A Report on the Community of Bolton's Existing and Possible Tree Canopy



Why is Tree Canopy Important?

Tree canopy (TC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Tree canopy provides many benefits to communities, including improving water quality, saving energy, lowering Community temperatures, reducing air pollution, enhancing property values, providing wildlife habitat, facilitating social and educational opportunities, and providing aesthetic benefits. Establishing a TC goal is crucial for those communities seeking to improve their green infrastructure. A TC assessment that estimates the amount of tree canopy currently present (Existing TC), along with the amount of tree canopy that could theoretically be established (Possible TC), is the first step in the TC goal-setting process.

How Much Tree Canopy does Bolton have?

An analysis of Bolton's tree canopy based on land cover derived from high resolution satellite imagery (Figure 1) found that more than 286 ha of the Community were covered by tree canopy (termed Existing TC) representing 17% of all land in the Community. An additional 59% (989 ha) of the Community could theoretically be improved (Possible TC) to support tree canopy (Figure 2). In the Possible TC category, 29% (478 ha) of the Community were Impervious Possible TC and another 31% were Vegetated Possible TC (512 ha). Vegetated Possible TC, or grass and shrubs, is more conducive to establishing new tree canopy, but establishing tree canopy on Impervious Possible TC will have a greater impact on water quality.

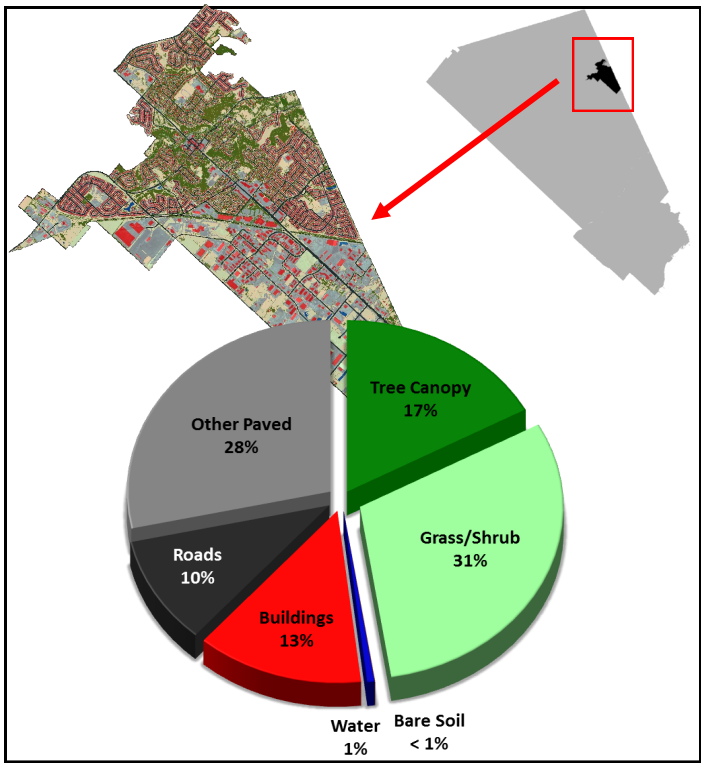


Figure 1: Land cover derived from high resolution satellite imagery for the Community of Bolton.

Project Background

The analysis of Bolton's tree canopy (TC) was carried out in collaboration with the Toronto and Region Conservation Authority (TRCA), Peel Region, and the USDA Forest Service. The analysis was performed by the Spatial Analysis Laboratory (SAL) of the University of Vermont's Rubenstein School of the Environment and Natural Resources, in consultation with the USDA Forest Service's Northern Research Station.

The goal of the project was to apply the USDA Forest Service's TC assessment protocols to the Community of Bolton. This analysis was conducted based on year 2009 data.

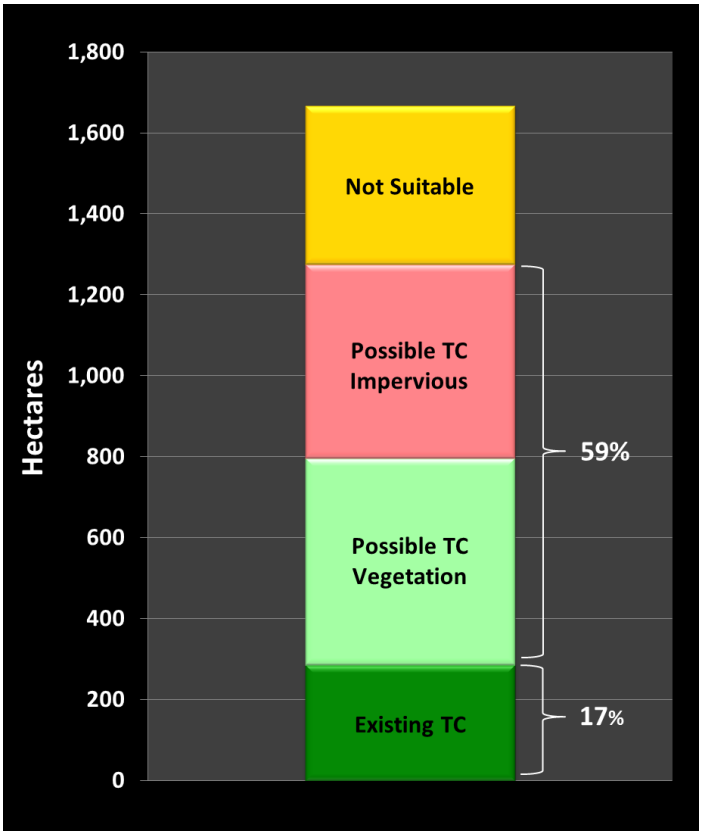


Figure 2: TC metrics for Bolton based on % of land area covered by each TC type.

