees, 1.2 million private trees) (Table 14). This is not attainable.

Enhanced management to increase tree growth and reduce mortality rates reduces the number of trees needing to be planted. For the long-term (**2124**) goal, the total number of trees planted with enhanced management over 100 years is estimated at **1.9 million trees or 18,700 trees per year** (4,100 public trees, 14,600 private trees).

Shortening the goal to **2051** increases the total number of trees planted over the 100 years to **2.9 million trees with a starting annual planting number of 55,900 trees/year** (14,800 public trees, 41,100 private trees).

Shortening the goal even more to **2031** increases the total number of trees planted over the 100 years to **7.5 million trees with a starting annual planting number of 1.12 million trees/year** (234,000 public trees, 890,000 private trees) (Table 15a).

As the city is planting 19,000 trees annually in woodlots to expand tree cover, another estimate was made assuming that the public woodlot available space (51.4 ha) is fully stocked (with trees). This

additional tree cover would reduce tree planting needs by 2.5%. With woodland plantings, the total number of trees planted with enhanced management over the 100 years (long-term 2124 goal) is estimated at 1.8 million trees or 18,200 trees per year (4,000 public trees, 14,200 private trees). Shortening the goal to 2051 increases the total number of trees planted over the 100 years to 2.8 million trees with a starting annual planting number of 54,500 trees/year (14,400 public trees, 40,100 private trees). Shortening the goal even more to 2031 increases the total number of trees planted over the 100 years to 7.3 million trees with a starting annual planting number of 1.1 million trees/year (227,800 public trees, 867,700 private trees) (Table 15b).

While the number of trees to be planted increases as the date of attaining the 30% goal shortens, these shorter goal dates (2051, 2031) also exceeds their intended goal and thus will produce more benefits; however, for both the 2051 and 2031 goals, and particularly the 2031 goal, there is likely not enough available planting space to sustain the tree cover. Planting spaces could be filled in the short term with many small trees to reach the goal, but as these trees grow, they will likely run out of space and conflict with other trees and urban objects (e.g., buildings). In many cases the projected tree cover peaked at an amount that exceeded the reasonable space available for trees (i.e., areas already with tree cover and permeable areas with land uses that would not preclude tree planting) (Table 16).

Table 14. Estimated annual tree planting by land use to attain 30% tree cover within 3 goals: 1) long-term (year 2124), 2) 2051, and 3) 2031 under current conditions (3% mortality rate).

Land Use	Long-term	2051 Goal		2031 Goal	
	2025-2124	2025-2051	2052-2124	2025-2031	2032-2124
Commercial	2,000	4,300	1,300	33,700	4,600
Future Development^a	900	4,700	1,100	47,600	2,800
Public other	8,000	27,000	7,500	277,500	18,800
Public park^b	3,200	4,000	3,000	45,000	5,000
Residential	36,700	101,000	22,400	1,122,000	37,400
Total	50,800	141,000	35,300	1,525,800	68,500
(Total public)	11,200	31,000	10,500	322,500	23,800
(Total private)	39,600	110,000	24,800	1,203,300	44,800

^a Tree planting occurred within community (86%), employment (12%) and other (2%) zoned areas with assumption that existing trees in the area were removed during the development process. Tree cover in greenway areas was assumed to be sustained at current levels through natural regeneration (see Appendix 1).

^b Tree cover in forest areas within parks are assumed to be sustained cover via natural regeneration. Growth in forest trees or forest area would reduce the number of trees needing to be planted to reach the tree cover goal.

Table 15a. Estimated annual tree planting by land use to attain 30% tree cover within 3 goals: 1) long-term (year 2124), 2) 2051, and 3) 2031 under **enhanced conditions** (increased growth and 2.5% mortality rate).

Land Use	<u>Long-term</u>	<u>2051 Goal</u>		<u>2031 Goal</u>	
	2025-2124	2025-2051	2052-2124	2025-2031	2032-2124
Commercial	600	1,100	600	27,500	1,800
Future Development^a	500	3,400	400	39,900	0
Public other	3,600	14,300	3,000	213,800	1,500
Public park^b	500	500	500	20,000	2,000
Residential	13,500	36,700	15,000	822,800	2,200
Total	18,700	55,900	19,500	1,124,000	7,600
(Total public)	4,100	14,800	3,500	233,800	3,500
(Total private)	14,600	41,100	16,000	890,200	4,100

^a Tree planting occurred within community (86%), employment (12%) and other (2%) zoned areas with assumption that existing trees in the area were removed during the development process. Tree cover in greenway areas was assumed to be sustained at current levels through natural regeneration (see Appendix 1)

^b Tree cover in forest areas within parks are assumed to be sustained cover via natural regeneration. Growth in forest trees or forest area would reduce the number of trees needing to be planted to reach the tree cover goal.

Table 15b. Estimated annual tree planting by land use to attain 30% tree cover within 3 goals: 1) long-term (year 2124), 2) 2051, and 3) 2031 under **enhanced conditions** (increased growth and 2.5% mortality rate) assuming 51.4 ha of available space in woodlands in filled with tree cover.

Land Use	Long-Term	2051 Goal	2031 Goal		
	2025-2124	2025-2051	2052-2124	2025-2031	2032-2124
Commercial	600	1,100	600	26,800	1,800
Future Development^a	500	3,300	400	38,900	0
Public other	3,500	13,900	2,900	208,300	1,500
Public parks^b	500	500	500	19,500	1,900
Residential	13,100	35,700	14,600	801,900	2,200
Total	18,200	54,500	19,000	1,095,500	7,400
(Total public)	4,000	14,400	3,400	227,800	3,400
(Total private)	14,200	40,100	15,600	867,700	4,000

^a Tree planting occurred within community (86%), employment (12%) and other (2%) zoned areas with assumption that existing trees in the area were removed during the development process. Tree cover in greenway areas was assumed to be sustained at current levels through natural regeneration (see Appendix 1)

^b Tree cover in forest areas within parks are assumed to be sustained cover via natural regeneration. Growth in forest trees or forest area would reduce the number of trees needing to be planted to reach the tree cover goal.

Table 16. Percent tree cover goal, likely maximum tree cover attainable, 100-year average tree cover and peak tree cover attained in projecting tree cover for the 2051 and 2031 goals. The 2051 and 2031 time frames exceeded their land use tree cover goals and peak cover often exceeded readily available space for trees.

Land Use	2051				2031	
	Goal ^a	Max ^b	Average ^c	Peak ^d	Average ^c	Peak ^d
Commercial	15.5	27.4	15.8	17.9	61.3	81.2
Future Development	30.0	38.4	35.2	49.9	75.9	99.5
Public other	27.3	33.2	32.8	40.7	79.1	96.7
Public park	46.6	73.8	46.4	47.3	55.2	58.1
Residential	32.0	35.9	34.1	40.9	69.7	85.2
Total	30.0	39.1	32.6	-	66.6	-

^a Tree cover goal (see Appendix 1).

^b Maximum tree cover estimates based on permeable available space that is or likely could be filled with tree cover.

^c 100-year average tree cover (2025-2124).

^d Peak tree cover in projection between 2025 and 2124.

2.1.4.2.2. RECOMMENDATIONS / ACTION ITEMS

The most sustainable and cost-effective means to increase tree cover to 30% is to increase tree cover gradually under the long-term scenario (2124) with sustained annual tree planting through time. The shortest scenario (2031) is likely not realistic due to cost and space limitations. The 2051 goal could potentially work but will lead to some sustainability issues due to potentially limited growing space and a cohort of trees that will likely die together, creating a potential major loss in tree cover over a relatively short-time frame (5-10 years).

The Strategic Framework section (Table 18) and the Five-Year Operating Plan for 2026-2030 (Table 19) emphasize the need for an enhanced approach to land use planning and the design of road cross-sections that affect the urban forest. This is essential to help attain Markham's Urban Tree Canopy (UTC) Target. This approach should prioritize designing and constructing sufficient space for trees by increasing the volume of uncompacted soil to support the growth of large trees. By implementing these measures, we can enhance tree growth, reduce tree mortality, and significantly decrease the number of new trees required to reach the desired level of tree cover in the coming years. It would substantially reduce the number of trees to be planted in the coming years to attain the desired tree cover level. A strong, public-private partnership is essential to attain any tree cover goal as most (~78%) of the tree planting will occur on private land. This will require a comprehensive program to be developed both to promote and to measure results.

A higher Urban Tree Canopy (UTC) target for the City of Markham is not recommended at this time. This is due to the challenges posed by increasing urban development density and traditional urban

design approaches and engineering methods, which will not support the creation of sufficient uncompacted soil volume necessary for growing and sustaining larger trees.

2.2. Tree Equity

A UFMP (Urban Forest Management Plan) presents an opportunity for municipalities, such as the City of Markham, to address the issue of “*Tree Equity*”. *Tree Equity* emphasizes the importance of ensuring a fair distribution of the urban forest throughout the city.

Tree Equity means that every area of the city should have an adequate number of trees, allowing all residents to benefit from the health, economic, and other advantages that trees provide (American Forests, 2024). Tree Equity ensures that *every resident*, regardless of income, race, age, ability, or neighborhood, can experience the environmental, social, and health benefits of the urban forest. Achieving equity may require *different levels of investment and support* in areas where canopy cover or access is historically limited. Urban trees help prevent heat-related illnesses and fatalities. By striving to achieve Tree Equity, we can save lives and lessen the impacts of climate change (Figure 22).



Operations

Tree Equity Analysis

What is Tree Equity?

- Trees are essential urban infrastructure for human health and well-being
- Tree equity helps address damaging environmental inequities
- Tree equity analysis identifies inequalities and prioritizes human-centered investment in areas with the greatest need



Figure 22. Tree Equity

“In both cities and suburbs, affluent neighbourhoods are more likely to enjoy the cool shade of trees than lower-income neighbourhoods... The absence of trees is not just an aesthetic discrepancy — it can impact human health and well-being, as a growing body of research shows. Neighbourhoods devoid of trees often grapple with the [urban heat island](#) effect, where concrete and asphalt absorb and magnify summer’s heat and elevate the risk of heat-related illnesses. Heat islands are often linked to factors such as [income and race](#)” (Miller, 2023).

Municipal planning, urban design, and engineering are crucial in shaping our cities and communities, particularly by highlighting the significance of impervious surfaces on the inequitable distribution of ecosystem services. City policies could be designed to address these disparities by enhancing tree cover and reducing impervious surfaces in under-resourced areas (Nowak *et al.*, 2022).

In the City of Markham, we evaluated how urban tree cover (UTC) is distributed as part of the tree equity study. To do this, we used an expanded environmental justice framework, which builds on a recent review of several American municipal Urban Forest Management Plans (UFMPs) published between 2002 and 2020 (Grant *et al.*, 2022). This review found that while some plans considered distributive justice—focused on fairly distributing benefits and burdens among stakeholders—a more comprehensive approach should also incorporate “procedural and recognition” justice. Environmental Justice is an emerging trend in UFMPs in North America. Environmental Justice investigates why specific communities historically have fewer trees than others (Figure 23). Tree Equity supports the City of Markham’s commitments under its Diversity, Equity, Inclusion, (DEIA) and Accessibility Frameworks (the Diversity Action Plan and Multi-year Accessibility Plans), Climate Change initiatives, and the Municipal Sustainability Plan ensuring environmental justice is embedded across corporate strategies.



Operations

Tree Equity Analysis

Establishing the Tree Equity Index

- The Tree Equity Analysis produced the Tree Equity Index
- These indices/areas were determined based on:
 - Tree Equity Score (forest cover, heat index, age, income)
 - Population Density
 - Tree Cover
 - Impervious Surfaces



Figure 23 Tree Equity Analysis

2.2.1. What is an Environmental Justice Framework?

This Plan uses an expanded framework of environmental justice based on the recent study that reviewed municipal U.S. UFMPs published between 2002 and 2020 (Grant *et al.*, 2022). That study showed that some plans considered distributive justice, which deals with distributing benefits and burdens among stakeholders. While it is beneficial to examine distributional justice, it provides a limited perspective on the other aspects of justice. A more holistic approach to environmental justice includes not only distributional justice, but also procedural and recognition justice.



Figure 24. The 3 Pillars of Environmental Justice. Source: Grant *et al.*, 2022.

Procedural justice focuses on fair and transparent decision-making and complements distributive justice by considering the disadvantages of marginalized groups regarding power and participation. Recognition justice directly affects procedural and distributive outcomes and considers how certain populations are made visible or invisible in policy development contexts. Recognitional injustices occur when urban foresters unintentionally or intentionally do not give certain groups a voice in the political process. Including these three elements when developing UFMPs is essential to understanding the underlying causes of distributive injustice.

The procedural and recognitional aspects of environmental justice are rarely explored in studies on environmental management, especially in urban forest management. This is because they are less obvious than distributional injustices and are linked to complex power dynamics that are difficult to measure and modify. To address these types of injustices, it is important to have a thorough understanding of the social, political, and institutional histories that shape local decision-making. In urban forestry, the few studies that take a procedural justice approach have found that organizing community meetings, stewardship opportunities, and other tree-related events is essential to include all residents, regardless of their socioeconomic status, cultural background, language, or schedule.

