A Report on the Community of Caledon East'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 Caledon East have?

An analysis of Caledon East's tree canopy based on land cover derived from high-resolution QuickBird (DigitalGlobe) satellite imagery (Figure 1) found that more than 140 ha of the community were covered by tree canopy (termed Existing TC) representing 29% of all land in the community. An additional 62% (295 ha) of the community could theoretically be improved (Possible TC) to support tree canopy (Figure 2). In the Possible TC category, 9% (42 ha) of the community were Impervious Possible TC and another 53% were Vegetated Possible TC (253 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.

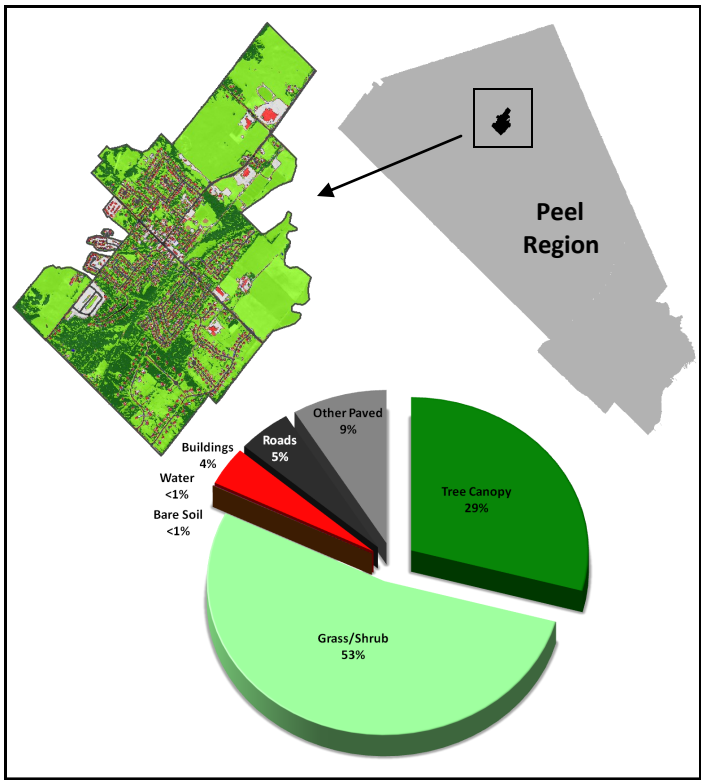


Figure 1: Land cover derived from high-resolution satellite imagery for the Community of Caledon East.

Project Background

The analysis of Caledon East'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 Caledon East. This analysis was conducted based on year 2009 data.