Key Terms

TC: Tree canopy (TC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above.
Land Cover: Physical features on the earth mapped from aerial or satellite imagery, such as trees, grass, water, and impervious surfaces.
Existing TC: The amount of tree canopy present when viewed from above using aerial or satellite imagery.
Impervious Possible TC: Asphalt or concrete surfaces, excluding roads and buildings, that are theoretically available for the establishment of tree canopy.
Vegetated Possible TC: Grass or shrub area that is theoretically available for the establishment of tree canopy.

Mapping Bolton's Trees

Advanced automated processing techniques using high-resolution (0.6 meter) QuickBird imagery (DigitalGlobe) acquired in the summer of 2007 (Figure 3a) and ancillary datasets (Figure 3b) were used for mapping land cover for the entire Community with such detail that single trees were detected (Figure 3c).

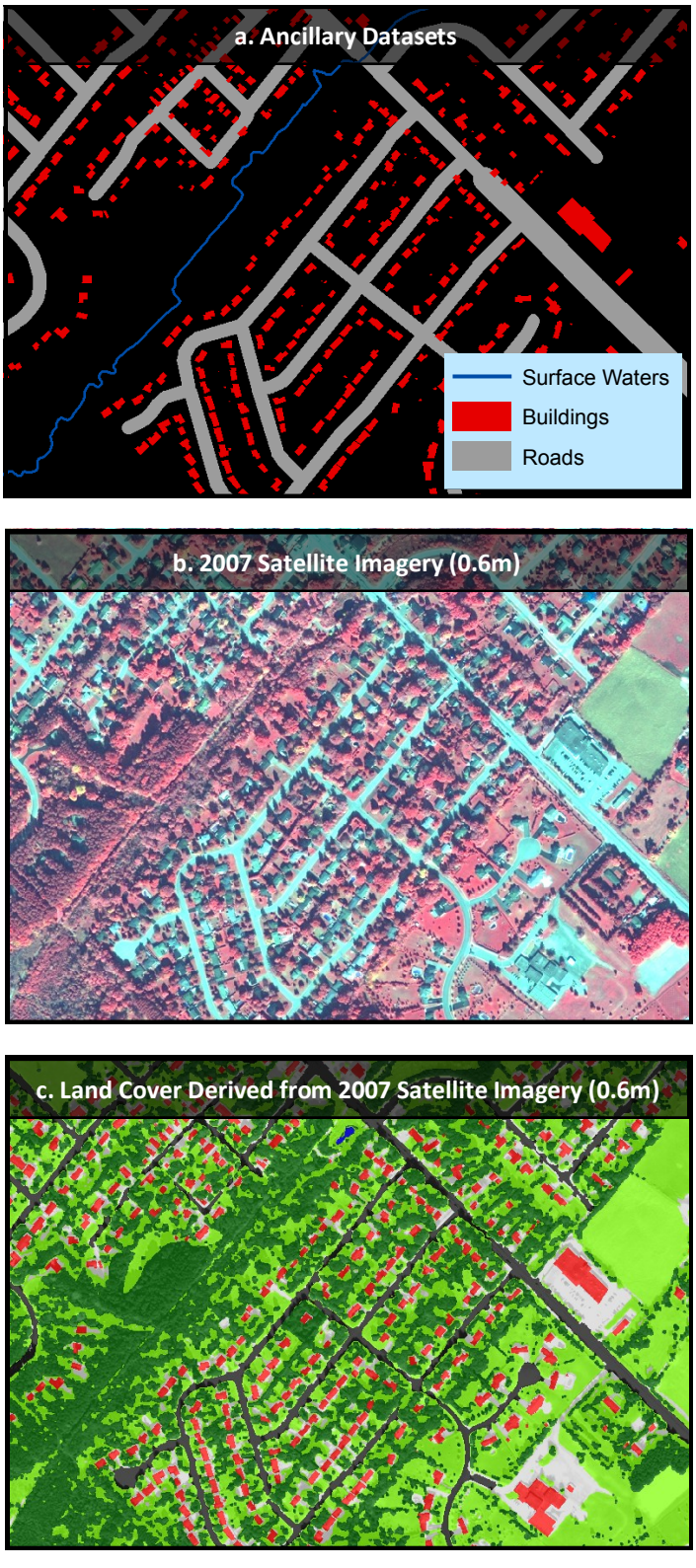


Figure 3a, 3b, 3c: Datasets and imagery used for generating high-resolution land cover.

Parcel Summary

Following computation of Existing and Possible TC, the TC metrics were summarized for each property in the Community's parcel database (Figure 4). For each parcel, the absolute area of Existing and Possible TC was computed along with the percent of Existing TC and Possible TC (TC area/area of the parcel).