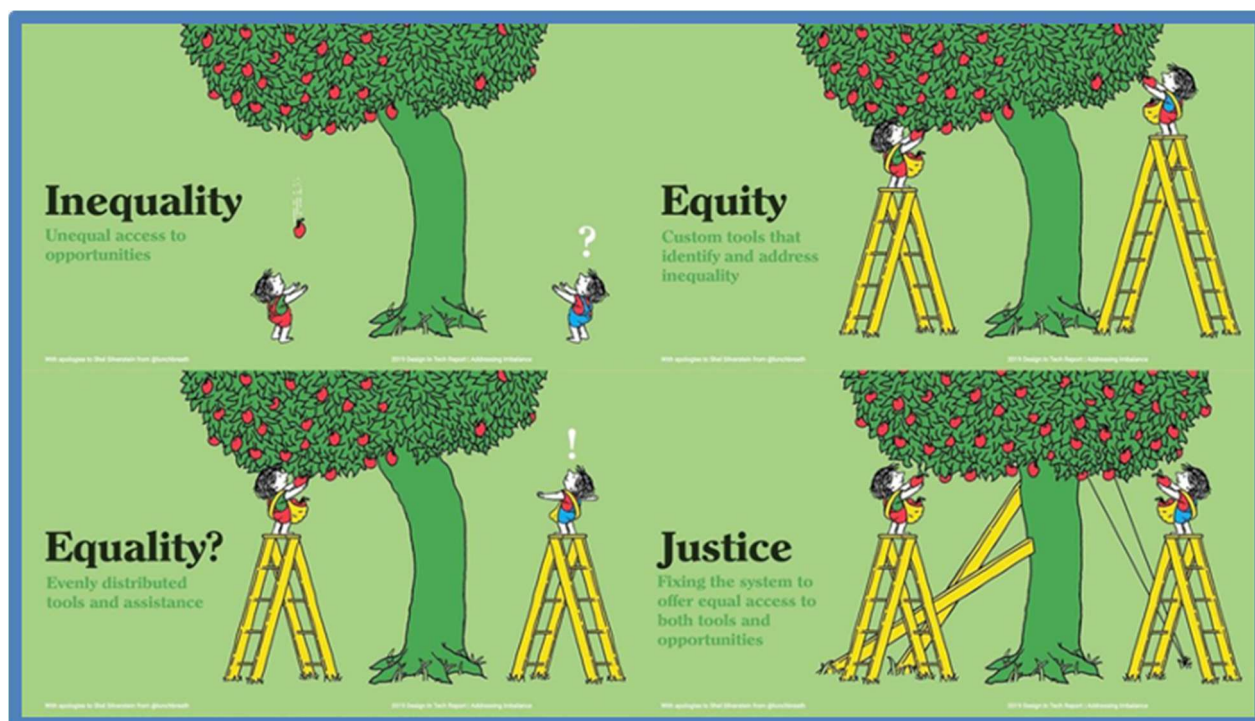


Image 1. Credit: Tony Ruth (@lunchbreath on twitter)

Equity involves custom tools that identify and address inequality. The image above shows custom ladders to help both apple pickers reach the tree. A Tree Equity Index was developed (Figure 25) as a tool for tree equity, helping to address and identify inequitable tree distribution across Markham.

Progress toward Tree Equity will be tracked through indicators such as canopy coverage by ward or census tract, and regularly reported through the City's environmental and DEIA performance updates.

2.2.2. Applying an Environmental Justice Framework

To apply this framework in our study, Tree Equity is examined through:

1. Distributional Justice
 - Conducting a Tree Equity Analysis of the City of Markham
 - Developing specialized approaches to study tree equity
 - Producing a Tree Equity Index
2. Procedural Justice
 - Identifying opportunities for improved procedural justice (i.e. approaches, policies and procedures that may enhance tree equity)
 - Providing recommendations for correcting procedural injustice
3. Recognition Justice
 - Developing community engagement ideas for the targeted representation of a community identified as a priority area(s) the Tree Equity Index

- Identifying opportunities for improved recognition justice
- Providing recommendations for correcting recognition injustice

2.2.2.1. Distributional Justice

The plan emphasizes that Markham faces challenges with tree equity. Our analysis of tree equity in Markham involved creating a tool called the Tree Equity Index (Figure 25); this tool is a map designed to help ensure that the benefits of trees are distributed fairly across all neighbourhoods. We developed our tool using four indicators:

- Tree Equity Scores (TES)
- Population Density
- Tree Cover
- Impervious Surfaces

The tool assigns scores to each neighbourhood on a scale from zero to 100 to indicate the levels of tree equity. A higher score (closer to 100) signifies a neighbourhood with a higher priority for actions such as tree planting, creating space for large-stature trees and community engagement about the benefits of urban tree canopy. These are shown as neighbourhoods coloured white (Figure 25). A lower score (closer to 0) indicates a neighbourhood with a lower priority for actions, represented as darker green-coloured neighbourhoods (Figure 25). Mapping analysis shows variations in canopy cover across Markham, with disparities often aligning with social and economic indicators such as income, housing density, and renter versus homeowner status. Recognizing these patterns helps the City address both *environmental and social inequities* in planning decisions.

Residents and community organizations, especially in neighborhoods with limited tree canopy will be engaged to help identify local priorities, planting sites, and stewardship opportunities. Community participation ensures that the City's tree planting strategy is inclusive and responsive to lived experience.



Tree Equity Index

Legend

- Municipal Boundary
- Urban Area
- New Urban Area
- Census Tract Boundary

Tree Equity Index

- 81-100
- 61-80
- 41-60
- 40 or less

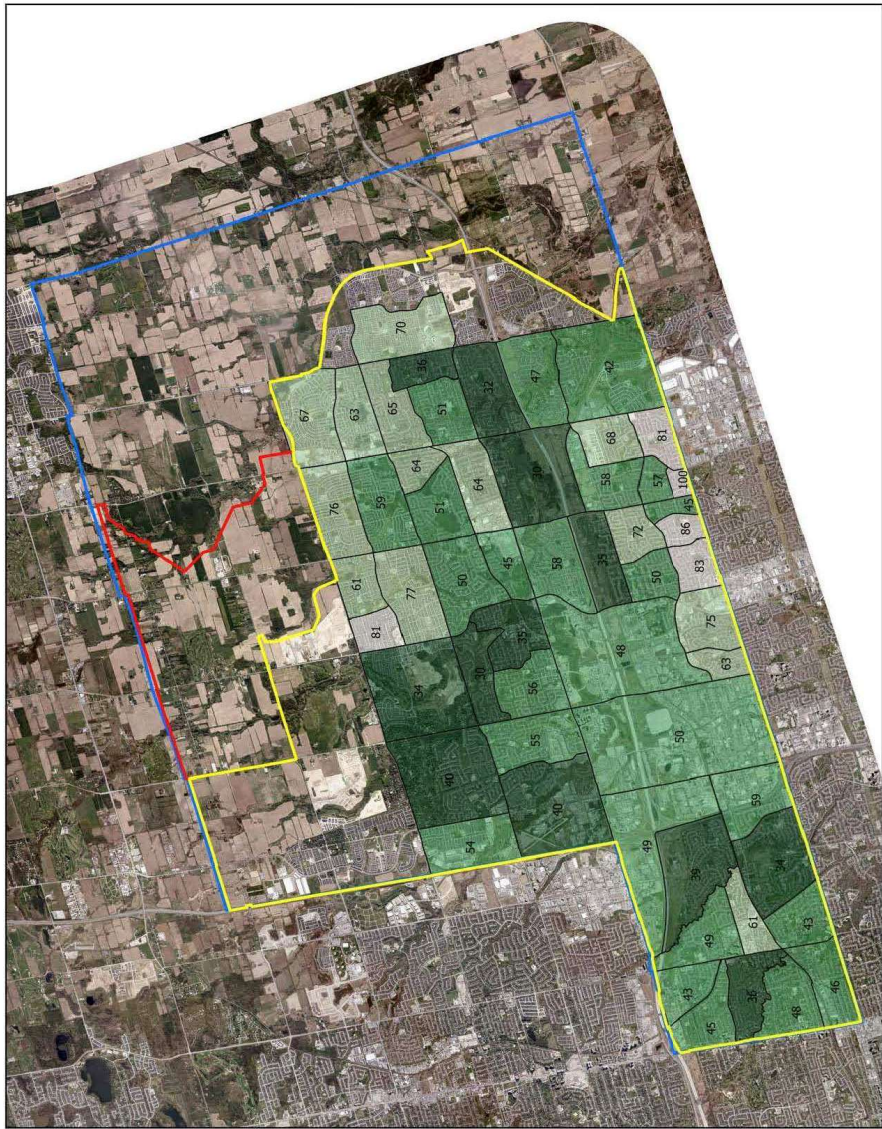


Figure 25. Tree Equity Index

Our Tree Equity Index tool is designed to help City staff prioritize strategies and guide the implementation of various action items outlined in Chapter 4 through an environmental justice lens.

2.2.2.2. Procedural Justice

Procedural justice seeks to enhance organizational processes. Zhuang's 2023 study on Tree Equity in Guangzhou, China, suggests revising the development application process (DAP) to establish minimum guaranteed standards that support urban tree canopies (UTC) by creating designated space for trees. This recommendation aligns with the Sustainable Forestry Initiative's Urban and Community Forest Sustainability Standard 2024, performance measure 4.3, which focuses on protecting soil quantity, quality, and health.

The City of Toronto's Toronto Green Standard serves as a unique example of integrating design specifications for tree space directly into the development application process. The Toronto Green Standard mandates that project architects allocate designated space for trees based on calculations to ensure each tree has access to a minimum volume of uncompacted soil. This initiative supports Toronto's 40% urban tree canopy target, as outlined in its Strategic Forest Management Plan for 2012-2022. The environmental justice principles reflected in the Toronto Green Standard should serve as a model for other municipalities. The Toronto Green Standard serves as the framework for analyzing urban forest management to address existing tree inequities, especially in areas dominated by hard surfaces, like new urban intensification zones.

When examining Tree Equity, a clear contrast emerges between the ideal streetscape envisioned by the City, as described in the City of Markham's Streetscape Manual (2009), and the current reality depicted in the Tree Equity Index (Figure 25).

The Toronto Green Standard demonstrates how to tackle this issue through procedural justice. The City of Toronto revised its municipal development application process to ensure that urban spaces in high-density and medium-density developments are designed and constructed to support large trees, including a minimum volume of uncompacted soil. This initiative involves collaboration between various stakeholders. The City's municipal development application process now ensures that urban spaces in high-density and medium-density developments are designed and built to accommodate large trees with a minimum volume of uncompacted soil. Collaboration between civic departments responsible for designing and building urban tree spaces, such as the Planning Department and the Development Engineering Department is crucial. Procedural justice addressed the issue of insufficient space for large trees by incorporating and front-loading the specifications needed by the project architect to create space for large trees in Tier 1 of the Toronto Green Standard. This success story demonstrates that collaboration among forestry, planning, and development engineering can lead to positive changes in urban tree canopy through increased tree growth and planting rates, as well as reduced tree mortality and removal rates. Similar collaboration among Forestry, Planning, and Engineering will be crucial for Markham to create a Markham Green Standard to attain and sustain Markham's Urban Tree Canopy (UTC) Target of 30% by 2124, or an equivalent mechanism to ensure trees are considered early in the planning and design process to guarantee minimum soil volume and adequate space for trees during the development application process.

Our team's "Projection Scenario 2 - Enhanced," as detailed in the section on Future UTC - Tree Cover Projection Options, is based on the expectation that the City of Markham will develop and implement a *Markham Green Standard*, or an equivalent mechanism to ensure trees are considered early in the planning and design process to guarantee minimum soil volume and adequate space for trees during the development application process. To achieve this, each civic department must concentrate on a specific aspect of the “5 Factors that impact Tree Canopy Change” equation (see Figure 26).

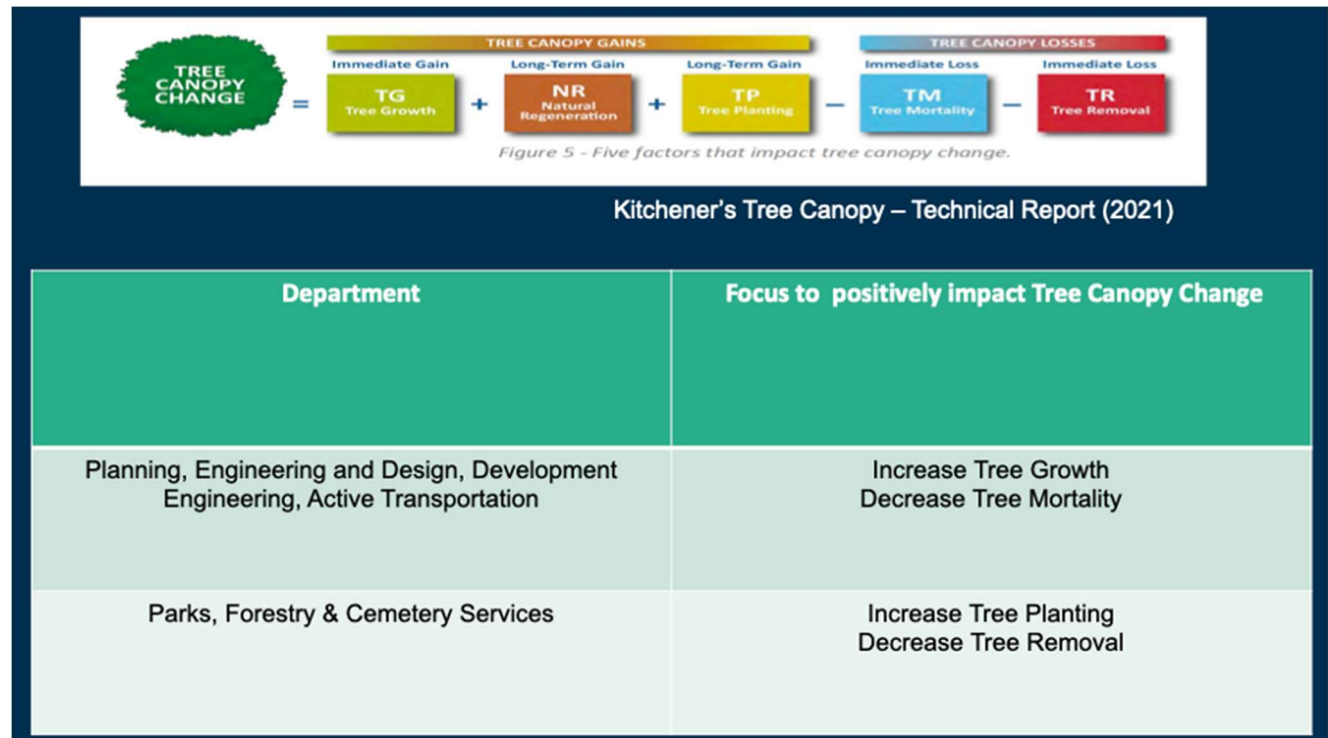


Figure 26. 5 Factors that impact Tree Canopy Change - Supporting positive Tree Canopy Change through Departmental Areas of Focus. Source: City of Kitchener, 2021.

