A Report on the City of Burlington's Existing and Possible Urban Tree Canopy

Summary

An analysis of Burlington's urban tree canopy (UTC) using a top down approach based on high resolution imagery found that 2648 acres of Burlington is covered by tree canopy (termed Existing UTC). This corresponds to 39% of the City of Burlington and 43% of the city's land area (land area refers to all areas not occupied by water or wetland). An additional 36% (2198 acres) of Burlington could conceivably be covered by urban tree canopy (termed Possible UTC).

The majority of Burlington's Existing UTC (39% of the land area, 1028 acres) is located in areas of residential land use. Residential land also contains most of the Possible UTC (34% of the land area, 745 acres).

UTC enhancement can be most efficiently realized by maximizing protection and maintenance in combination with new plantings and natural regeneration.

The impacts of setting a UTC goal will likely include focusing or reallocating public agency resources (funds, staff, etc.) to enhance UTC urban open land. On private lands, a combination of education and outreach, landowner and redevelopment incentives, and refocusing of regulatory mechanisms to specifically achieve the objectives of the UTC goal will likely be required.

Project Background

The analysis of Burlington's urban tree canopy (UTC) was carried out by the Spatial Analysis Laboratory (SAL) of the University of Vermont's Rubenstein School of the Environment and Natural Resources and USDA Forest Service's Northern Research Station at the request of the City of Burlington and was done in collaboration with the Vermont Department of Forest, Parks and Recreation's Urban and Community Forestry Program.

The goal of the project was to apply the USDA Forest Service's UTC assessment protocols to the City of Burlington. The UTC assessment protocols rely on land cover information extracted from high resolution remotely sensed. When used in combination with GIS datasets to compute the Existing UTC and Possible UTC at the property parcel level.

This project sought to leverage existing investments in geospatial data made by the city to enable the analysis to be completed with minimal cost.

Development of a High Resolution Land Cover Dataset

The need for high resolution land cover

Land cover datasets lack both the accuracy and the resolution to effectively map tree canopy in urban areas. The National Land Cover Dataset's (NLCD) tree canopy layer in very valuable for regional analysis but with a relatively coarse resolution (30 meters) fails to compute much of the tree canopy in the urban forest (Figure 1).

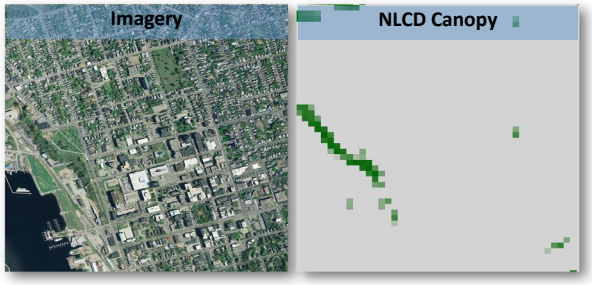

Figure 1: NLCD 2001 Canopy comparison

Capitalizing on existing data investments

In 2004 the City of Burlington participated in the Chittenden County Metropolitan Planning Organization's (CCMPO) purchase of high resolution imagery and high resolution elevation data (know as LIDAR). Leveraging this existing investment in high quality data automated feature extraction technology, a sub-meter, seven class land cover map was created at a fraction of what it would cost to map it manually (Figure 2). This detailed assessment enabled the compilation of city-wide land cover (Figure 3) and parcel based UTC metrics.