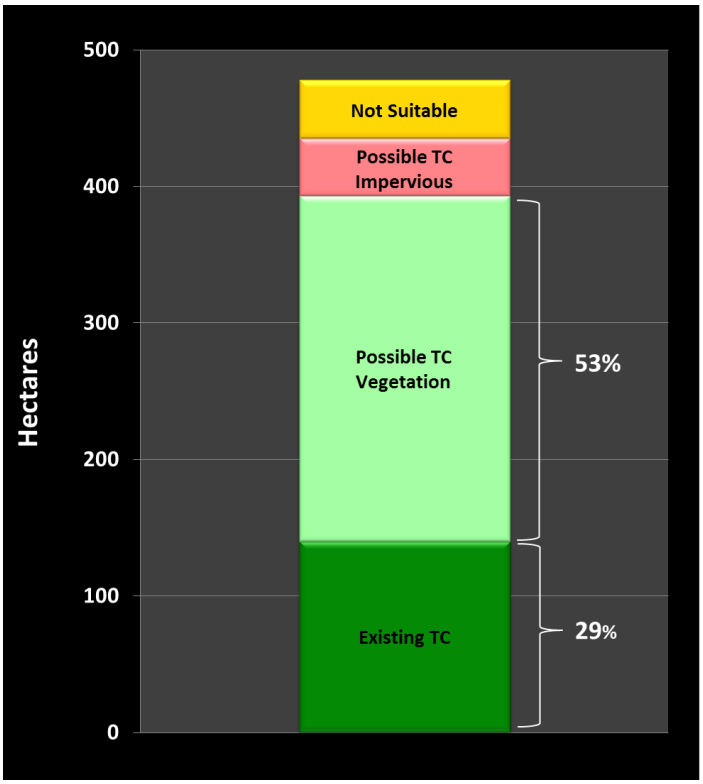


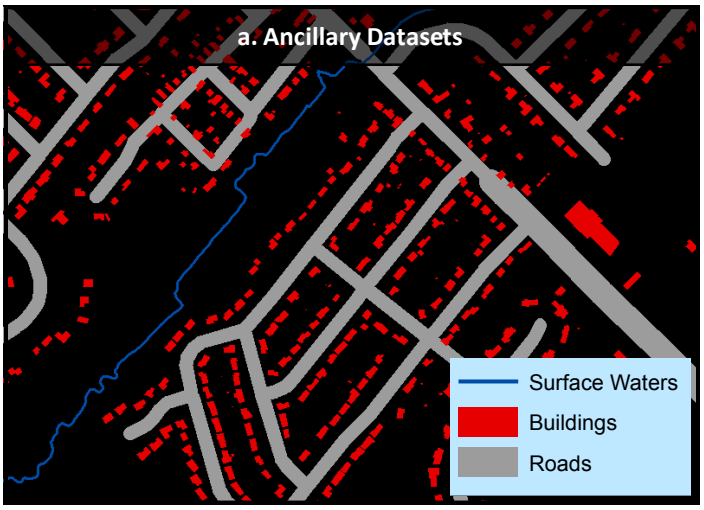
Figure 2: TC metrics for Caledon East based on % of land area covered by each TC type.

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 Caledon East's Trees

Advanced automated processing techniques using high-resolution (0.6 meter) QuickBird imagery 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).





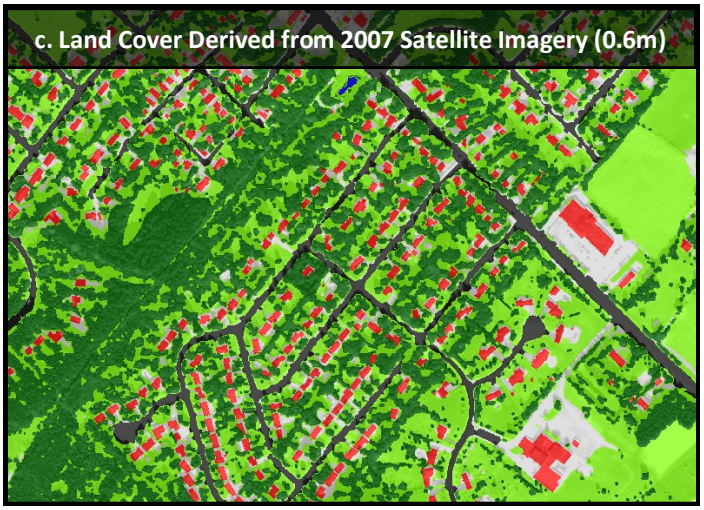


Figure 3a, 3b, 3c: Datasets and imagery used for generating high-resolution land cover.

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).