2.2.2.3. Recognition Justice

Lack of recognition is as harmful and unjust as inadequate urban tree cover (UTC). An ideal distribution of urban trees can only be achieved by acknowledging the diverse perspectives and experiences surrounding the urban forest. Recognition justice can help address long-standing inequalities by including a variety of marginalized voices in the development and implementation of Urban Forest Management Plans (UFMPs), studies, and forestry programs. Our Team's findings indicate that Markham's forestry staff has a significant role to play in promoting city-wide policies and initiatives focused on equity, diversity, inclusion, and the health and well-being of residents through an emphasis on environmental justice.

Recognition justice examines how certain individuals or groups are included or excluded from decision-making processes. In the context of urban forestry, this encompasses various elements, including community engagement strategies, program development, urban forest management study design, and the creation of initiatives, goals, policies, and procedures. Essentially,

recognition justice serves as the foundational principle that underpins both procedural and distributional justice.

To effectively integrate recognition justice into practice, we recommend that the City utilize the checklist developed by Klinsky and Mavrogianni (see Table 17). This checklist contains practical questions that can guide practitioners in implementing recognition justice. It can be used with the support of the City's Reconciliation, Diversity, Equity and Inclusion (REDI) staff.

Table 17. Klinsky and Mavrogianni's framework for built-environment practitioners and researchers to enable the integration of recognition justice into decision-making processes.

What benefits/burdens have been included/excluded in the study or were included/excluded in the decision context being examined? Has analysis included means for observing both processes and outcomes of decision-making?
Have the appropriate data been collected to enable meaningful comparison across groups?
Which groups of people or aspects of people's lives are captured by the metrics being used in the decision or study context, and which ones are left out? Are there assumptions built into the metrics being used that systemically privilege and/or devalue particular people or aspects of people's lives?
How does this decision or analysis deal with both past accumulation and future needs?
How does this decision or analysis deal with jurisdictional boundaries and the potential for those outside these boundaries to be affected by this decision?

Building strong relationships is essential for achieving recognition justice. We recommend that Markham's Forestry Section establish long-term partnerships with organizations and community groups that support and engage with marginalized communities in Markham. The City could start by connecting with organizations that serve residents in areas identified as priorities for tree equity. This process can be facilitated by REDI staff.

The intensification pressures brought about by Bill 23, the *More Homes Built Faster Act, 2022*, are expected to exacerbate the issue of lack of space for large trees in communities such as Markham and could worsen Markham's UTC Gap. As discussed in Chapter 2, Background Research & Data Collection - City Policy Review section, Theme 5- *collaboration* is also a key environmental justice element: "The Planning [and Engineering] Department(s) play a crucial role in achieving UTC Targets." As the City establishes an interdepartmental team to update protocols, policies and procedures that promote tree equity, recognition justice should be integrated throughout this process using Table 17 and consultation with REDI staff and relevant organizations. For example, many urban downtown areas lack adequate space designed and constructed for mature trees,

which hinders the realization of "complete" streets and instead creates tree inequity. To address this issue, Markham's land use planning policies and engineering specifications can be revised to promote a healthier relationship between people and trees. This is crucial for large trees to thrive and contribute to people's health. The Canadian Urban Institute's 2020 report, *Bringing Back Main Street*, acknowledges that a "high degree of coordination amongst all relevant municipal departments..." supports the creation of both business District Main Streets and Neighbourhood Main Streets. Successful organizations recognize the difference between coordination and collaboration. Coordination involves aligning efforts, while collaboration means working together toward a common goal. Collaboration is especially valuable when organizations need to brainstorm and develop solutions to complex problems. For example, designing and constructing space for large-stature trees to meet a municipality's Urban Tree Canopy (UTC) target requires collaborative efforts.

In the context of reconciliation with Indigenous peoples, it is essential to focus on building relationships with local Indigenous organizations and community members. We need to acknowledge that Indigenous perspectives extend beyond just human-to-human relationships. These perspectives may include the need to reconcile relationships with all living and non-living entities. Therefore, reconciliation should involve discussions about Indigenous environmental justice, encouraging both Indigenous and non-Indigenous people to heal their connections with the land. Markham's Forestry Section can contribute to reconciliation by recognizing and incorporating Indigenous perspectives and practices in urban forest management and environmental justice initiatives.

CHAPTER 3

3. Strategic Framework: Vision, Guiding Principles, Goals & Objectives

The *Strategic Framework* (Table 18) for Markham's *Urban Forest Management Plan* (UFMP) consists of a Vision Statement for Markham's urban forest, Five Guiding Principles, Five Strategic Goals and Nine Objectives. These goals & objectives are translated into 33 Action Items in Chapter 4.

3.1. Vision Statement



Operations

Vision Statement

The City of Markham's urban forest, a vital system of the City's green infrastructure, is an essential asset and critical to making Markham a sustainable community. A healthy and resilient urban forest supports a growing and equitable community. Through recognition of value, nature-based scientific solutions, and City-wide strategic planning, our urban forest will be planned, built, protected, maintained, and enhanced for the benefit of all generations.



Figure 27. Vision Statement for Markham's Urban Forest

The key parts of the Vision Statement are:

- The urban forest is a green asset
- A healthy urban forest supports a healthy community
- Strong collaboration from the forestry, planning, and engineering disciplines plus community support is necessary to ensure that the urban forest is sustainably managed



Figure 28. Key parts of the Vision statement

Several individuals consulted together to develop the UFMP Vision Statement. (Figure 29).

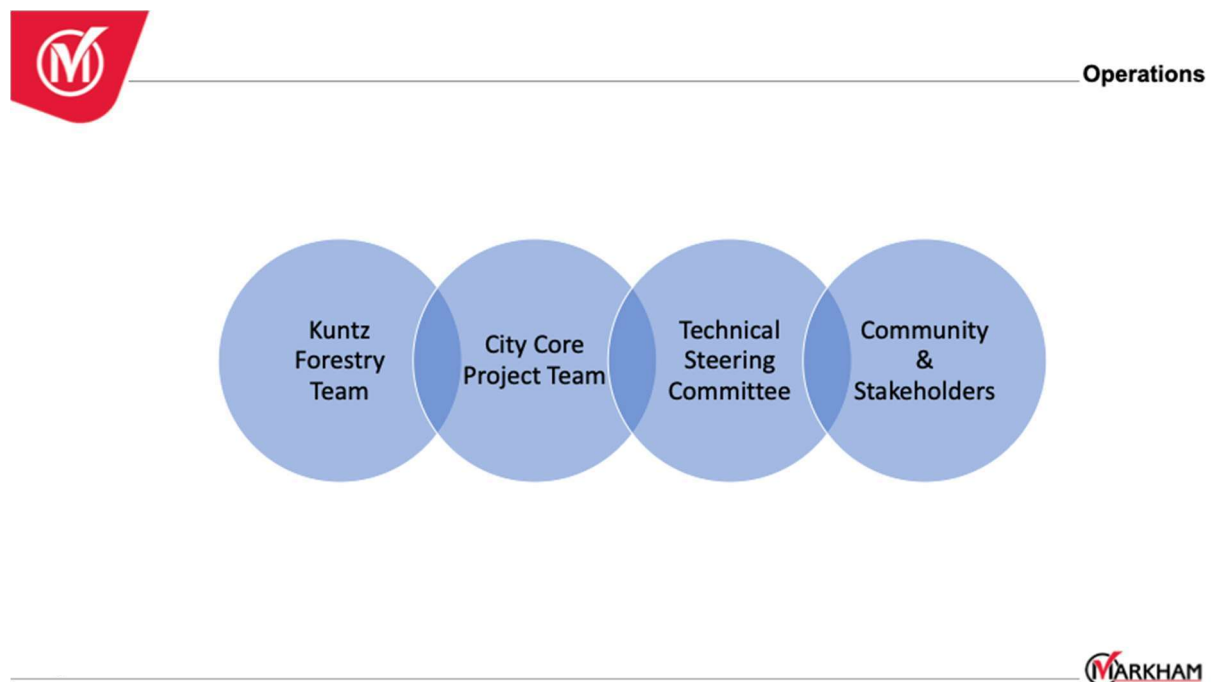


Figure 29. UFMP Project Collaboration

3.2. Guiding Principles

The Guiding Principles are based on Markham's values for its urban forest. They reflect how Markham believes in the importance of its urban forest. These principles are high-level, inspirational, and aspirational directions that guide the UFMP's actions and decisions. They are derived from the *Sustainable Forestry Initiative* (SFI, 2024):

- Urban and community forests and trees are vital for community well-being, health, resiliency, and sustainability.
- Urban and community forests and trees and their associated benefits should be accessible and available to everyone.
- Urban and community forests and trees depend upon understanding, awareness, appreciation, stewardship, and engagement by communities and people in order to thrive.
- Urban and community forests and trees require proper planning, care, and management to optimize benefits and minimize risks.
- Urban and community forests and trees are nature-based solutions to pressing issues and essential green infrastructure."

3.3. Goals & Objectives

3.3.1. Goal 1. Maintaining: Manage the public tree as green and social infrastructure while reducing risk

In Ontario, the courts have set a standard of care for trees. According to Dunster (1997): "Under English common law, there is a presumption that the owner of or the person responsible for a tree has what is termed a duty of care for that tree....Once a duty of care is established, the standard of care determines the extent to which any one individual's actions fulfil the duty...Thus the standard of care determines how the duty of care is measured...The courts define what is reasonable. Could the incident in question have been reasonably foreseen?... Did any government own or bear responsibility for the tree[s] in question, and did it inspect [it]? If so, was the inspection carried out correctly?...Anyone undertaking work that might affect a tree...has a duty of care to consider the outcome of their actions. If a clearly defined cause can be proven to have led to a clearly assessable effect (the resulting damage), then the issue of negligence may arise... Negligence takes many forms...It [negligence] is characterized by inadvertence, thoughtlessness, inattention, and the like... In general terms, the actions necessary to establish negligence require proof that a duty of care existed, that this duty of care has been breached in some manner, and that damage has resulted from this breach."

3.3.1.1. Objective 1.1 Maximize public benefits from street trees while minimizing costs by continuing to fund the City's proactive care for public trees.

"The pruning cycle is the number of years it takes to prune all the street trees in the community using programmed maintenance...a method to determine the *optimum* pruning cycle for a community is to compare the marginal cost of pruning to its marginal return...a pruning cycle of 5 years will produce optimum tree values" (Miller, 1988). Maintaining the existing *Neighbourhood*

Block Tree Pruning Program in Markham is essential for: reducing tree risk management exposure, maximizing the value of street trees and lowering maintenance costs in the long term.

3.3.1.2. Objective 1.2 The design of the City’s urban fabric reflects elements that demonstrate people and trees need each other

People naturally gather under the shade of trees, whether in public parks or at street-side cafés, as part of our social infrastructure. To promote this, a land use planning guideline known as the “3-30-300 rule” has been proposed (Konijnendijk van den Bosch, 2023). The aim of implementing the “3-30-300 rule” is to enhance and expand the urban forest. This rule should serve as a guideline for community planning on city-controlled lands. According to the “3-30-300 Rule” every citizen should be able to:

- See at least 3 well-established trees in view from their home;
- Live in neighbourhoods with at least 30% UTC;
- Live no more than 300 metres from the nearest public green space.

3.3.1.3. Objective 1.3 Fully account for the value of the urban forest in the Asset Management Plan

The current method for valuing City assets is based on their replacement cost, as a distinct asset class, appreciating over time and providing additional benefits through the ecological services they offer. Trees should be included in any asset management plan. A comprehensive assessment should also consider the modular soil systems that support the growth of large, healthy street trees, as well as the ecological services provided by street trees, park trees, and municipal woodlots.

3.3.2. Goal 2. Protecting: ensure that trees and grey infrastructure coexist.

The urban forest in municipalities such as Markham needs continuous care and maintenance, even without specific provincial regulations. This is essential not only to comply with the 'standard of care' set by the Ontario court system but also to recognize that trees are valuable municipal assets that increase in worth over time. “Forest-grown trees are self-maintaining unless a specific forest management objective requires otherwise. Street trees, on the other hand, are forest trees and cultivars of forest trees transplanted to an alien environment, thus demanding intensive management (arboriculture) ...through cultural practices [which]...include pruning, fertilization, protection, cabling and bracing...[removals and emergency storm response]” (Miller, 1988).

3.3.2.1. Objective 2.1 Recognize trees as part of green and social infrastructure

Effectively managing trees as green infrastructure requires recognizing that public trees are part of the city’s infrastructure. Therefore, public trees should be planned and managed in conjunction with all other infrastructure in the City of Markham.

3.3.2.2. Objective 2.2 Close Markham’s “UTC Gap”

Chapter 2 examined the difference between the Urban Tree Canopy (UTC) goal that the City of Markham aims to achieve, which is 30%, and the projected UTC based on historical trends. This gap can be addressed by implementing the Urban Forest Management Plan (UFMP) Strategic Framework, as illustrated in Table 18.

3.3.3. Goal 3: Planting - Sow the seeds of success.

This UFMP prioritizes the planting of new trees in appropriate locations, with appropriate follow-up where they can grow to full size and flourish, rather than dying prematurely—a common issue observed throughout the Greater Toronto Area.