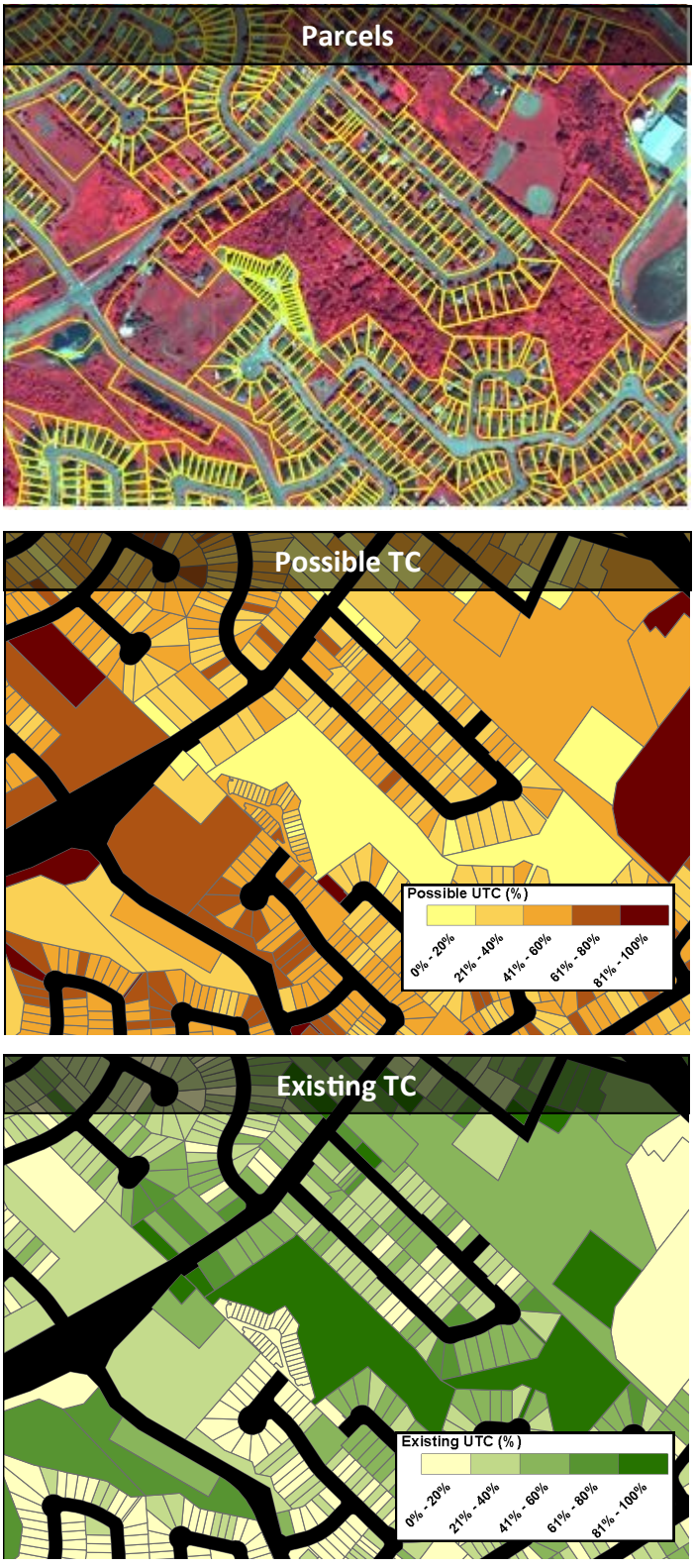


Figure 4: Parcel-based TC metrics. TC metrics are generated at the parcel level, allowing each property to be evaluated according to its Existing TC and Possible TC.

Land Use

An analysis of Existing and Possible TC by land use category was conducted using the most recent land use layer for the Community (Figure 5; Table 1). For each land use category, TC metrics were calculated as a percentage of all land in the Community (% Land), as a percentage of land area in the specified land use category (% Category), and as a percentage of the area for TC type (% TC Type). The Residential Low category had the greatest amount of existing tree canopy (10% of the Community's total land area). Residential Low also has the most Possible TC (11%) relative to the percentage of land area, but the Agriculture category comprises a much larger proportion of Possible TC by category (92%).

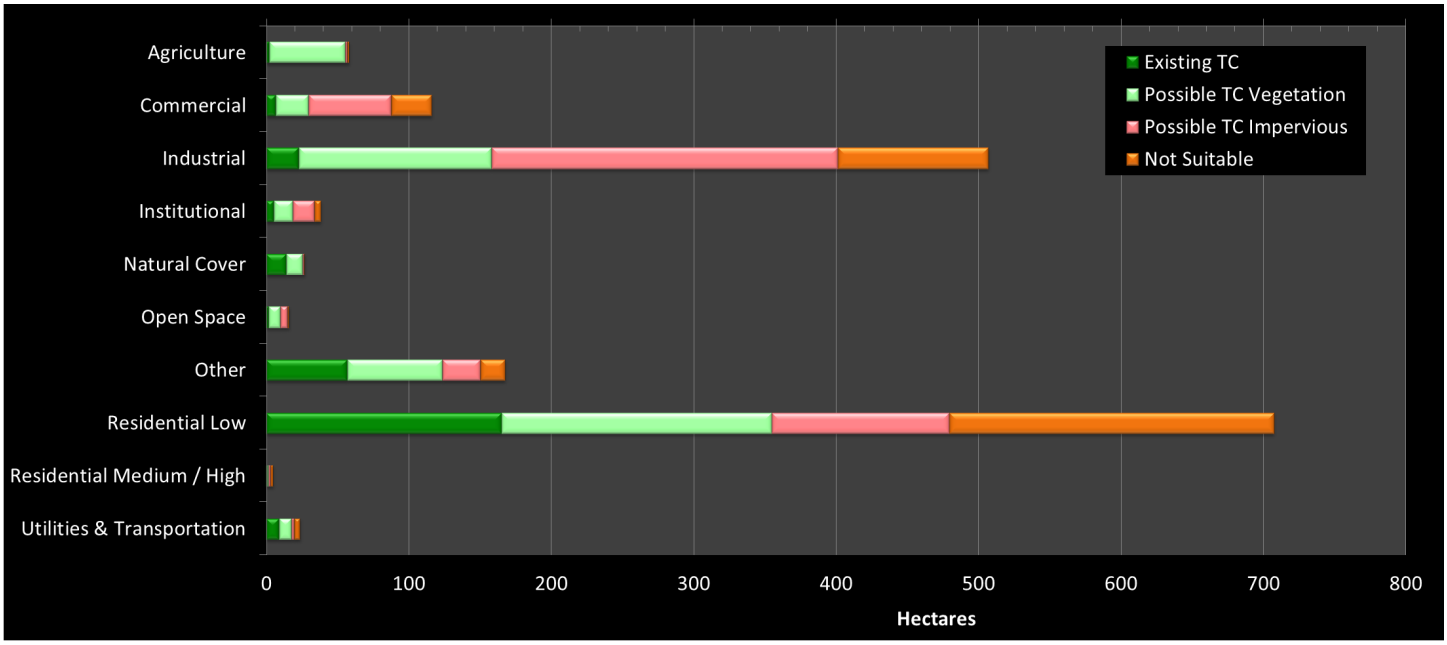


Figure 5: TC metrics summarized by land use category.