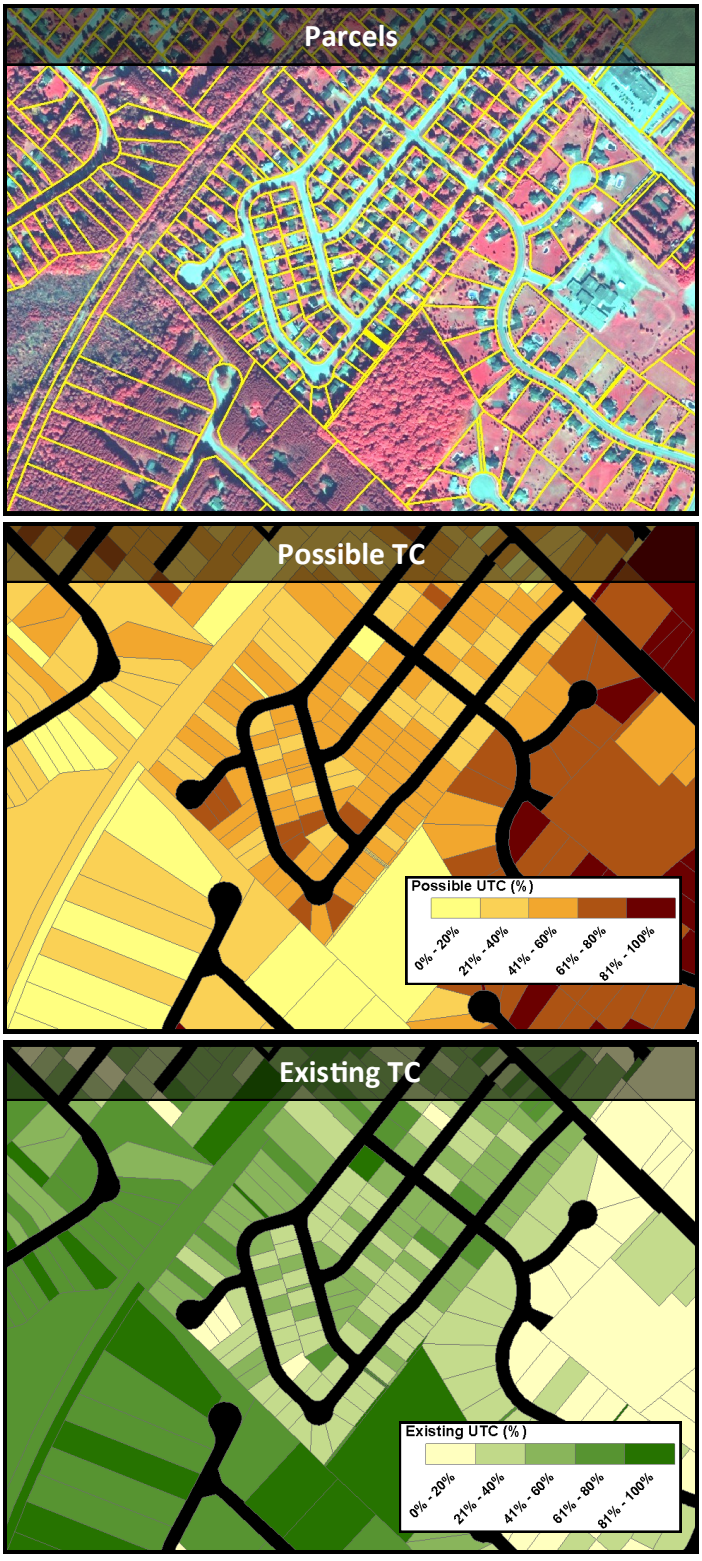


Figure 4: Parcel-based TC metrics. TC metrics are generated at the parcel level, allowing each property to be evaluated according to its Existing TC and Possible TC.

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 Residence Low category had the greatest amount of existing tree canopy (18% of the community's total land area). Agriculture has slightly more Possible TC (25%) than the Residential Low category (21%) relative to the percentage of land area, but the Agriculture category comprises a much larger proportion of Possible TC by category (89%). Natural Cover represents 1.8m^2 of Caledon East and was not included below.