3.3.3.1. Objective 3.1 Design and construct space for growing large shade trees in the public realm through the creation of a formal mechanism to translate this vision into a built reality for Markham’s urban fabric

The current approach to urban development often overlooks the needs of trees, particularly their requirement for large volumes of uncompacted soil. Frequently, there is insufficient space allocated for large shade trees, which impairs their growth and can lead to premature death. To address this issue, it is essential to establish clear requirements for adequate space for trees within the municipal development application approval process. By codifying these requirements, cities can standardize the inclusion of trees in urban planning. This can be achieved by mandating a minimum volume of uncompacted soil to support tree growth.

3.3.3.2. Objective 3.2 Ensure that trees and their benefits are available for everyone

Having trees nearby offers significant benefits to people (Nowak, 2015). In this way, everyone in the community to enjoy a healthy tree environment, it is essential to ensure that the urban tree canopy is distributed equitably across all neighbourhoods.

3.3.4. Goal 4. Planning in collaboration with all relevant City departments and agencies to sustain and enhance the urban forest.

The Corporation of the City of Markham is one of 444 municipalities in Ontario. Municipal governments are established by provincial statutes and have powers that are limited to those granted by the province. “The Municipal Act is a consolidated statute governing the extent of powers and duties, internal organization and structure of municipalities on Ontario...Municipal governments are responsible for providing many of the services within their local boundaries that [people] rely on daily...” (AMO, 2001). These services include the maintenance of municipal trees. Unlike other municipal assets, the regulations in this Act do not establish minimum maintenance standards for these trees. This presents a challenge for budget requests from the Forestry Department, as they must compete for funding against regulated services that have statutory compliance requirements, which take priority in funding decisions.

3.3.4.1. Objective 4.1 Cultivate a culture of collaboration towards the stewardship of Markham's urban forest

Effective management of an urban forest requires the collective efforts of multiple municipal departments (and private landowners); no single department can achieve sustainable outcomes independently. Insights gained from past experiences highlight the importance of collaboration among various civic departments, such as Planning, Operations, Engineering and Environmental Services. Moreover, successful urban forest management relies on strong partnerships between the public sector and private stakeholders invested in tree stewardship, including community organizations, local businesses, landowners and resident volunteers. This cooperative approach is vital to realizing the ambitious goals in the *Urban Forest Management Plan* (UFMP), which seeks to enhance urban greenery, promote biodiversity, and improve overall community well-being. By fostering teamwork and leveraging diverse resources and expertise, stakeholders can work together to create a thriving urban forest that benefits all residents.

3.3.4.2. Objective 4.2 Measure and monitor the sustainability of the urban forest

This Urban Forest Management Plan (UFMP) is grounded in the principles of Adaptive Management, which emphasizes the importance of ongoing assessment and flexibility in approach. To effectively evaluate progress, the City requires implementation of a systematic monitoring process utilizing Key Performance Indicators. These indicators will help track various aspects of Markham's urban forest's health and performance over time.

Regular monitoring will allow Markham to identify areas where our strategies may need adjustment or improvement, ensuring the City can respond swiftly and effectively to changing conditions or challenges. The insights gained from this monitoring process will guide the necessary modifications to UFMP's strategies and action items.

Furthermore, this Adaptive Management framework has been thoughtfully integrated into the *Operating Plan* for the period of 2026-2030. This alignment ensures that the plan's long-term operational goals are informed by real-time data and feedback, enabling Markham to make informed decisions for sustainable urban forest management.

3.3.5. Goal 5. Environmental Justice: our lens to view urban forest management to address current inequities.

Urban forest management plans have historically overlooked the concept of tree equity, which refers to the fair distribution of tree resources and the benefits they provide across different communities (Grant, 2022). This traditional oversight often perpetuates disparities, particularly in marginalized neighbourhoods that may suffer from a lack of green spaces and the associated ecological advantages. In contrast, this urban forest management plan takes a comprehensive approach, explicitly prioritizing tree equity. It lays out a strategy for communities to create access to a well-distributed and healthy urban canopy, through an evidence-based approach to tree planting prioritization. This shift in perspective acknowledges the importance of equitable tree distribution not only for environmental benefits but also for enhancing community well-being and resilience.

3.3.5.1. Objective 5.1 Aspire to attain Tree Equity throughout Markham

Effectively conveying the ecological advantages of trees plays a crucial role in advancing environmental justice and benefiting society as a whole. By highlighting how trees contribute to cleaner air, reduced urban heat, and enhanced biodiversity, the City can foster a deeper understanding of their importance. This awareness not only encourages responsible environmental practices but also supports equitable access to green spaces, ensuring that all communities can enjoy and benefit from the natural world around them.

3.3.5.2. Objective 5.2 Form tree-related solid partnerships with the community

The partnership between the City of Markham and local tree organizations will play a pivotal role in reaching the ambitious tree planting targets outlined for private properties within the *Urban Forest Management Plan*. By joining forces, these groups aim to enhance the community's efforts to effectively close the *Urban Tree Canopy Gap* in Markham. This collaboration is essential not only for the enhancement of local green spaces but also for fostering community engagement and environmental sustainability as they work together to create a healthier urban ecosystem.

3.4. Strategic Framework

The consulting team created a Strategic Framework (Table 18) that consolidates the Vision, Guiding Principles, Goals and Objectives, and Action Items from Chapter 4 in one comprehensive document.

Table 18. The Strategic Framework for Markham's UFMP.

Urban Forest Strategic Framework					
VISION FOR THE URBAN FOREST					
The City of Markham's urban forest, a vital system of the City's green infrastructure, is an essential asset and critical to making Markham a sustainable community. A healthy and resilient urban forest supports a growing and equitable community. Through recognition of value, nature based scientific solutions and City-wide strategic planning, our urban forest will be planned, built, protected, maintained, and enhanced for the benefit of all generations.					
GOALS					
Maintaining: the public tree as green and social infrastructure while reducing risk	Protecting: trees and grey infrastructure coexist	Planting: Plant for success	Planning: Sustain and enhance the urban forest in collaboration with all relevant city departments	Environmental Justice: our lens to view the management of the urban forest to address current inequities	
GUIDING PRINCIPLES*					
Urban & Community forests are vital for community well-being, health, resiliency, and sustainability.	Urban & Community forests depend upon understanding, awareness, appreciation, stewardship, and engagement by communities and people to thrive.	Urban & Community forests are nature-based solutions to pressing issues and essential green infrastructure.	Urban & Community forests require proper planning, care, and management to optimize benefits and minimize risks.	The benefits of Urban & Community forests should be accessible to everyone. * Modified from the Sustainable Forestry Initiative https://forests.org/wp-content/uploads/SFI_UCFSS_101_June7.pdf	
Targets/Objectives					
Pruning Cycle Maintain the Neighbourhood Block Tree Pruning Program (8-Year pruning cycle) for Markham's 120,000 Street trees	People need Trees Consider adopting the "3-30-300 Rule" as a guideline for community planning over city-controlled lands https://ucurbanalliance.org/promoting-health-and-wellbeing-through-urban-forests-introducing-the-3-30-300-rule/	Eliminate Markham's UTC Gap Formalize a Tree replacement policy* * http://phytosphere.com/treeord/treebank.htm	Optimize the value of the ecological services provided by the urban forest Increase the intrinsic value of the urban forest through increasing the number of bigger and healthier trees	Make Space for Trees Provide access to a minimum of 30 m³ of uncompacted soil per tree within the Public Realm	Trees for Everyone Facilitate Community-based Urban Forest Workshops Develop incentives and programs for private tree planting and stewardship
			Cultivate a culture of collaboration towards the stewardship of Markham's urban forest Address the staffing & resource needs to lead the implementation of the Urban Forest Management Plan	City-wide Urban Tree Canopy (UTC) Target Attain & Sustain 30% UTC through 2124	Tree Equity The Tree Equity Index helps prioritize strategies Trees thrive through community The Tree Equity Index helps guide Action Items

HOW/Action Items							
0-5 Years	5-10 Years	0-5 Years	5-10 Years	0-5 Years	5-10 Years	0-5 Years	5-10 Years
Maintain funding for Neighbourhood Block Tree Pruning Program	*According to the "3-30-300 Rule," every citizen should be able to: - See at least 3 well-established trees in view from their home; - Live in neighbourhoods with at least 30% UTC;	Apply the Tree Replacement Policy to Lands subject to certain Planning Act applications (e.g. Draft Plan of Subdivision, Site Plan) as well as to Public lands impacted by third-party construction projects, such as Utilities.	Conduct an Urban Tree Canopy (UTC) Change Analysis every 5 years using i-Tree Canopy. *	Plant 4,000 trees per year on Public lands. Incorporate direction from the Urban Forest Management Plan into Markham's updated Streetscape Manual, Urban Design Manual: Trees are recognized as Green Infrastructure plus new technical standards and specifications to ensure the urban fabric contains access to a minimum of 30 m³ of uncompacted soil per tree within the Public Realm and new development applications.	Plant 14,200 trees per year on private lands through the creation of a new community program called the proposed Markham Strong Roots Outreach Program.	Create the supporting high-level Policy Framework for Markham's urban forest in Phase 2 of the Official Plan Review: The public tree is an essential component of the public road allowance. Forestry added as a member of the Markham Utilities Coordinating Committee.	Urban Tree Canopy targets reflected in Phase 2 of Official Plan Review. Address neighbourhoods with highest Tree Equity Index scores. Create a City of Markham Green Standard (MGS)* This new standard supports Markham's UTC Targets. Apply the MGS* to the Development Application Process: Embed and front-load mandatory regulatory code for minimum standards & specifications for soil as detailed in Markham's revised Urban Design Manual and Streetscape Manual. *or an equivalent mechanism to ensure trees are considered early in the planning and design process to guarantee minimum soil volume and adequate space for trees during the development application process
Establish a Forest Health Monitoring Program.	Live no more than 300 metres from the nearest public green space. * https://naturecanada.ca/news/blog/the-urgency-and-opportunity-to-increase-the-access-of-all-canadians-to-urban-forests/	Create a new corporate Tree Protection Permit linked to Municipal Consents.	Conduct a UTC Study every ten years using i-Tree Eco.* * https://www.itreetool.org/	Tree Equity Index guides tree planting.	Review and update the Criteria & Indicators for Sustainable Forest Management Planning every 5 years.	Recruit at least 5,000 volunteer citizen members of the proposed Markham Strong Roots Outreach Program	

CHAPTER 4

4. Action Plan

Translating the Goals and Objectives in the *Strategic Framework* into SMART Goals (specific, measurable, attainable, realistic and timely) is achieved using the following numbering system:

- Goal (first number),
- Objective (second number) and
- Action Item (third number).

Example: Action Item 1.1.1:

- Goal 1 (Maintaining);
- Objective 1.1 (Maximize public benefits from street trees while minimizing costs by continuing to fund the City's proactive care for public trees.);
- Action Item 1.1.1 (Maintain the City's Neighbourhood Block Tree Pruning Program)

4.1. Action Items

The cost associated with each Action Item is budgeted and prioritized in the *Operating Plan 2026-2030* (Table 19).

Action Item 1.1.1 Maintain the City's Neighbourhood Block Tree Pruning Program.

Divide the Forestry Zones into eight (8) working areas with approximately equal volumes of annual pruning work. This annual pruning workload is approximately 15,000 street trees based on the number of City street trees. The work consists of elevating low limbs and structural pruning to ensure the maturing tree grows structurally sound and eliminates conflicts with traffic (both sight lines and safe vehicular flow). The program also produces city trees that are less vulnerable to damage from storm events, which reduces the cost of Forestry's after-hours emergency response events. Expanding the block tree pruning program to include approximately 69,000 trees located in active parks would be beneficial as it would improve program efficiency. Continuing the practice of using contracted services for this tree pruning work would allow the in-house Operations Forestry crews and additional contracted services crews to concentrate on pruning requests from residents and on tree removals.

Action Item 1.1.2 Update and maintain the Municipal Tree Inventory.

It is recommended that the City maintain an inventory of approximately 120,000 street trees and 69,000 active park trees. This inventory can be updated whenever work is performed on a tree, such as during municipal pruning activities. As part of the Tree Elevation and Corrective Pruning Program (Action Item 1.1.1), the inventory should be updated in real-time using data collectors that upload information to the City's GIS-based tree inventory. This process supports tree maintenance efforts and enhances the green infrastructure components of the City's Asset Management Plan.

Action Item 1.1.3 Maintain the Forest Inventory and Forest Management Plan for City Woodlot properties.

As part of this UFMP project, a forest management plan for city woodlots was prepared. It should be reviewed every five years.

Action Item 1.1.4 Develop an Enhanced Young Tree Maintenance Program.

To support the UTC Target in this UFMP, the City needs to enhance the growth rate of street and parks trees. A study conducted by the Region of York in 2013 identified the factors that most influence the growing conditions for street trees as follows:

“Using the data collected investigators identified a multitude of factors affecting the survival and performance of street trees. However, four factors were identified as having the most influence:

1. Available water.
2. Boulevard soil quality and quantity.
3. Planting stock quality and planting practices.
4. Environmental conditions including salt from winter maintenance and exposure to wind.”
(Region of York,2013).

The Region of York also concluded that enhancing the tree growing conditions in the public road allowance can be accomplished through an Enhanced Street Tree Maintenance Program that focuses on the following six points:

1. “Enhanced tree watering program.
2. Improved species selection.
3. Enhanced tree planting specification.
4. Improved implementation of tree planting contracts.
5. Integration of trees into infrastructure design and construction.
6. Continued monitoring.

(Region of York 2013).

This approach focuses on the site conditions for trees and the cultural practices necessary for their maintenance. These cultural practices could include an enhanced tree maintenance program to complement the existing watering and mulching schedule.

Key cultural practices may include:

1. Air Spading: fractures the soil, improving aeration around the tree roots.
2. Vertical Mulching: enhances soil quality and drainage.
3. Soil Amendments: applied if necessary to meet city standards for soil quality.
4. Mycorrhizae Addition: during planting can significantly boost tree growth rates.

Furthermore, the City could consider extending the watering period for newly planted trees from two to five years. Due to climate change, municipalities in the Greater Toronto Area are increasingly

adopting water extension practices to alleviate drought stress caused by longer and more severe droughts.