Table 1: TC metrics were summarized by land use category. For each land use category, TC metrics were computed as a percentage of all land in the Community (% Land), as a percentage of land in the specified land use category (% Category), and as a percentage of the area for TC type (% TC Type).

Land Use	Existing TC			Possible TC Vegetation			Possible TC Impervious		
	% Land	% Category	% TC Type	% Land	% Category	% TC Type	% Land	% Category	% TC Type
Agriculture	0%	4%	1%	3%	92%	10%	0%	3%	0%
Commercial	0%	6%	2%	1%	20%	4%	3%	50%	12%
Industrial	1%	5%	8%	8%	27%	26%	15%	48%	51%
Institutional	0%	15%	2%	1%	35%	3%	1%	39%	3%
Natural Cover	1%	52%	5%	1%	43%	2%	0%	4%	0%
Open Space	0%	12%	1%	0%	51%	2%	0%	30%	1%
Other	3%	34%	20%	4%	40%	13%	2%	16%	6%
Residential Low	10%	23%	58%	11%	27%	37%	7%	18%	26%
Residential Medium / High	0%	18%	0%	0%	24%	0%	0%	23%	0%
Utilities & Transportation	1%	38%	3%	1%	38%	2%	0%	7%	0%

% Land = $\frac{\text{Area of TC type for land use category}}{\text{Area of all land}}$

The % Land Area value of 10% indicates that 10% of Bolton's land area is covered by tree canopy in the residential low land use category.

% Category = $\frac{\text{Area of TC type for land use category}}{\text{Area of all land for specified land use}}$

The % Land value of 23% indicates that 23% of land in the residential low land use category is covered by tree canopy.

% TC Type = $\frac{\text{Area of TC type for land use category}}{\text{Area of all TC type}}$

The % TC Type value of 58% indicates that 58% of all "existing TC" is classified in the residential low land use category.

Small Geographic Units

Possible and Existing tree canopy were summarized by Small Geographic Units for Bolton (Figure 6). Small Geographic Unit C0428 had the most possible tree canopy (94%) while C1177 had the by category most existing tree canopy (33%).

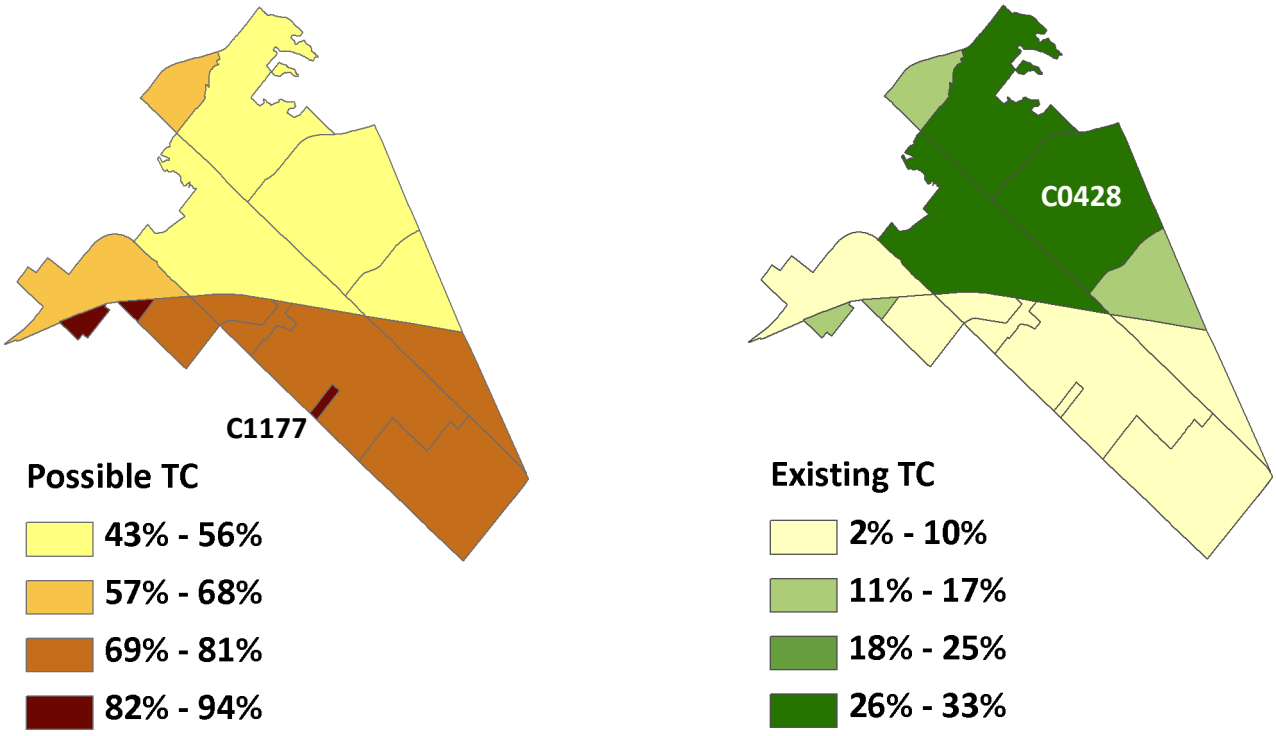


Figure 6. Percent Possible TC and Percent Existing TC by Small Geographic Unit.