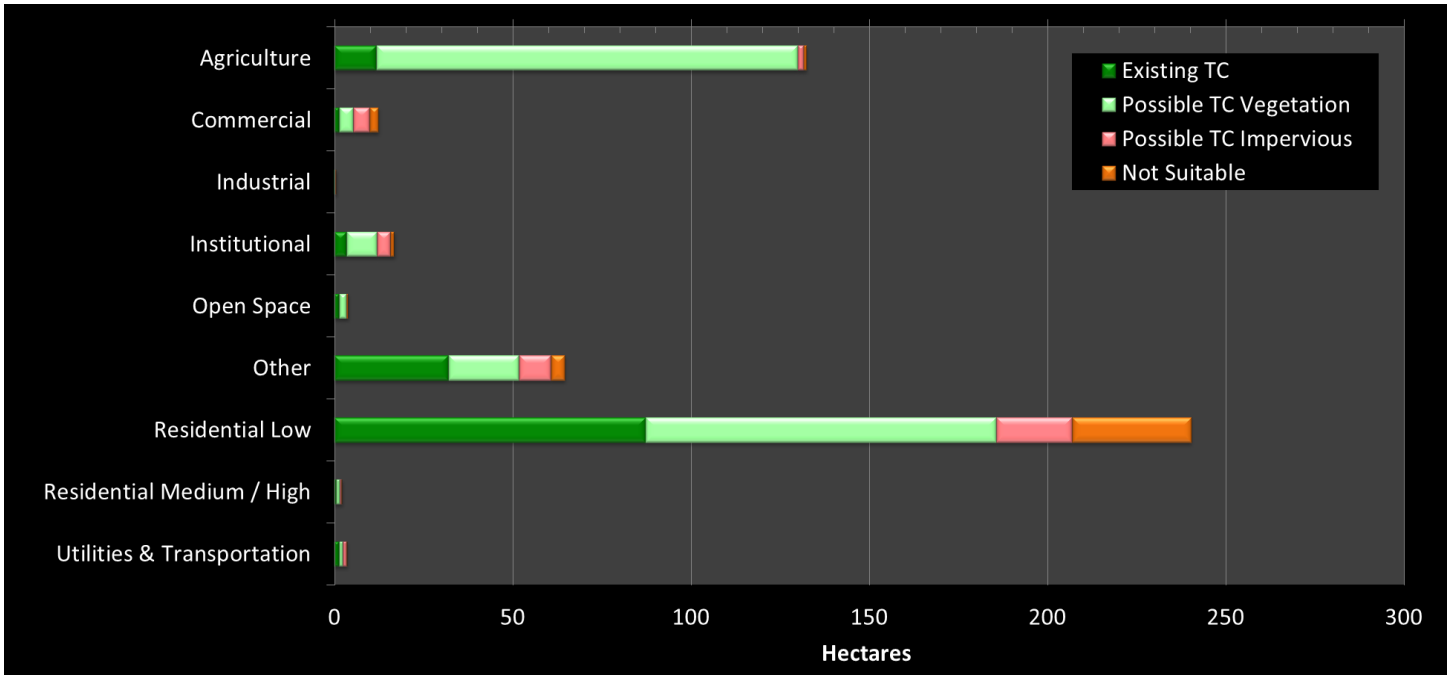


Figure 5: TC metrics summarized by land use category. Natural Cover represents 1.8m^2 of Caledon East and is not included in the above figure.

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	3%	9%	9%	25%	89%	47%	0%	1%	1%
Commercial	0%	11%	1%	1%	32%	2%	1%	37%	2%
Industrial	0%	36%	0%	0%	25%	0%	0%	17%	0%
Institutional	1%	0%	3%	2%	0%	3%	1%	0%	1%
Open Space	0%	35%	1%	0%	54%	1%	0%	2%	0%
Other	7%	49%	23%	4%	31%	8%	2%	14%	4%
Residential Low	18%	36%	63%	21%	41%	39%	4%	9%	8%
Residential Medium / High	0%	31%	1%	0%	44%	0%	0%	17%	0%
Utilities & Transportation	0%	39%	1%	0%	32%	0%	0%	26%	0%

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

The % Land Area value of 18% indicates that 18% of Caledon East's land area is covered by tree canopy in the residential low land use category.

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

The % Land value of 36% indicates that 36% of land in the residential low land use category is covered by tree canopy.

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

The % TC Type value of 63% indicates that 63% of all "existing TC" is classified in the residential low land use category.

Service Delivery Areas

Tree canopy currently exists on 29% (140 ha) of Service Delivery Area C003 while 62% of this area was identified as possible tree canopy (Figure 6).