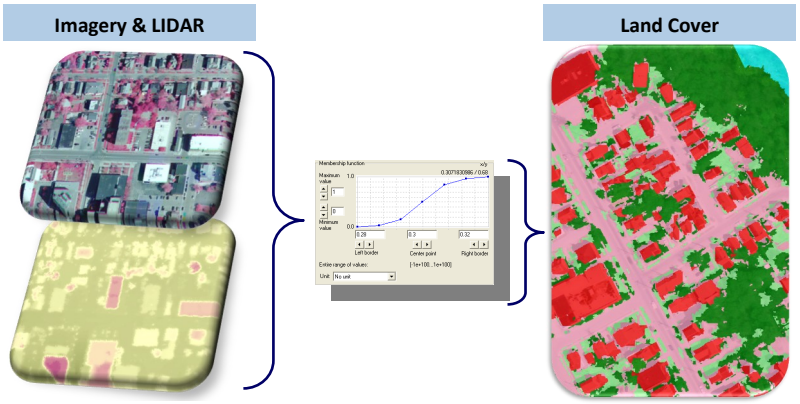

Figure 2: Automated land cover mapping steps

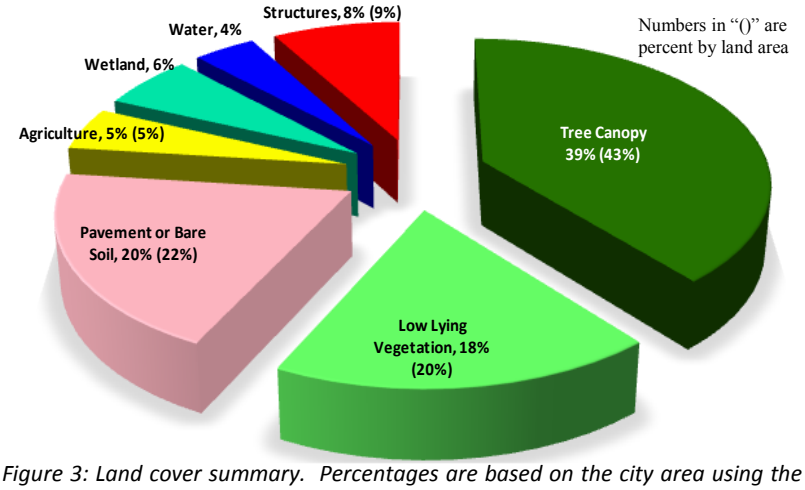

Figure 3: Land cover summary. Percentages are based on the city area using the city shoreline boundary that excludes Lake Champlain. Values in "()" represent the percent based on the city's land area (water and wetland are excluded).

Existing and Possible UTC

UTC metrics for the City of Burlington were computed using the UTC assessment protocols. The UTC protocols integrate the land cover layer with existing GIS datasets from the City's database.

Existing UTC was computed by simply summarizing the tree canopy land cover class. Two types of Possible UTC were computed: Possible UTC (Vegetation) and Possible UTC (Impervious/Bare Soil). Possible UTC (Vegetation) was computed by finding all areas in the land cover layer identified as "low lying vegetation." Possible UTC (Vegetation) excludes all wetland and agricultural vegetation. Possible UTC (Impervious/Bare Soil) was computed by summarizing all land cover in the "pavement/bare soil" category excluding the roadways. It is typically easier to increase tree canopy on Possible UTC (Vegetation) as compared to Possible UTC (Impervious/Bare Soil) areas.

Parcel & Land Use Summary

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

Using the land use information associated with each parcel UTC metrics were summarized by land use category (Figure 5). Table 1 shows how for each land use category UTC metrics were computed as a percent of all land within the particular land use category (% Land Use), as a percent of the UTC type (% UTC Type) and as a percent of the area of all land (% Land Area). % Land Use allows for comparison of Existing UTC and Possible UTC in a given land use class while % UTC Type allows the relative contribution of a land use category to either the Existing or Possible UTC.