These new practices will ensure that tree roots receive the necessary oxygen, improve soil conditions, and maintain adequate soil moisture content, ultimately enhancing growing conditions. A key focus on improving site conditions will involve amending the soil.”

Action Item 1.1.5 Prioritize the staffing & resource needs to keep pace with the growth of the City and development and the maturing urban forest.

Action Item 1.1.5.1 The current Operations complement of 1 Arborist Contract Crew should be increased to 3 to keep up with the volume of resident requests for tree work due to Markham’s growing urban forest. This is the most cost-effective way to address the backlog of service issues.

Action Item 1.1.5.2 A second Full-time Inspector position is required to minimize the backlog of resident requests and to determine what action is required. This will expedite getting work into the hands of the field staff and maximize productivity.

This additional inspector would allow Operations Parks Forestry to improve service delivery through creating an “Operations West” and “Operations East” organizational model - each staffed with a Full-time Forestry Inspector and a Full-time Forestry Working Supervisor. This model would yield the most effective productivity and service given the current and short-term growth of the City. Prioritizing service work across the entire City is difficult and efficiency will be improved with this internal change.

Action Item 1.1.5.3 The Operations Parks Forestry department requires a manager to oversee the administrative, financial, planning, strategic initiatives and departmental liaison responsibilities.

The *Urban Forest Management Plan* (UFMP) requires a dedicated leader for its implementation. The Supervisor of Operations Parks Forestry will be the lead to implement the UFMP and provide feedback to the manager for changes and budget requests.. The Urban Forest Management Plan (UFMP) necessitates the appointment of a dedicated leader to ensure its successful implementation. This leadership will significantly enhance operational efficiencies within Forestry and promote closer collaboration with other key departments, ultimately contributing to the achievement of Markham's Urban Tree Canopy (UTC) target.

This will allow the Supervisor to oversee the daily operations of staff and contractors, focusing on improved productivity and service delivery. The current model requires the Supervisor to spend a disproportionate amount of their time on administrative tasks.

Action Item 1.1.5.4 The current Operations Parks Forestry complement of Six Full-time in-house Arborists (3 crews of 2 Arborists/crew) should be increased to Eight Full-time in-house Arborists (4 crews of 2 Arborists/crew). This will maximize field staff and have two crews per east and west area working with contractor crews for maximum productivity.

Action Item 1.1.5.5 A contracted Arboricultural Inspector is required to be retained every two years to be responsible for Woodlot assessment/coordination across the whole City. This is a cost effective way to assess woodlots, especially those which border residential homes.

Action Item 1.2.1 Consider Adopting the ‘3-30-300 rule’ as a guideline for community planning over City-controlled lands.

The "3-30-300 rule" is a guideline for community planning, advocating for 3 trees visible from homes, 30% tree canopy cover in neighbourhoods, and access to green spaces within 300 meters, promoting healthier and greener urban environments. This approach, utilized by municipalities in several countries, aims to expand the urban forest through land use planning at the neighbourhood level (Konijnendijk van den Bosch, 2021). It highlights the significance of thorough local planning for the urban forest. It has been endorsed by a wide cross-section of agencies, such as the Credit Valley Conservation Authority, to create landscapes for change and enhance climate resilience. The City of Markham should consider adopting this approach for street trees and landscaping in Site Plan applications and Secondary Plans.

Action Item 1.2.2 Complete a comprehensive Transportation Master Plan Complete Streets Policy

During the background research phase of the Urban Forest Management Plan, staff interviews were conducted in 2023. The goal of these interviews was to foster discussions on how the project can support staff in their work and to understand how the activities of various city departments impact trees.

The staff discussions revealed the following key themes:

- Theme 2: There are strengths to build upon.
- Theme 3: Urban tree canopy cover is important to Markham.
- Theme 5: Interdepartmental collaboration is essential for maximizing the role that the urban tree canopy can play in mitigating the impacts of climate change.

Planning and Engineering staff are vital in supporting the urban tree canopy and significantly influence the City's ability to meet its UTC Target. They are responsible for creating the necessary site conditions for trees, particularly public ones, which ultimately influence both the quality and quantity of the urban tree canopy. These staff members are essential for successfully integrating trees into infrastructure design and construction, as highlighted in the report by the Region of York Forestry staff (2013).

This interdependence is illustrated in Figure 30.



Figure 30. Urban Tree Canopy depends on City interdepartmental collaboration

To effectively manage the urban forest in Markham, it is essential to ensure coordination and collaboration among the following departmental action items: Action Item 2.2.1, Action Item 2.2.4, Action Item 3.1.1, Action Item 3.1.2, Action Item 3.2.3, Action Item 4.1.2, and Action Item 4.1.4.

Each department's actions are focused on achieving the corporate Urban Tree Canopy (UTC) Target outlined in this *Urban Forest Management Plan* (UFMP) to promote positive changes in the tree canopy, as illustrated in Figure 31.

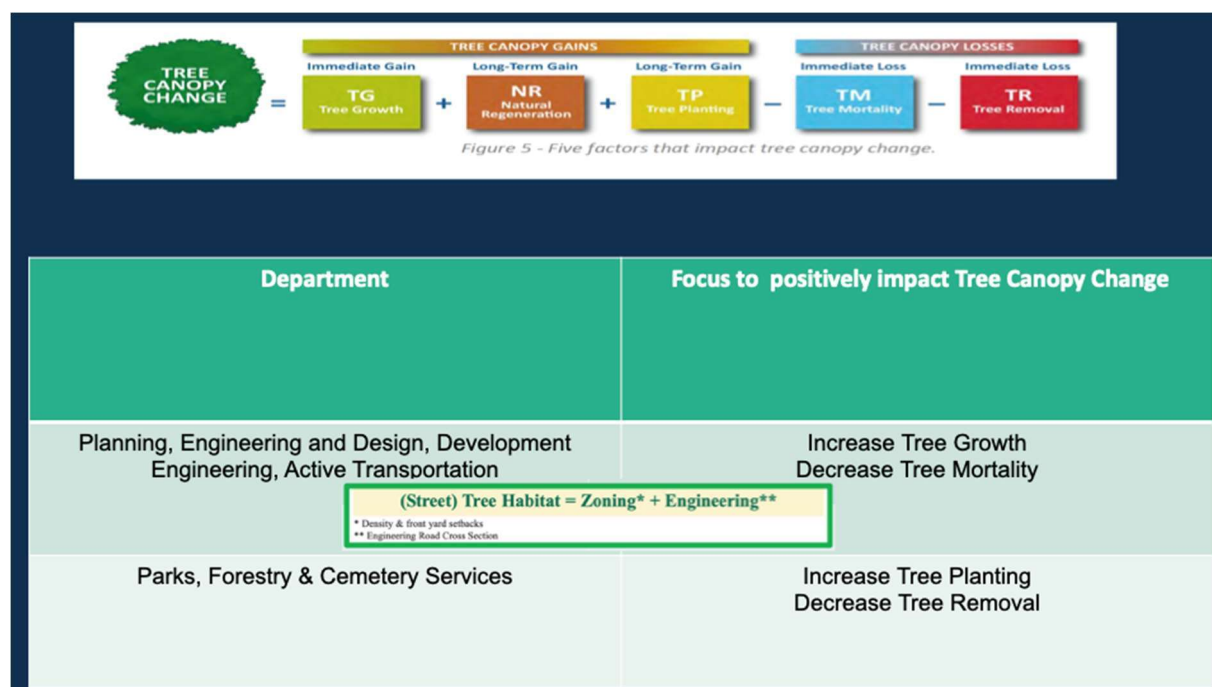


Figure 31. Departmental focus for positive Urban Tree Canopy change. Source: City of Kitchener, 2021 and Town of Oakville, 2006.

Action Item 1.3.1 Engineered soil conditions, and their associated volumes should be included in the Asset Management Plan and ‘owned’ by Forestry.

Assigning ownership of both the engineered soil conditions and the planted trees to the same department can create significant benefits for project management and environmental stewardship. This integrated approach allows for a cohesive strategy in maintaining soil health and tree vitality, as the same team will oversee both elements. Having a unified department approach for engineered soil conditions and tree care ensures optimal soil conditions tailored to the specific needs of the planted trees. This alignment fosters collaboration and accountability, leading to more effective resource allocation, improved long-term ecological outcomes, and a more sustainable management of the landscape as a whole. Additionally, it streamlines communication and decision-making processes, ultimately contributing to the project's overall success.

Action Item 1.3.2 Include ‘Urban Tree Cover’ as a metric in the Asset Management Report Card.

Given the recent emphasis on setting a tangible Urban Tree Cover (UTC) Target within the framework of this *Urban Forest Management Plan* (UFMP), it is essential that UTC be utilized as a key metric for reporting progress and outcomes to the City Council. This will enable a clear assessment of our urban forestry initiatives and their impact on the community. In addition, trees must be included in any asset management inventory and initiative.

Action Item 2.1.1 Update the Forestry Operations Manual to reflect current Best Management Practices (BMPs) such as ANSI A300 Tree Care Standards.

Following discussions with the Forestry Operations team, it has become clear that an update and revision of the City's technical arboricultural standards is necessary to enhance the effectiveness of municipal tree maintenance crews. By establishing updated guidelines, the City can ensure that these teams have access to the most current practices and techniques in tree care. Continuing regular training sessions for the staff will play a crucial role in maintaining a uniform and high-quality approach to tree pruning across the City, fostering both the health of Markham's urban forest and the skills of its dedicated maintenance personnel.

Action Item 2.1.2 Create an Urban Forest Policy Manual incorporating the policy and procedure for Tree Protection in the Construction Process.

Public trees play a vital role in Markham's urban environment, yet they occasionally remain unprotected during third-party construction projects. This lack of protection often leads to avoidable damage inflicted by utility construction crews, which can compromise the health and longevity of these essential green assets. As a result, the urban tree canopy (UTC) throughout the City suffers, diminishing its environmental and aesthetic benefits.

The financial burden of necessary repairs to these damaged trees ultimately falls on taxpayers, as the costs are absorbed by the Forestry Operations budget. To effectively address this pressing issue, the City should consider strengthening the oversight of existing regulations governing third-party construction (Municipal Consents). By incorporating specific protections for public trees into these regulations, we can safeguard Markham's urban forest and ensure its preservation for future generations.

Action Item 2.2.1 Conduct an Urban Tree Cover Change Analysis every 5 years using *i-Tree Canopy*.

An Urban Tree Cover Change Analysis, as the name suggests, involves comparing tree canopy coverage to identify changes in *Urban Tree Cover* (UTC). UTC is one of the 25 metrics used by Markham to assess the performance of urban forest management, as outlined in the "*Criteria and Indicators for Sustainable Urban Forest Management*" in (Chapter 2). Monitoring UTC every five years will help the City track its progress toward achieving the UTC targets established in the *Urban Forest Management Plan* (UFMP). The most effective current tool for this analysis is an online resource developed by the United States Forest Service, *i-Tree*.

An urban tree cover study entails a comprehensive examination of the structure, roles, and significance of the urban forest in a given community. This in-depth analysis involves identifying the various species of trees that thrive within the area, providing essential data that informs effective management and conservation strategies for the urban forest. The Region of York has a commitment to conduct an *Urban Tree Cover Study* every 10 years using *i-Tree Eco* that includes the City of Markham (Region of York, 2023).

Action Item 2.2.2 Ensure the City’s new Enhanced Streetscape Manual for intensification areas includes details that provide public trees with adequate access to soil and space.

To enhance the well-being of public trees, it is essential to establish tree planting details and standards that provide each tree access to a minimum of 30m³ of uncompacted, healthy soil. This is particularly crucial in urban areas where streets are predominantly paved with hard, impervious surfaces that hinder a tree’s root growth and provide them with little or no water. This approach will not only improve the health of the trees but also contribute to a more sustainable and vibrant urban ecosystem.

Action Item 3.1.1 Harmonize the new Enhanced Streetscape Manual for intensification areas, the Urban Design Manual and Streetscape Manual to reflect trees as part of the City’s Green Infrastructure.

It is important to recognize that utilities and vehicular traffic must coexist in an environment that supports tree growth. Collaborating with the *Markham Utilities Coordinating Committee* is vital to ensure that all members adhere to the new Corporate Policy and Procedure regarding Tree Protection in the Construction Process (Action Item 2.1.2).

Action Item 3.1.2 Amend the Zoning By-law to change the definition of a “landscape area.”

The definition of 'landscape area' needs to be revised because it currently allows for the applicant to build hardscape such as interlocking brick as a ‘landscape feature.’ To meet the City's UTC Targets outlined in this UFMP, any designated "landscape area" must be designed and built to support at least 30% tree canopy cover. If there are hardscape surfaces within this area, they must comply with the City's updated engineering technical standards. This involves meeting specific criteria for the minimum soil volume of uncompacted soil that is accessible to trees, while also allowing for impervious surfaces.

Action Item 3.2.1 Develop incentives and programs for private tree planting and stewardship including leveraging existing programs.

Numerous communities across the country have established collaborative partnerships between local governments and tree planting organizations dedicated to enhancing urban green spaces. These initiatives aim to introduce and expand tree planting programs, ultimately contributing to healthier, more vibrant environments. To support municipalities in the development and implementation of these important programs, a variety of resources are available. Notably, Tree Canada’s *Growing Canada’s Community Canopy* offers funding opportunities specifically designed for capacity building, ensuring that communities have the necessary tools and support to successfully launch their tree planting efforts. (Tree Canada, 2024). LEAF is also a valuable resource for private tree planting and is a well-established program which can be promoted at many levels.

Action Item 3.2.2 Support planting an average of 14,200 trees annually on private lands.