Possible TC per Capita (m^2) | **Existing TC per Capita (m^2)**

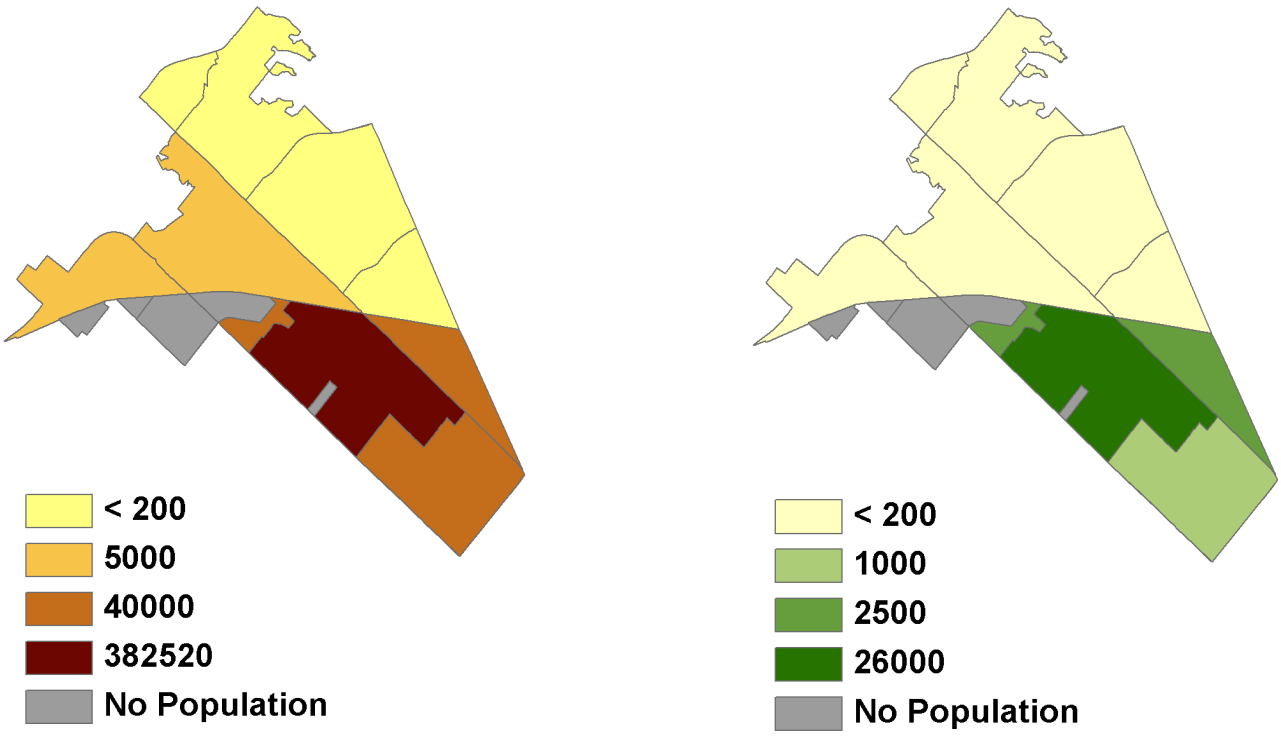


Figure 7. Possible TC and Existing TC per capita by Small Geographic Unit population values.

Service Delivery Areas

Existing and possible TC were summarized by Service Delivery Area (Figure 8). M004 covers 51% (847 ha) of the land area of Bolton but only had 3% (57 ha) of the existing TC.