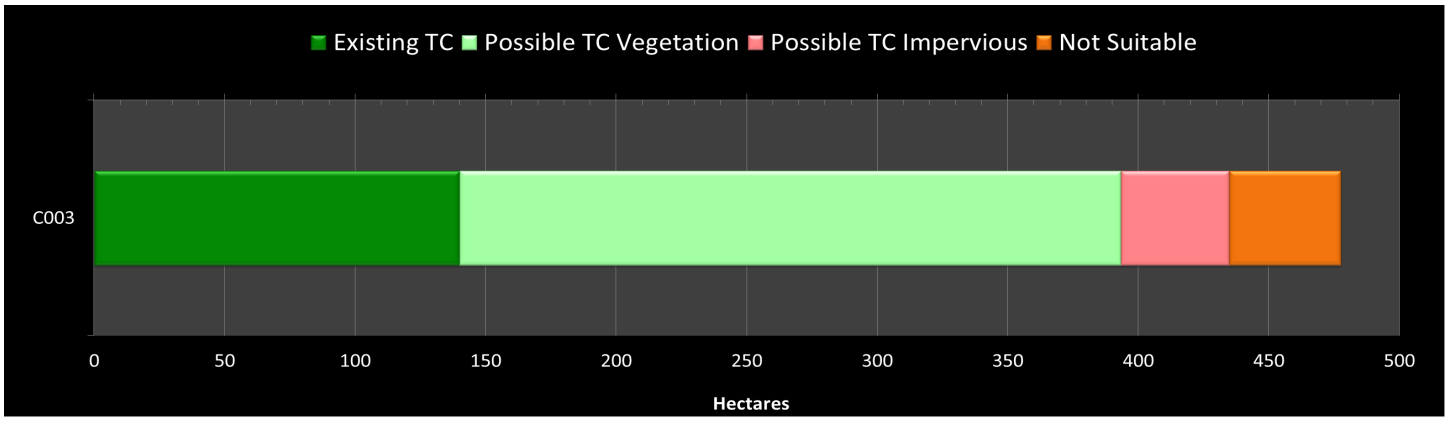


Figure 6: TC metrics summarized for Service Delivery Area C003.

Subwatersheds

TC Metrics were summarized by the Humber River and East Credit River subwatershed boundaries within Caledon East. (Figure 7). The section of the Humber River subwatershed covers 94% (451 ha) of Caledon East compared to East Credit River which covered 6% (26 ha). While Humber River had a larger total land area and % tree canopy by land area (28%), East Credit River had a greater % of the watershed covered by tree canopy (32%) compared to Humber River (29%). Possible UTC for Humber River and East Credit River were similar when compared by % category (62% and 60% respectively).

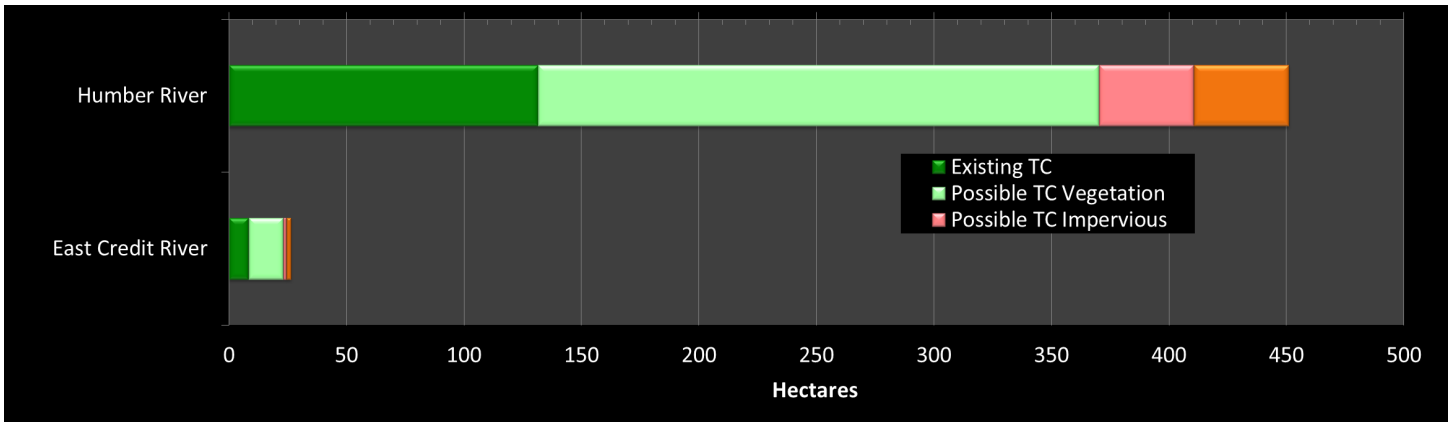


Figure 7: TC metrics summarized by subwatersheds covering Caledon East.

Wards

Tree canopy metrics were summarized by Ward (Figure 8). Ward 3 covers 99% of Caledon East and had the greatest amount of existing tree canopy (29%) and possible tree canopy (61%).