The City should use the tool, Tree Equity Index, introduced in Chapter 2, to inform and guide the initiatives of a new neighbourhood outreach program, which is proposed to be called the "Strong Roots" Program. This community-driven program will rely on the dedication of volunteers and

support from the City. It will focus on the important task of planting trees on private properties (not owned by the City of Markham). The goal of "*Strong Roots*" will be to achieve the ambitious objective of planting an average of 14,200 trees each year in order to meet the UTC target outlined in this *Urban Forest Management Plan* (UFMP)

These trees will require maintenance. Therefore, a potential companion initiative for future city consideration is to promote private tree stewardship. An example of this type of program is the City of Burlington's new Significant Tree Maintenance Rebate Program.

Action Item 3.2.3 Support planting an average of 4,000 annually on the City of Markham lands.

As outlined in the proposed *Forest Strategy Framework*, the City of Markham aims to plant an average of 4,000 trees/year on City-owned lands. Section 2.1.4.2 provides details about the City's current plantings of an average of 3,336 Street trees annually: 1,396 trees in new developments and 1,950 planted by Forestry as replacement trees. This leaves a deficit of 664 trees. It is recommended that the 664 trees/year deficit could be overcome by shifting funds from the natural regeneration program to other public land tree planting after the public greenways reach the maximum capacity for tree cover. There are currently 51.2 ha of available space within public greenway areas in Markham's urban areas. Given that 12.2 ha of natural regeneration will be established annually by the City, the greenway available space will be filled with trees in 5 years. After that time, only about 2.7 ha of new land will need to be established annually to sustain the greenway tree cover. Savings from the reduction in tree planting in public greenway areas could be used to help cover the tree deficit. This would enhance the ecological richness of City parkland, through converting large sections of turf into vibrant, tree-filled spaces, creating a more natural environment that supports biodiversity while providing a peaceful setting for recreation and community activities. This initiative is linked to Action Item 2.2.2.

Action Item 3.2.4 Scale-up green infrastructure projects by replacing impervious surfaces with trees and green spaces to mitigate costly flooding.

Trees play a crucial role in mitigating the impacts of storm events by intercepting rainwater runoff that often carries harmful pollutants. This natural filtration process helps prevent these contaminants from entering waterways, which can be costly to remediate. Incorporating green infrastructure solutions into stormwater management systems has proven to be an effective strategy for managing excess rainwater and improving the overall quality of urban environments (Figure 18, section 2.1.2.1).

Action Item 4.1.1 Include Operations Forestry as a member of the *Markham Utilities Coordinating Committee* and the *Environmental Sustainability Team*.

Integrating urban forestry management into utility planning would streamline corporate initiatives. This initiative is connected to Action Item 2.1.1, which highlights the importance of protecting public trees during third-party construction projects, including utility capital projects and infill land development. Formally including Forestry as a member of this committee would enhance relationships and knowledge sharing, thereby helping to achieve the UTC target outlined in this *Urban Forestry Management Plan* (UFMP).

Action Item 4.1.2 The City should organize a series of interdepartmental sessions to collaborate and identify a list of City technical manuals that regulate various city business processes impacting the public tree.

Update the relevant city documents and processes to align with a new corporate policy and procedure for tree protection during construction.

This initiative is associated with Action Item 1.2.2, which highlights the importance of collaboration among key departments to effectively manage Markham's urban forest. This is further demonstrated through the following related action items: 2.2.1, 3.1.1, 3.1.2, 3.2.3, and 4.1.2. Bringing these key departments together to focus on the urban forest is crucial for achieving the UTC targets outlined in the *Urban Forest Management Plan* (UFMP).

Action Item 4.2.1 During Phase 2 of Markham's *Official Plan Review*, the Urban Forests policy Section should be updated.

This update would include new policies including:

1. The public tree as a crucial element of the public realm. The City will establish and enforce regulations to ensure that the public tree effectively occupies the public realm, including full stocking on the public road allowance in all projects approved by the City;
2. City-wide Tree Canopy Cover Target(s), as established in the *Urban Forest Management Plan*: 30% by 2124 for public & private lands;
3. Trees are recognized as green and social infrastructure;
4. Leveraging the City's Sustainability Metrics to cover the development application process by making the tools to support the UTC Targets;
5. *Tree Equity* in support of Complete Community policies.

Action Item 4.2.2 Review and Enhance the Sustainability Metrics Program for all development applications to ensure adequate space for trees in the planning and design process.

The City needs to formalize the planning approval process for development applications that includes specific provisions for designing and constructing adequate space for trees from the outset. This approach will ensure that trees are recognized as essential components of public roadways, as well as in other public and private spaces.

A mandatory "Tier 1" performance standard should be set to define the minimum volume of uncompacted soil required to support the Urban Tree Canopy Targets outlined in the *Urban Forest Management Plan* (UFMP), which aims to attain and sustain 30% urban tree canopy cover by 2124.

The Sustainability Metrics Program should mandate the inclusion of this minimum volume of uncompacted soil, with detailed guidelines provided in Markham's new *Enhanced Streetscape Manual* for areas undergoing intensification that are expected to contain significant hard surfaces. Additionally, the process should include a checklist of requirements for developers to qualify for reduced development fees as an incentive for compliance.

Action Item 4.2.3 Review and update the *Criteria & Indicators* for Sustainable Forest Management Planning every 5 years.

The 25 metrics that Markham used to evaluate the performance of its urban forest management should be reviewed and updated regularly. It is recommended that this review take place on a five-year cycle (Criteria and Indicators for Sustainable Urban Forest Management in Chapter 2).

Action Item 5.1.1 Ensure that *Tree Equity* continues as a vital component of the UFMP.

This initiative is reflected in Action Item 4.2.1, which involves the comprehensive update of the *Official Plan*. Additionally, it introduces a proposed *Markham Green Standard* (or an equivalent mechanism to ensure trees are considered early in the planning and design process to guarantee minimum soil volume and adequate space for trees during the development application process) as part of the *Urban Forest Management Plan* (UFMP). This initiative aims to create a structured framework that will guide the City of Markham in promoting *Tree Equity*, ensuring that all communities have equitable access to the benefits of trees and green spaces. Through this effort, the City seeks to enhance urban forestry practices, improve environmental sustainability, and foster community well-being.

Action Item 5.1.2 The *Tree Equity Index* tool guides tree planting priorities.

This initiative is connected to Action Item 3.2.2, planting trees on private lands, and Action Item 3.2.3, planting trees on public lands, for the City of Markham to attain the UTC Target outlined in this UFMS.

Action Item 5.2.1 Address neighbourhoods with highest *Tree Equity Index* scores.

The *Tree Equity Index* tool will become a useful guide to support the City as it works towards *Tree Equity*.

Action Item 5.2.2 Create a new Markham *Strong Roots* Outreach Program. Recruit at least 5,000 citizen participants in the Program by Year 5.

This initiative relates to Action Item 3.2.1 and emphasizes the important role of private trees in achieving the UTC Targets outlined in this UFMP. A concerted communication effort must be launched to engage private landowners in assisting and stewarding increased canopy cover on private land.

4.2. Operating Plan 2026-2030

The 5-Year *Operating Plan* for 2026 to 2030, as detailed in Table 19, strategically prioritizes and identifies required budgetary resources for the comprehensive list of *Action Items* required to fulfill the *Goals & Objectives* outlined in Chapter 3. This plan not only focuses on immediate needs but also incorporates a forward-looking schedule that lays the groundwork for the subsequent 5-Year *Operating Plan*, from 2031 to 2035.

Table 19. 5-Year Operating Plan for the period 2026-2030

5-Year Operating Plan 2026-2030 *estimated costs in 2026

Action Item	Lead	Partners	2026	2027	2028	2029	2030	2026-2030 Total	# of FTE
Strategic Goal 1: Maintaining									
Objective 1.1									
Maximize public benefits from street trees while minimizing costs by continuing to fund the City's proactive care for public trees.									
1.1.1 Maintain the City's Neighbourhood Block Tree Pruning Program	Operations Forestry		\$536,000	\$536,000	\$536,000	\$536,000	\$536,000	\$2,680,000	-
1.1.2 Update and maintain the Municipal Tree Inventory	Operations Forestry			\$79,800			\$79,800	\$159,600	2 seasonal staff
1.1.3 Maintain the Forest Inventory and Forest Management Plan for City Woodlot properties.	Operations Forestry	Consultant					\$25,000	\$25,000	
1.1.4 Develop a Enhanced Young Tree Maintenance Program.	Operations Forestry		\$23,750	\$23,750	\$23,750	\$23,750	\$23,750	\$118,750	
1.1.5.1 Address the staffing & resource needs to keep pace with growth and development and the maturing urban forest.									
The current Operations complement of 1 Arborist Contract Crew should be increased to 3 to keep up with the volume of resident requests for tree work due to Markham's growing urban forest. <i>This is the most cost-effective way to address the backlog of service issues.</i>			\$369,797	\$551,957	\$574,035			\$1,495,789	
1.1.5.2 Address the staffing & resource needs to keep pace with growth and development and the maturing urban forest.	Operations Forestry			\$141,419	\$145,662	\$145,662	\$145,662	\$578,405	1.0

Action Item	Lead	Partners	2026	2027	2028	2029	2030	2026-2030 Total	# of FTE
A second Full-time Inspector position is required to minimize the backlog of resident requests and to determine what action is required. This will expedite getting work into the hands of the field staff and maximize productivity.									
This additional inspector would allow Operations Parks Forestry to improve service delivery by creating an "Operations West" and "Operations East" organizational model - each staffed with a full-time Forestry Inspector and a full-time Forestry Working Supervisor. This model would yield the most effective productivity and service given the current and short-term growth of the City. Prioritizing service work across the entire City is difficult and efficiency will be improved with this internal change.									
1.1.5.3 Address the staffing & resource needs to keep pace with growth and development and the maturing urban forest.									
The Operations Parks Forestry department requires a manager to oversee the administrative, financial, planning, strategic initiatives and departmental liaison responsibilities.									
This will allow the Supervisor to oversee the daily operations of staff and contractors, focusing on improved productivity and service delivery. The current model requires the Supervisor to spend a disproportionate amount of their time on administrative tasks.				\$176,100	\$176,100	\$176,100	\$176,100	\$704,400	1.0
1.1.5.4 Address the staffing & resource needs to keep pace with growth and development and the maturing urban forest.									
The current Operations Parks Forestry complement of Six full-time in-house Arborists (3 crews of 2	Operations Forestry				\$217,175	\$217,175	\$217,175	\$651,525	2.0

Action Item	Lead	Partners	2026	2027	2028	2029	2030	2026-2030 Total	# of FTE
Arborists(crew) should be increased to Eight full-time in-house Arborists (4 crews of 2 Arborists/crew). This will maximize field staff and have two crews per east and west area working with contractor crews for maximum productivity.									
2 additional Arborist positions @ \$108,587.50 / position									
1.1.5.5 Address the staffing & resource needs to keep pace with growth and development and the maturing urban forest.									
A Contracted Arboricultural Inspector is required to be retained every two years to be responsible for Woodlot assessment/coordination across the whole City. This is a cost effective way to assess woodlots, especially those which border residential homes.	Operations Forestry		\$85,000		\$85,000		\$85,000	\$255,000	0.6
Objective 1.2									
The design of the City's urban fabric reflects elements that demonstrate people and trees need each other									
1.2.1 Adopt the 3-30-300 'Rule' as a guideline for community planning over City-controlled lands.	Planning	Interdepartmental	In-house					\$0	
1.2.2 Create a comprehensive Complete Streets Policy.	Planning & Design – Streetscape & Intensification Design & Coordination	Interdepartmental	In-house					\$0	
Objective 1.3									
Fully account for the value of the urban forest in the Asset Management Plan									
1.3.1 Engineered soil conditions and their associated volumes should be included in the Asset Management Plan and 'owned' by Forestry.	Sustainability & Asset Management	Interdepartmental	In-house					\$0	

Action Item	Lead	Partners	2026	2027	2028	2029	2030	2026-2030 Total	# of FTE
1.3.2 Include "Urban Tree Cover" as a metric in the Asset Management Report Card	Sustainability & Asset Management	Interdepartmental	In-house					\$0	
Strategic Goal 2: Protecting									
Objective 2.1									
Recognize trees as part of green and social infrastructure	Planning	Interdepartmental	In-house						
2.1.1 Update the Forestry Operations Manual to reflect current Best Management Practices (BMPs) such as ANSI A300 Tree Care Standards.	Operations Forestry		In-house					\$0	
2.1.2 Create an Urban Forest Policy Manual and create a new policy and procedure for Tree Protection in the Construction Process.	Operations Forestry								
Objective 2.2									
Close Markham's "UTC Gap"									
2.2.1 Conduct an Urban Tree Cover Change Analysis every 5 years using <i>i-Tree Canopy</i>	Operations Forestry						\$10,000	\$10,000	
2.2.2 Ensure the City's new <i>Enhanced Streetscape Manual</i> for intensification areas includes details that provide public trees with adequate access to soil and space.	Planning & Design – Streetscape & Intensification Design & Coordination	Interdepartmental	In-house					\$0	
Strategic Goal 3: Planting									
Objective 3.1									

Action Item	Lead	Partners	2026	2027	2028	2029	2030	2026-2030 Total	# of FTE
<i>Design and construct space for growing large shade trees in the public realm through the creation of a formal mechanism to translate this vision into a built reality for Markham's urban fabric</i>									
3.1.1 Harmonize the new Enhanced Streetscape Manual for intensification areas and the Urban Design Manual to reflect trees as part of the City's Green Infrastructure.	Planning & Design – Streetscape & Intensification Design & Coordination	Interdepartmental	In-house					\$0	
3.1.2 Amend the Zoning By-law to change the definition of a "landscape area."	Planning	Interdepartmental	In-house					\$0	
Objective 3.2									
Ensure that trees and their benefits are available for everyone									
3.2.1 Develop incentives and programs for private tree planting and stewardship including leveraging existing programs.	Operations Forestry		In-house					\$0	
3.2.2 Support planting an average of 14,200 trees annually on private lands. [Refer to Section 2.1.4.2, Markham Planting Estimates to Attain 30% Tree Cover]	Operations Forestry Services		In-house					\$0	
3.2.3 Support planting an average of 4,000 trees annually on City of Markham lands. [Refer to Section 2.1.4.2, Markham Planting Estimates to Attain 30% Tree Cover]	Operations Forestry		In-house					\$0	
3.2.4 Scale up green infrastructure projects by replacing impervious surfaces with trees and green spaces to mitigate costly flooding	Planning & Design – Streetscape & Intensification	Interdepartmental	In-house					\$0	