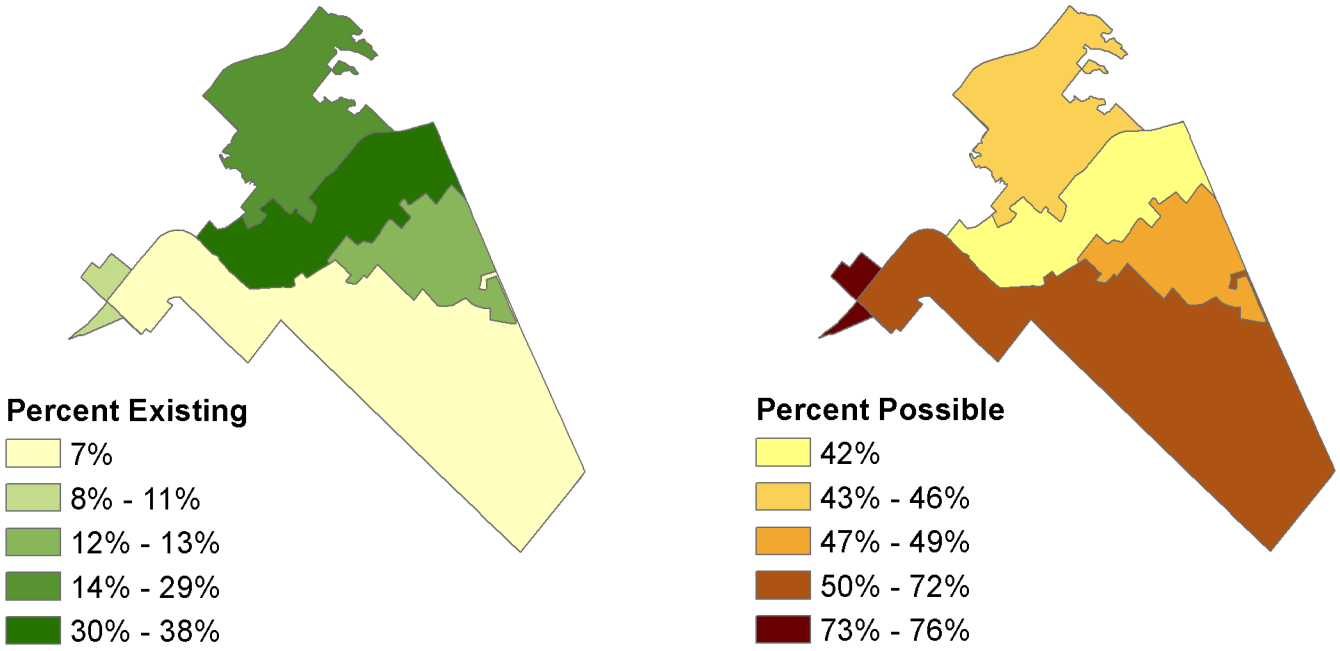


Figure 8: TC metrics summarized by Service Delivery Area.

Subwatersheds

TC Metrics were summarized by boundaries within Bolton. (Figure 9). The Main Humber River subwatershed covers the largest area (1364 ha) of Bolton and the highest % Existing TC (16%) and Possible TC (45%) by land area. The smallest subwatershed, West Humber Creek (304 ha) had the highest % Category for Possible TC (78%).

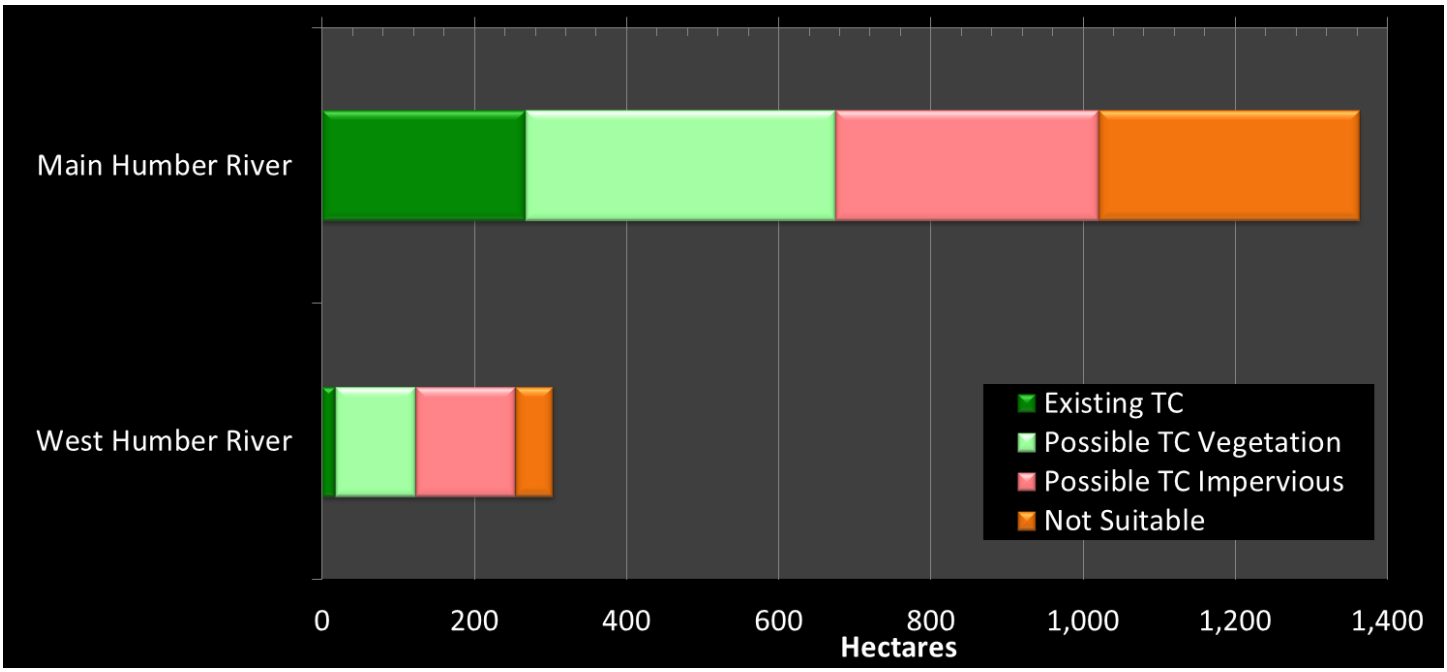


Figure 9: TC metrics summarized by subwatersheds covering Bolton.

Wards

Tree canopy metrics were summarized by Ward (Figure 10). Ward 5 covers the most land area within Bolton (88% or 1473 ha) and had the highest % Possible TC (51%) by land area the most Existing TC by land area (15%). Ward 4 had the highest % Possible TC by category (69%).