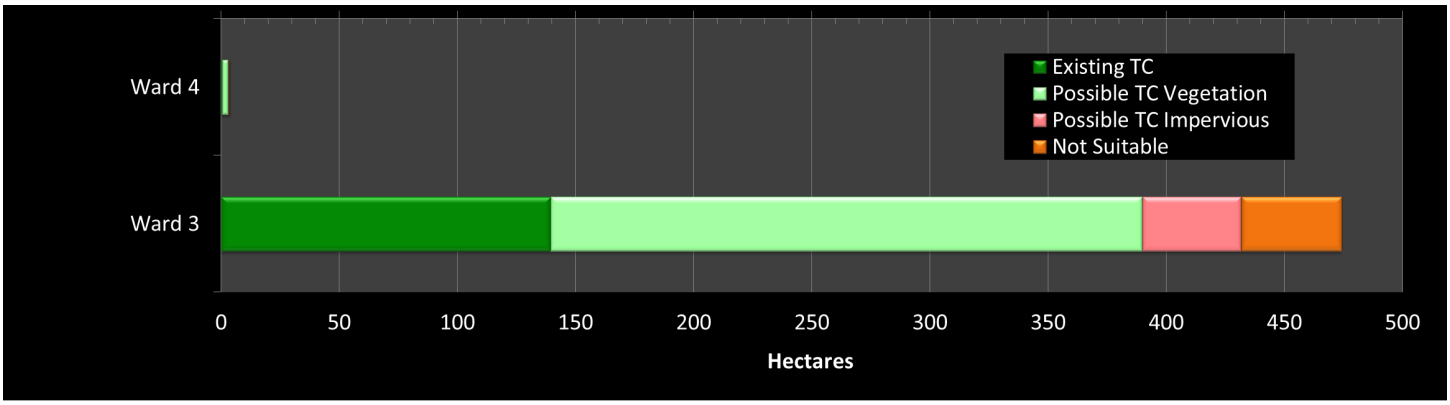


Figure 8. Existing and possible tree canopy summarized by Ward.

Small Geographic Units

Existing and Possible tree canopy were summarized by Small Geographic Units for Caledon East (Figure 9). Small Geographic Unit C0412 had the most existing tree canopy (13%) and possible tree canopy (13%) by land area.

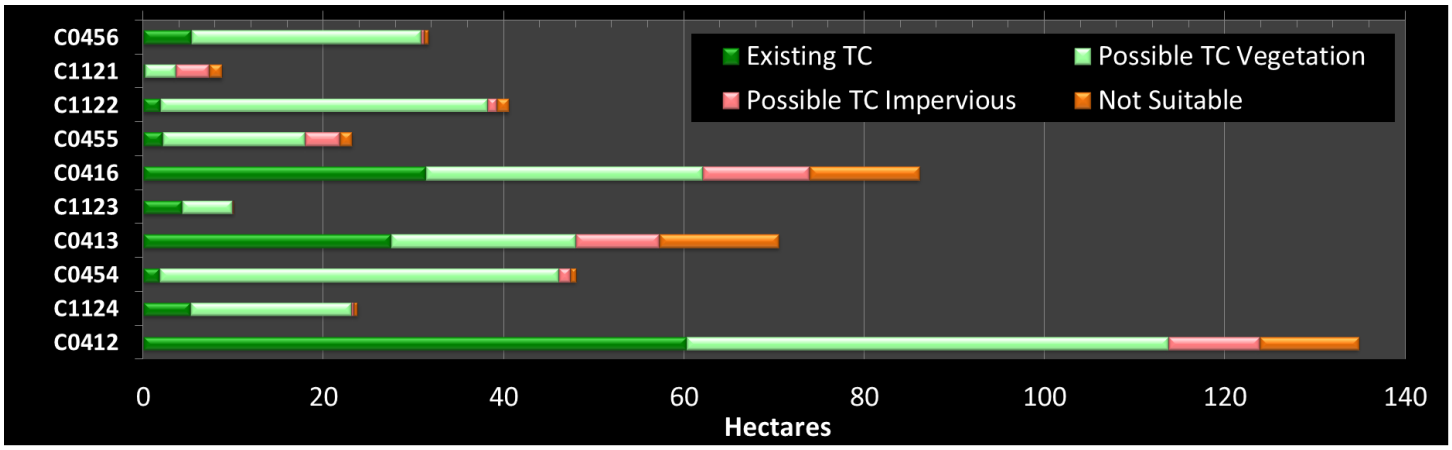


Figure 9. Possible TC (left) and Existing TC (right) as a percentage of land area by Small Geographic Unit boundaries.