Action Item	Lead	Partners	2026	2027	2028	2029	2030	2026-2030 Total	# of FTE
Strategic Goal 4: Planning	<i>Design & Coordination</i>								
Objective 4.1									
Cultivate a culture of collaboration towards the stewardship of Markham's urban forest	<i>Operations Forestry</i>	<i>Communications</i>							
4.1.1 Include Operations Forestry as a member of the <i>Markham Utilities Coordinating Committee</i> and the <i>Environmental Sustainability Team</i> .	<i>Operations Forestry</i>	<i>Interdepartmental</i>	In-house					\$0	
4.1.2 The City should organize a series of interdepartmental sessions to collaborate and identify a list of City technical manuals that regulate various city business processes impacting the public tree.	<i>Operations Forestry</i>	<i>Interdepartmental</i>				In-house		\$0	
Objective 4.2									
Measure and monitor the sustainability of the urban forest									
4.2.1 During Phase 2 of Markham's <i>Official Plan Review</i> , the Urban Forests policy Section should be updated.	<i>Planning</i>	<i>Interdepartmental</i>	In-house					\$0	
4.2.2 Develop a <i>Markham Green Standard</i> ** for all development applications to ensure adequate space for trees in the planning and design process. *or an equivalent mechanism to ensure trees are considered early in the planning and design process to guarantee minimum soil volume and adequate space for trees during the development application process	<i>Planning</i>	<i>Interdepartmental</i>	In-house					\$0	
4.2.3 Review and update the <i>Criteria & Indicators</i> for Sustainable Forest Management Planning every 5 years	<i>Operations Forestry</i>						In-house	\$0	

Action Item	Lead	Partners	2026	2027	2028	2029	2030	2026-2030 Total	# of FTE
Strategic Goal 5. Environmental Justice									
Objective 5.1									
Aspire to attain <i>Tree Equity</i> throughout Markham									
5.1.1 Ensure that <i>Tree Equity</i> continues as a vital component of the <i>UFMP</i> .	Operations Forestry	REDI					In-house	\$0	
5.1.2 The <i>Tree Equity Index</i> tool guides tree planting priorities.	Operations Forestry	REDI	In-house					\$0	
Objective 5.2									
Form tree-related solid partnerships with the community									
5.2.1 Address neighbourhoods with highest <i>Tree Equity Index</i> scores.	Operations Forestry						In-house	\$0	
5.2.2 Create a new Markham <i>Strong Roots</i> Outreach Program.	Operations Forestry	Communications		In-house				\$0	
Recruit at least 5,000 citizen participants in the Program by Year 5.									
Total			\$1,014,547	\$1,509,026	\$1,757,722	\$1,098,687	\$1,298,487	\$6,678,469	4.6

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Appendix 1. Tree Cover Projection Methods and Information

Forecasting future tree populations is dependent on three parameters:

1. annual influx of new trees (e.g., planting or natural regeneration),
2. annual tree growth, and
3. annual mortality rates

Unfortunately, there is limited information on urban forest influx and mortality rates. Thus, future projections are limited at best and based on the assumptions used for these three parameters. The *UFORE Population Projector* was used to project future tree populations based on various assumptions. Tree growth rates are reasonably known, so the influx and mortality assumptions are critical.

To maintain tree cover, it is important to know how many trees need to be planted annually to offset the canopy lost due to tree mortality. Although tree mortality varies through time (e.g., episodic events like storms and insect outbreaks can kill many trees in a short time) a consistent annual influx of new trees can help to help maintain a sustainable tree population. The number of trees needed to be planted annually depends on the average tree mortality. As mortality rates increase, more trees need to be planted to sustain tree cover. Maintenance efforts that reduce tree mortality and/or increase tree growth rates will reduce the number of trees needing to be planted each year. An average mortality rate of 3% was used for Markham based on discussions with City personnel.

Various model scenarios were run using the *Urban Forest Effects (UFORE)* population projector based on tree totals and tree diameter distributions derived from field data collection in Markham. The number of trees needing to be established annually was calculated to attain the desired tree cover (i.e., 30%) by the desired year [2031, 2051, and long-term (2124)]. In all cases, the current tree cover was sustained, plus additional trees were added to reach the tree cover goal. The estimates of annual tree influx needed to reach the goal were produced for each land use type. There is currently 18.6% tree cover in the study area (3,312 ha tree cover). To reach 30% tree cover, there must be 5,332 ha of tree cover. Thus, there is a tree cover shortfall of 2,020 ha. To attain 30%, the following cover distribution (Table A1) was developed in consultation with city personnel.

Table A1. Distribution of future tree cover by land use to attain 30% tree cover in study area.

Land Use	Current tree cover		Future tree cover	
	(ha)	(%)	Additional (ha)	(%)
Commercial	323	10.5%	155	15.5%
Future Development	374	19.7%	197*	30.0%
Public other	354	11.4%	494	27.3%
Public parks	642	43.6%	44	46.6%
Residential	1,184	16.4%	1,130	32.0%
Woodlots	435	43.9%	0	43.9%
Current & Future Urban	3,312	18.6%	2,020	30.0%

* number will be higher (see Table 4) due to expected loss of tree cover from development.

All scenarios were analyzed using two assumptions:

1. Current conditions: 3% annual mortality rate and average diameter growth rate of 0.61 cm/year.
2. Enhanced conditions: management efforts can enhance tree health and growth, and reduce mortality rates. This run used an annual mortality rate of 2.5% and average diameter growth rate of 0.76 cm/year.

Not all of the trees needing to be established need to be planted as some trees will become established through natural regeneration. To determine the planting rate for each land use, the estimate assumes that only a proportion of new influx trees will come from tree planting (Table A2).

Table A2. Percent of tree population planted by land use. Residential and commercial estimates are based on U.S. and Canadian data from Nowak (2012). Other estimates are assumptions. Overall, 2/3 of trees in U.S. and Canadian cities come from natural regeneration and 1/3 from tree planting (Nowak, 2012).

Land Use	% Planted
Commercial	61.2%
Future Development	70.0%
Public other	75.0%
Public parks	24.0%
Residential	74.8%
Woodlots	0%

Future Development Area

The “future development area” creates a special case for the tree cover projections. The current tree cover in this area is given in Table A3. Based on Table A1, the cover goal is 30.0%, which equates to 571.3 ha of tree cover. Tree cover in the greenways is assumed to be sustained, but the tree cover in the employment and community areas are assumed to be lost during development. Thus, tree cover in employment and community areas will need to be replanted to reach the tree cover goal. A total of 289.9 ha of tree cover will need to be established in the future developed area to reach 30.0% (assuming that all trees are removed in the employment and community land uses during development) (Table A3).

Table A3. New tree cover needed by land use to reach goal of 30.0% in the future development area.

Plan Land Use	Area(ha)	Curr. ^a (%)	Dev. ^b (%)	Tree Cover Goal	
				(%)	(ha)
Future Commercial^c	141.6	4.8	0.0	15.0	21.2
Future Residential^d	1052.5	8.2	0.0	25.1	264.2
Greenway	679.8	41.4	41.4	41.4	281.4
Other (Right-of-ways)	29.7	0.0	0.0	15.0	4.5
Total	1903.6	19.7	14.8	28.6	571.3
New cover^e					289.9

^a current percent tree cover

^b tree cover after development (assumes cover is sustained in greenways, but removed elsewhere)

^c also known and new employment or future development

^d also known as new community or countryside

^e new tree cover (ha) added in employment, community and other land uses to reach option goal

Impacts of Attaining a Tree Cover Goal within Varying Time Periods

Three time-frames were modeled to attain 30% tree cover:

1. 2031 – reaching 30% tree cover in 6 years
2. 2051 reaching 30% tree cover in 26 years
3. Long-term - reaching 30% tree cover in 100 years

There are three factors that affect tree cover through time: 1 - tree mortality rates (mortality decreases tree cover), 2 - tree growth rates (tree growth increase tree cover) and 3 - tree influx rates (influx increases tree cover). Thus, even with tree mortality and no tree influx, tree cover can increase if canopy growth is greater than canopy lost through tree mortality. The following figures illustrate what happens to tree cover, population totals, and tree diameter distribution using the three different goal years and residential land as an example. The residential tree cover goal was 32% (Table A1).

Long-Term Goal

For long-term goals, tree cover reaches the 32% goal over a century with a steady increase in cover (Figure A1), the population totals remain steady (Figure A2), and the tree diameter distribution retains an inverse j-shape within decreasing numbers as tree diameter increases (Figure A3).

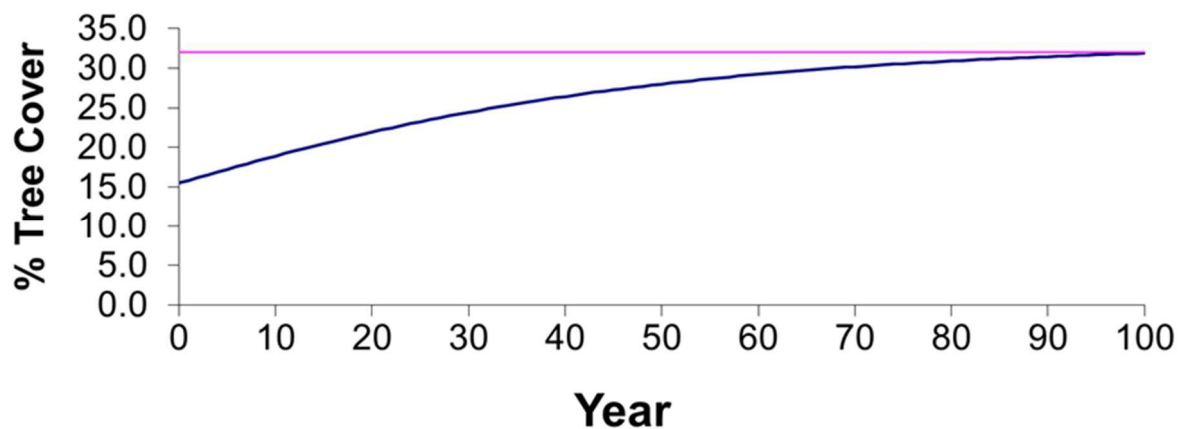


Figure A1. Projected tree cover in residential land with an annual influx of 49,000 trees (planted plus natural regeneration) and 3% mortality.

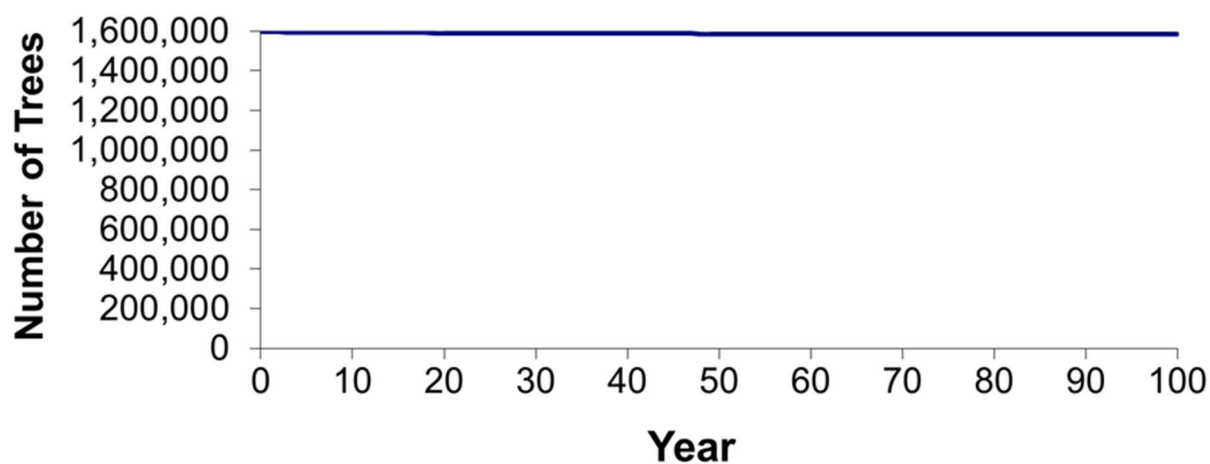


Figure A2. Projected number of trees over 100 years in residential land with an annual influx of 49,000 trees (planted plus natural regeneration) and 3% mortality.

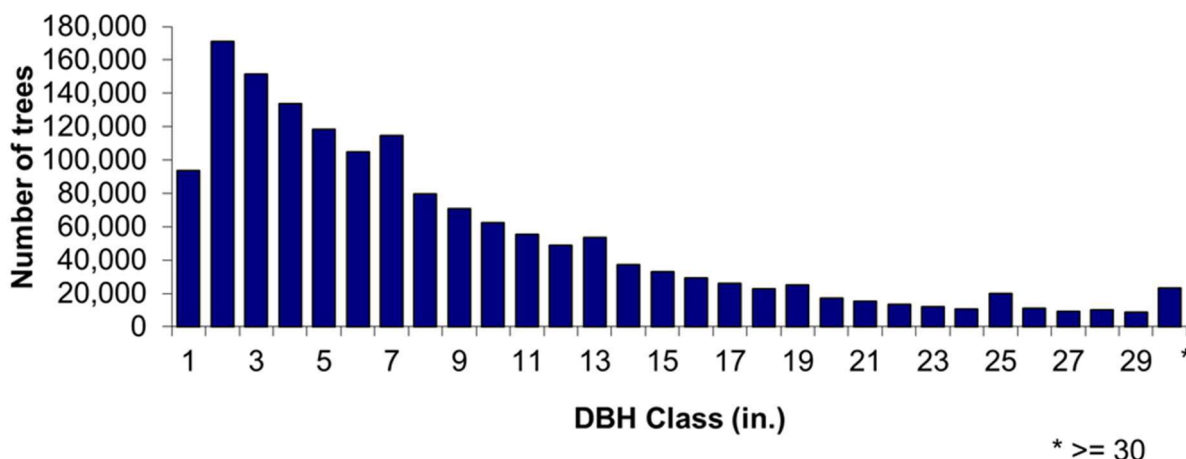


Figure A3. Projected tree diameter distribution in 2124 (year 100) in residential land with an annual influx of 49,000 trees (planted plus natural regeneration) and 3% mortality.