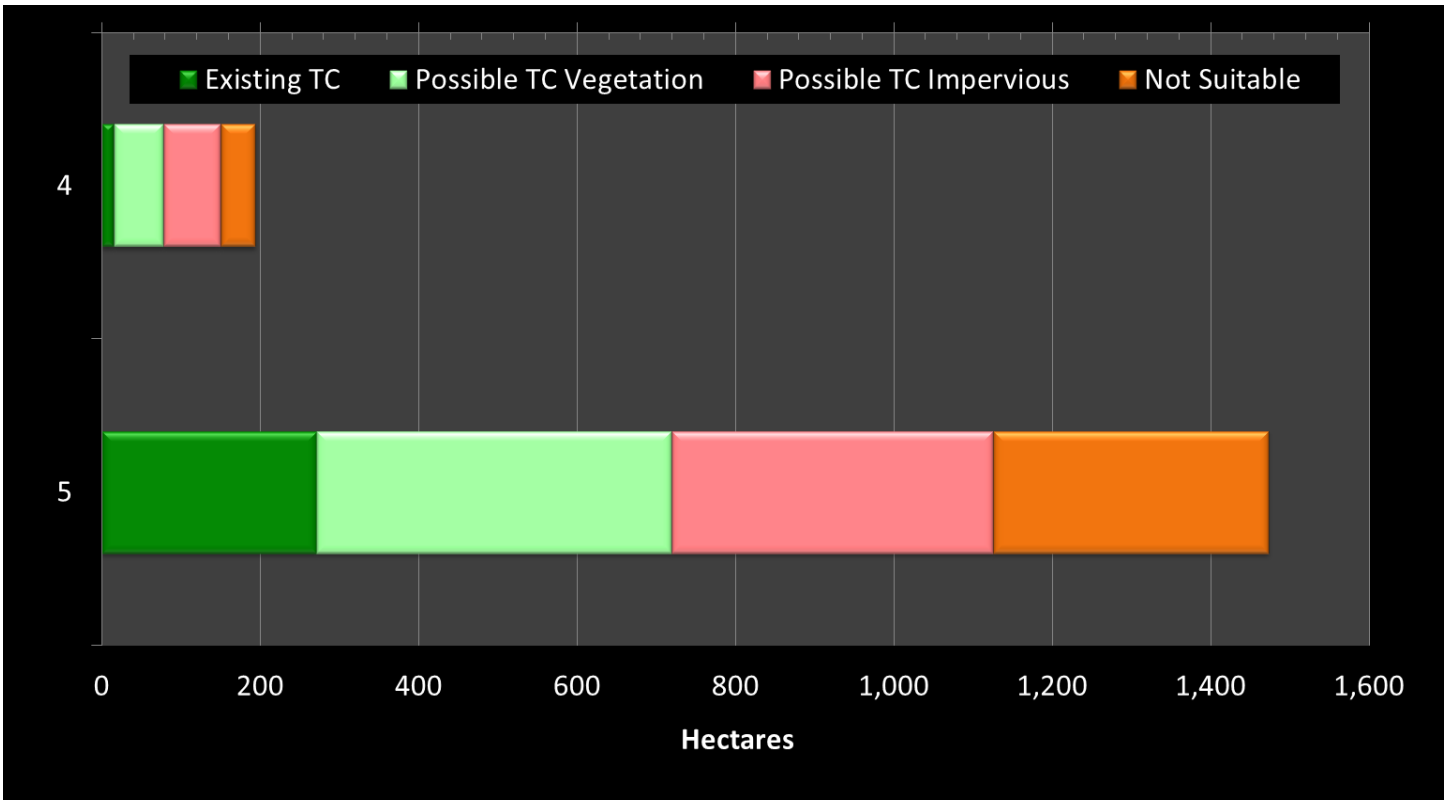
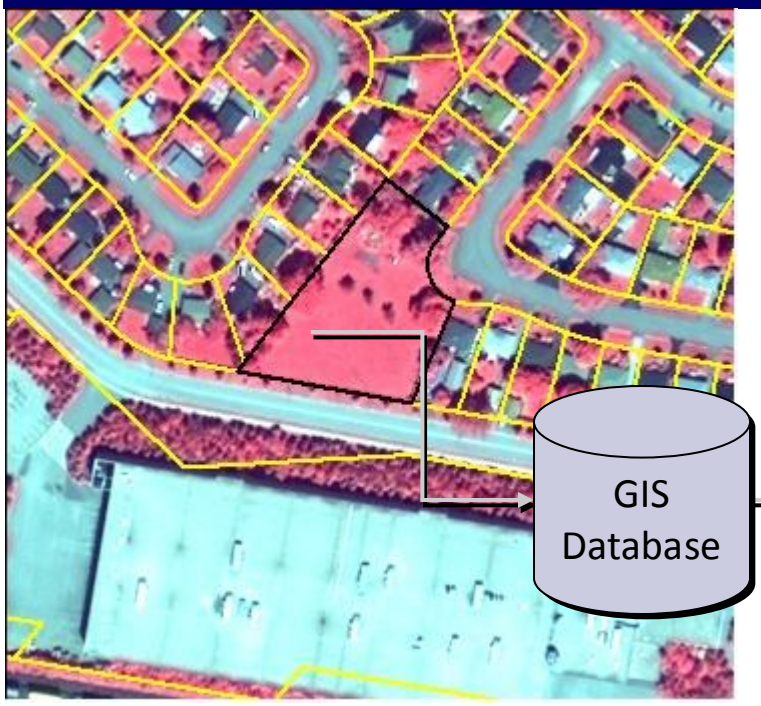


Figure 10. Existing and possible tree canopy summarized by Ward..

Decision Support



Parcel-based TC metrics were integrated into the Community's existing GIS database (Figure 11). Decision makers can use GIS to identify specific TC metrics for a parcel or set of parcels. For example, this information can be used to estimate the amount of tree loss in a planned development or set TC improvement goals for an individual property.

Attribute	Value
Land Use	Other
Roll number	2124090006023000000
Address	148 Stephen Dr
Existing TC	28%
Possible TC	73%
Possible TC—Vegetation	72%
Possible TC—Impervious	1%

Figure 11: GIS-based analysis of parcel-based TC metrics for decision support. In this example, GIS is used to select an individual parcel. The attributes for that parcel, including the parcel-based TC metrics, are displayed in tabular form providing instant access to relevant information.