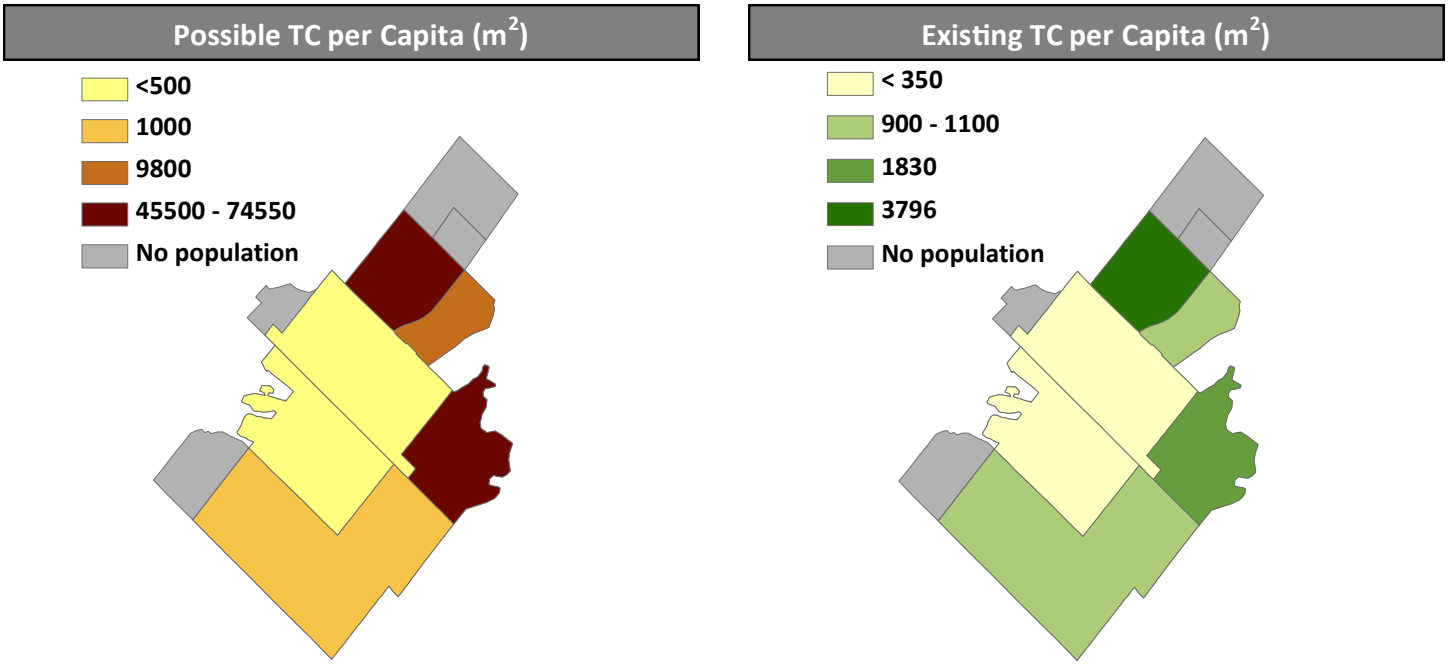
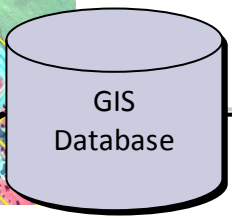


Figure 10. Possible TC and Existing TC per capita based on population of Small Geographic Units.

Decision Support



Parcel-based TC metrics were integrated into the community's existing GIS database (Figure 7). 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	Institutional
Roll number	2124030001061100000
Address	15738 Airport Road
Existing TC	15%
Possible TC	77%

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

- Caledon East'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.
- Caledon East 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 Units 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 (Geotz 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." Humber River and East Credit River are covered by 32% and 28% tree canopy, but have greater than 60% of the total area identified as possible tree canopy. Future initiatives should work to preserve and establish tree canopy within these subwatersheds in an effort to maintain or improve stream health.
- Within the community's rights-of-way (ROW) there is 18% Existing TC and 32% Possible TC, indicating that there is room for increasing street trees. Accordingly, a "street trees" initiative should be employed to increase tree canopy in along roads.
- By ownership type, it is Caledon East'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 Caledon East is going to sustain its tree canopy in the long term.
- With Existing and Possible tree canopy per capita based on Small Geographic Units it is possible to explore relationships between socio-economic data and tree canopy such as issues of environmental justice and implement programs to enhance or maintain tree canopy in these areas.