2051 Goal

For 32% residential tree cover goal in 2051 (Year 26), tree cover exceeds the goal after 2051 (Figure A4), the population totals decline after 2051 (Figure A5), and the tree diameter distribution has a population bubble (wave) in diameters between 19 and 25 inches (48.3 – 63.5 cm) due to the 26 years of increased tree planting (Figure A6). In this scenario, trees do not need to be established after 2051 as the tree cover goal is already exceeded. However, by not establishing trees after 2051 the population would be headed for a crash in future. Thus, trees were also established after 2051 to help sustain the tree cover after 2051.

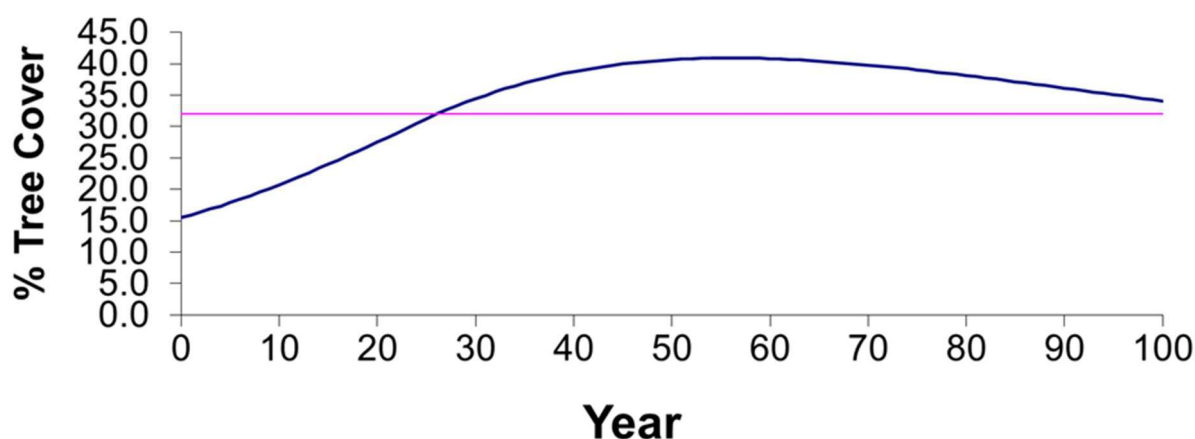


Figure A4. Projected tree cover in residential land with an annual influx of 135,000 trees for the first 26 years and 30,000 trees thereafter (planted plus natural regeneration), and 3% mortality.

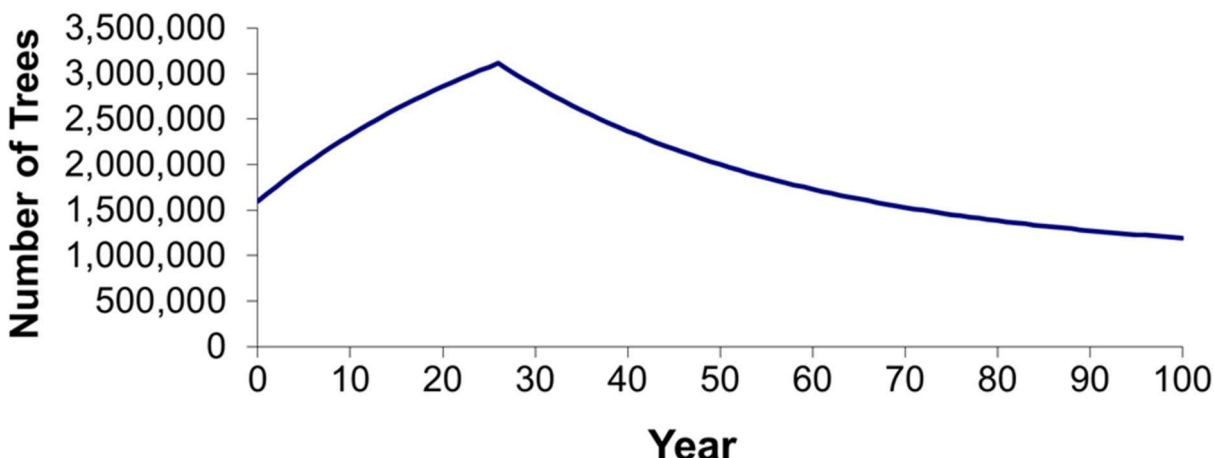


Figure A5. Projected number of trees over 100 years in residential land with an annual influx of 135,000 trees for the first 26 years and 30,000 trees thereafter (planted plus natural regeneration), and 3% mortality.

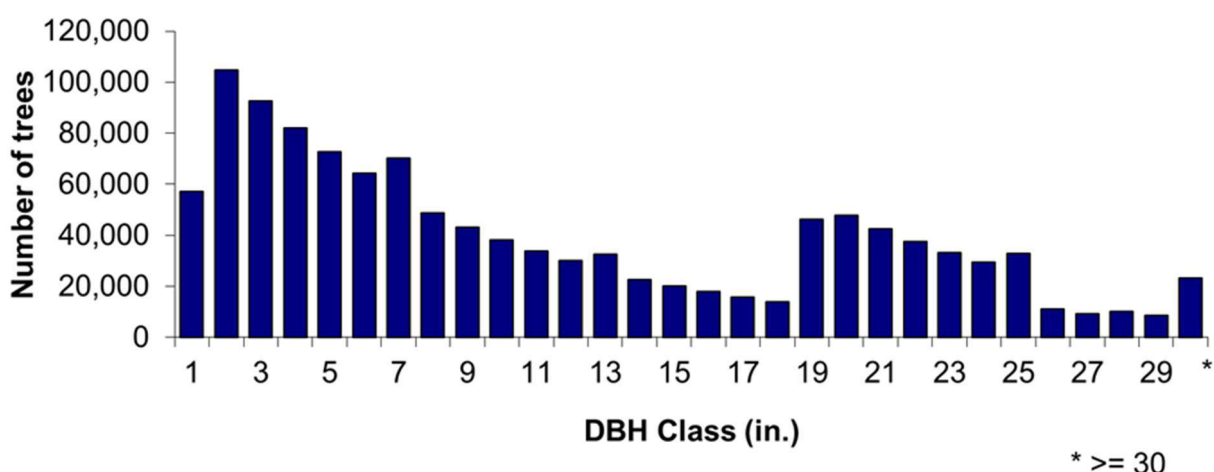


Figure A6. Projected tree diameter distribution in 2124 (year 100) in residential land with an annual influx of 135,000 trees for the first 26 years and 30,000 trees thereafter (planted plus natural regeneration), and 3% mortality.

2031 Goal

For the 32% residential tree cover goal in 2031 (Year 6), tree cover exceeds the goal after 2031 (Figure A7), the population totals decline after 2031 (Figure A8), and the tree diameter distribution has population bubble (wave) in diameters between 24 and 25 inches (61.0 – 63.5 cm) due to the 6 years of increased tree planting (Figure A9). In this scenario, trees do not need to be established after 2031 as the tree cover goal is already exceeded. However, by not establishing trees after 2031 the population would be headed for a severe crash in future. Thus, trees were also established after 2031 to help sustain the tree cover after 2031.

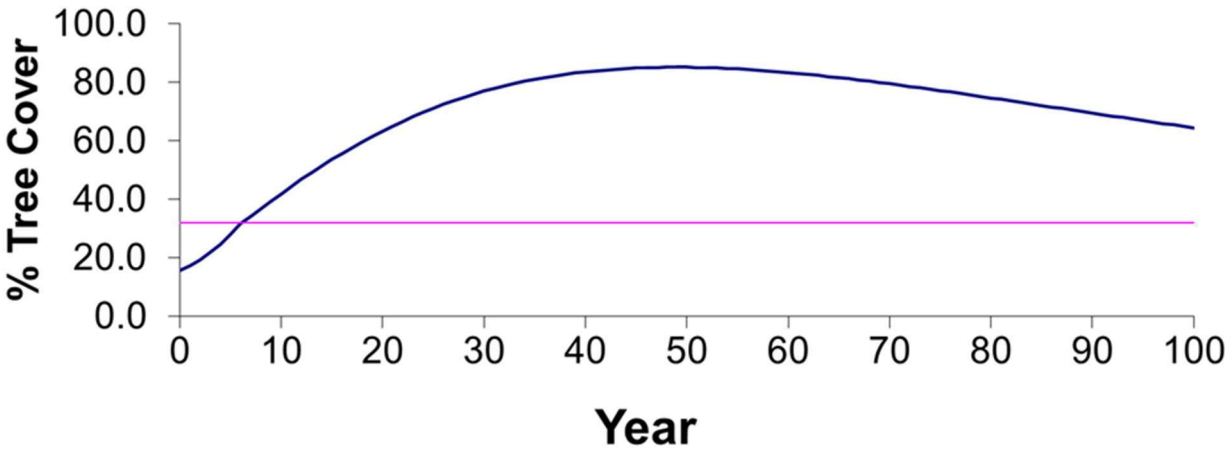


Figure A7. Projected tree cover in residential land with an annual influx of 1.5 million trees for the first 6 years and 50,000 trees thereafter (planted plus natural regeneration), and 3% mortality.

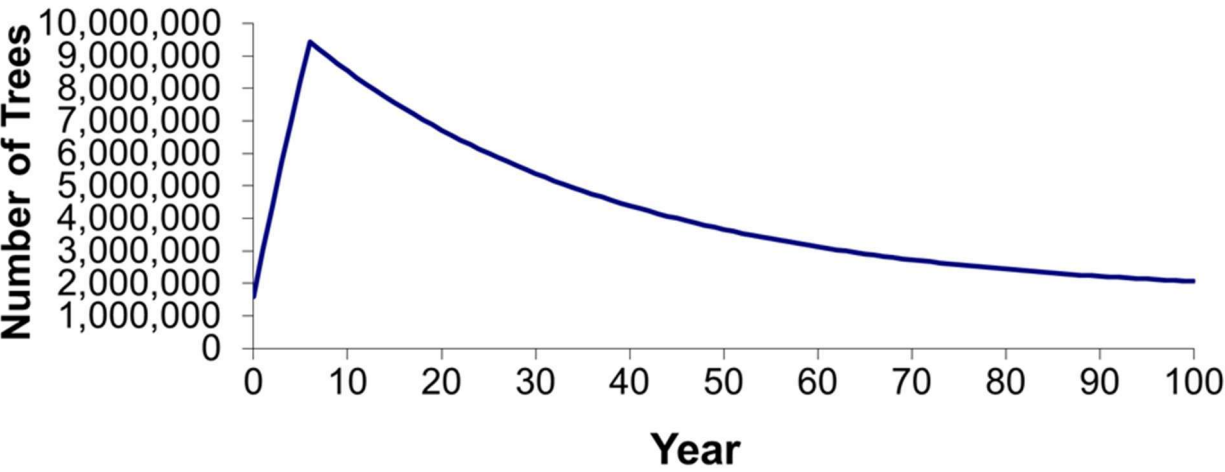


Figure A8. Projected tree cover in residential land with number of trees over 100 years in residential land with an annual influx of 1.5 million trees for the first 6 years and 50,000 trees thereafter (planted plus natural regeneration), and 3% mortality.

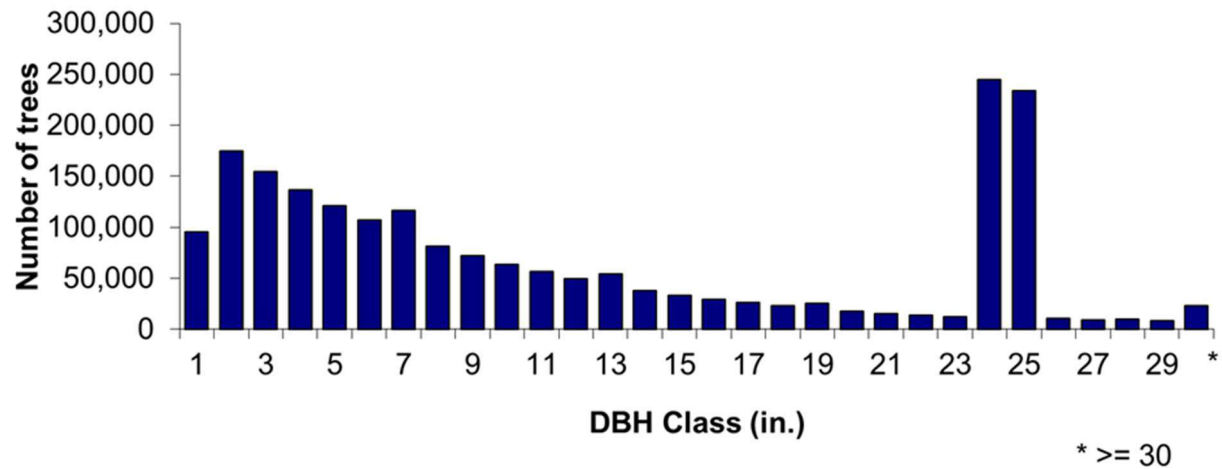


Figure A9. Projected tree diameter distribution in 2124 (year 100) in residential land with an annual influx of 1.5 million trees for the first 6 years and 50,000 trees thereafter (planted plus natural regeneration), and 3% mortality.