Conclusions

- Bolton's tree canopy is a vital Community asset that reduces stormwater runoff, improves air quality, reduces the Community's carbon footprint, enhances quality of life, contributes to savings on energy bills, and serves as habitat for wildlife.
- Bolton should consider establishing a TC goal. Such a goal should not be limited to increasing the Community's overall tree canopy; it should also focus on increasing tree canopy in those parcels or blocks that have the least Existing TC and highest Possible TC.
- Land use, Small Geographic Unit, Service Delivery Area, subwatershed and Ward level summaries can be used for targeting tree planting and preservation efforts within different regions of the Community.
- With Existing TC and Possible TC summarized at the parcel level and integrated with the Community's GIS database, individual parcels can be examined and targeted for TC improvement.
- Of particular focus for TC improvement should be parcels within the Community that have large contiguous impervious surfaces. These parcels contribute high amounts of runoff, which degrades water quality. The establishment of tree canopy on these parcels will reduce runoff during periods of peak overland flow.
- Research (Goetz et al., 2003) indicates that for small watersheds 37% tree canopy results in a "fair" stream health rating, and 45% tree canopy results in a stream health rating of "good." Main Humber River and West Humber River are covered by 20% and 6% tree canopy. With greater than 55% and 78% of their total area respectively identified as possible tree canopy future initiatives should work to establish additional tree canopy in an effort to maintain or improve stream health.
- Within the Community's rights-of-way (ROW) there is 14% Existing TC and 31% Possible TC, indicating that there is room for increasing street trees. Accordingly, a "street trees" initiative should be employed to increase tree canopy along roads.
- By ownership type, it is Bolton's residents that control the largest percentage of the Community's tree canopy. Programs that educate residents on tree stewardship and provide incentives for tree planting are crucial if Bolton is going to sustain its tree canopy in the long term.
- While agricultural land use has a high percentage of Possible TC, it may be socially-undesirable to plant trees in these areas. Incentive programs that encourage farmers to plant trees, particularly along riparian corridors, can reduce the impact of agricultural runoff on nearby surface waters.

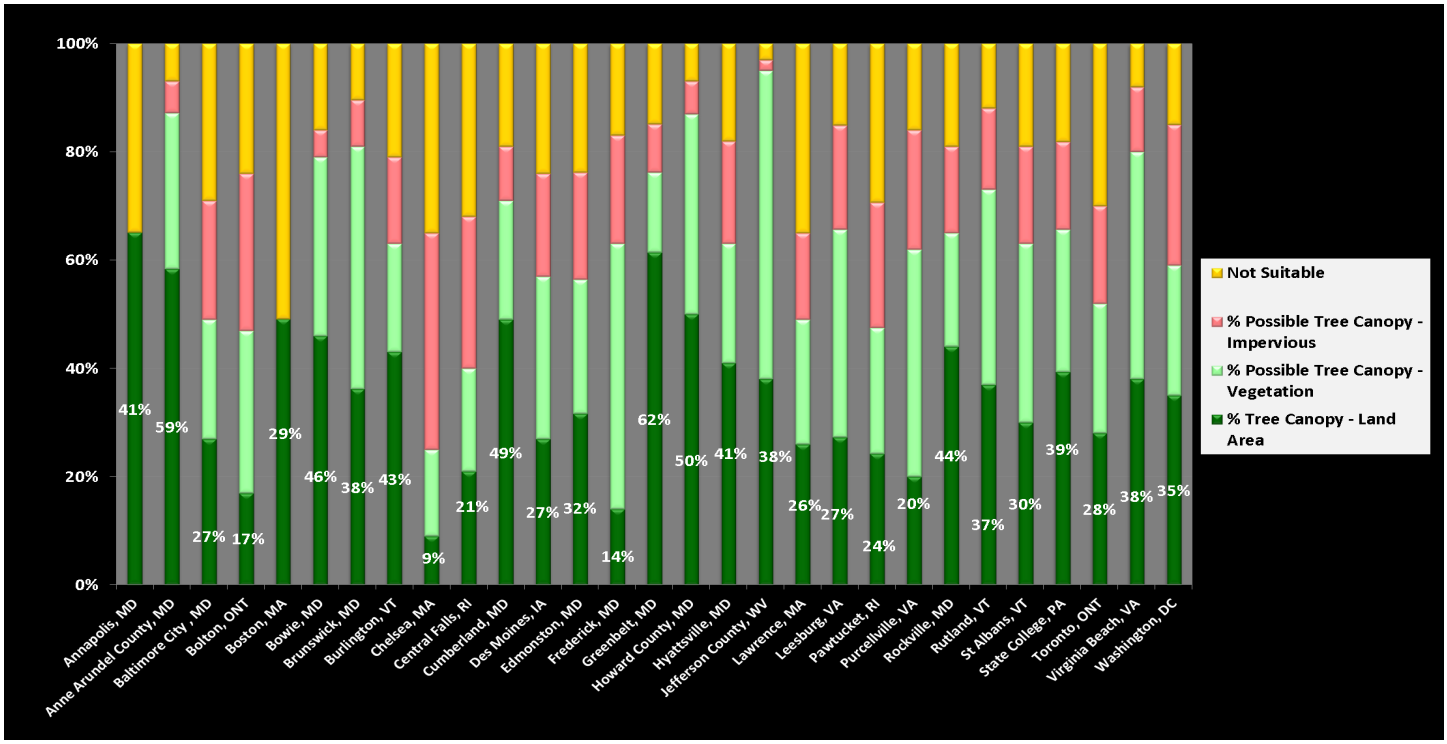


Figure 12: Comparison of tree canopy metrics with other selected cities that have completed TC assessments.

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Additional Information

Funding for this project was provided by TRCA and USDA Forest Service. More information on the TC assessment project can be found at the following web site:
http://nrs.fs.fed.us/urban/TC/