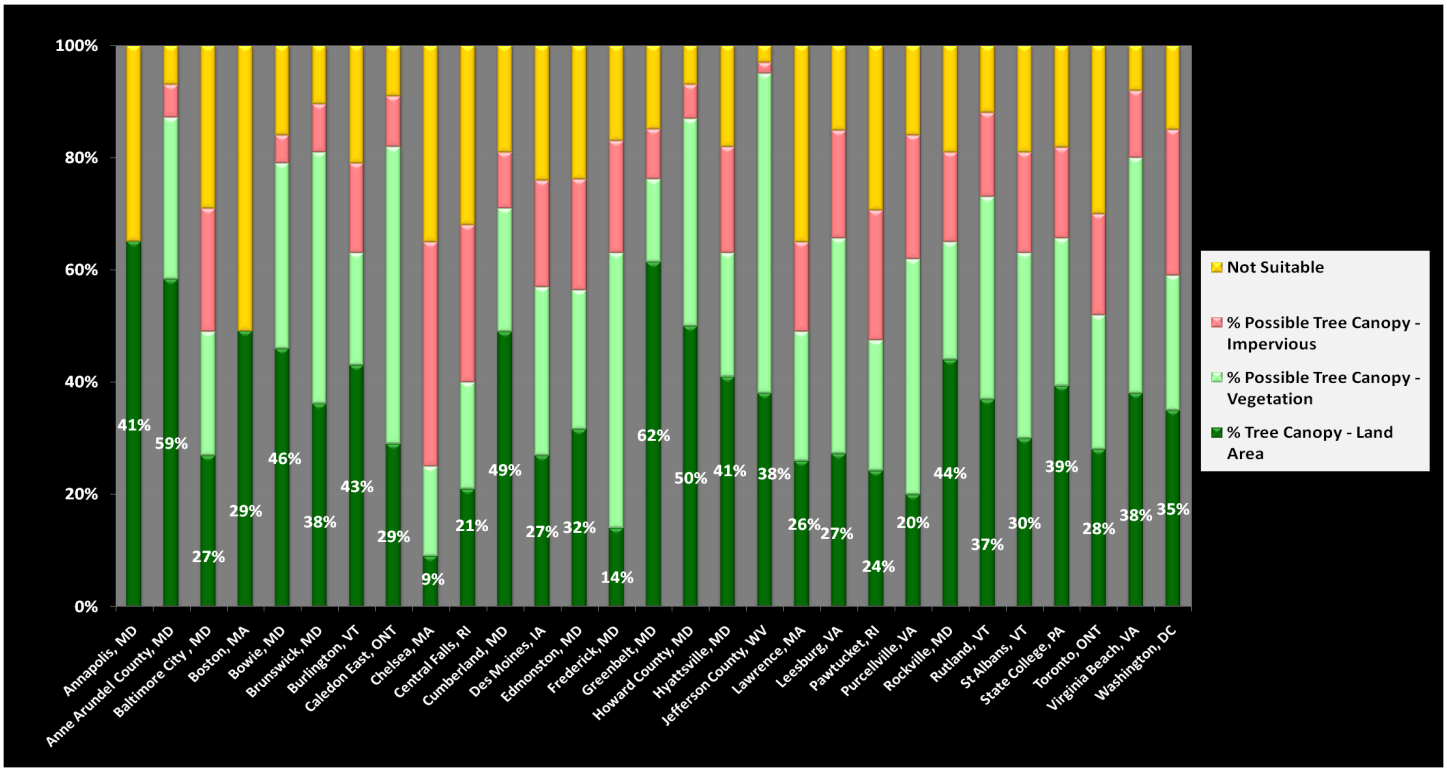


Figure 12: Comparison of tree canopy metrics with other selected cities that have completed TC assessments.

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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/