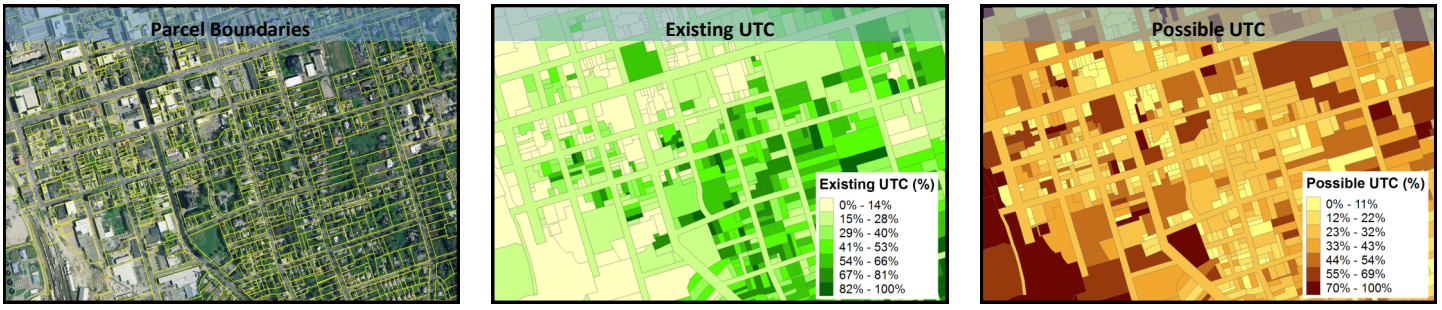

Figure 4: Parcel-based UTC metrics

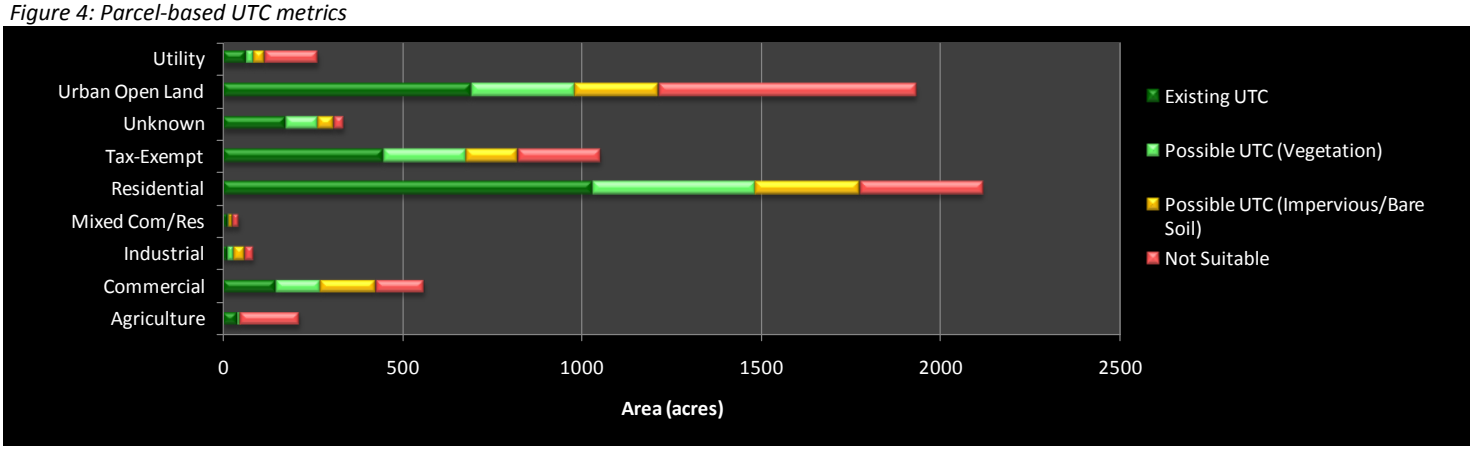

Figure 5: UTC metrics summarized by land use

LandUse	Existing UTC			Possible UTC (Vegetation)			Possible UTC (Impervious/Bare Soil)		
	% Land Area	% Land Use	% UTC Type	% Land Area	% Land Use	% UTC Type	% Land Area	% Land Use	% UTC Type
Agriculture	1%	19%	2%	0%	3%	0%	0%	1%	0%
Commercial	2%	27%	6%	2%	22%	10%	2%	27%	16%
Industrial	0%	16%	1%	0%	22%	1%	0%	37%	3%
Mixed Com/Res	0%	27%	0%	0%	7%	0%	0%	28%	1%
Residential	16%	49%	39%	7%	21%	36%	4%	14%	31%
Tax-Exempt	7%	42%	17%	3%	22%	19%	2%	14%	15%
Unknown	3%	53%	7%	1%	26%	7%	1%	13%	5%
Urban Open Land	10%	36%	26%	4%	15%	24%	4%	12%	25%
Utility	1%	24%	2%	0%	8%	2%	0%	12%	3%

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

The % Land Area value of 16% for Existing UTC residential land indicates that 16% of Burlington's land area (excluding water and wetland) is residential tree canopy.

$$\% \text{ Land Use} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all land for specified land use}}$$

The % Land Use value of 49% for Existing UTC residential land indicates that 49% of residential land is covered by tree canopy.

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

The % UTC Type value of 39% for Existing UTC residential land indicates that 39% of Existing UTC lies in residential land use.

Table 1: UTC metrics by type, summarized by land use

Results

- 43% of Burlington's land area (excludes water and wetland) is covered by tree canopy (Existing UTC) that encompasses 2648 acres.
- 36% (2198 acres) of the land area in the city is not a road a structure or being used for agriculture, and thus could conceivably support tree canopy. This Possible UTC is almost evenly split between impervious surfaces/bare soil and low-lying vegetation.
- The majority of land in Burlington (32%) falls into the residential category. Residential land has a relatively high percentage of Existing UTC, with 49% of all residential land covered by tree canopy. 36% of residential land can be classified as Possible UTC.
- Burlington's second largest land use type, urban open land, accounts for 26% of the city's land use base. Urban open land is primarily composed of the rights-of-way along roads, some parks, institutional land (e.g. UVM, school grounds), and open space (e.g. Starr Farm). Although only 36% of urban open land is Existing UTC, only 27% of the urban open land can be considered to be Possible UTC. Within the ROW, 20% is Existing UTC and 1% is Possible UTC (Possible UTC does not account for the UTC that could overhang a road).
- Commercial and industrial land have noticeably low amounts of Existing UTC (27% and 16% respectively) and high proportions of Possible UTC (49% and 59%) respectively. Unlike residential land where the majority of Possible UTC is low-lying vegetation, on commercial and industrial land it is impervious surfaces (Figure 7).

Conclusions

1. Investments in remotely sensed data such as the imagery and LIDAR acquired as part of the CCMPO purchase in 2004 provide a robust database for assessing Burlington's natural resources. National level land cover datasets underestimated Burlington's Existing UTC by 17 percentage points.
2. This report presents broad generalizations. With Existing UTC and Possible UTC summarized at the parcel level and integrated with the City's GIS database, individual parcels and groups of parcels can be examined and targeted for UTC improvement.
3. Burlington's urban tree canopy is a vital city asset; enhancing quality of life, reducing the city's carbon footprint, and serving as habitat for wildlife. Burlington has room to increase its UTC through a combination of maintenance, tree plantings, and natural regeneration.
4. Although residential land appears to be built-out with respect to tree canopy, analysis of individual parcels shows that there are a number of properties that have very low amounts of Existing UTC. Incentives or educational initiatives could be employed to encourage these members of the community to increase UTC on their properties.
5. Tree plantings in Burlington's ROW (street trees), should be continued due to the numerous benefits they afford, but street tree plantings alone will not be able to substantially increase the UTC in Burlington. Large parcels of land with high Possible UTC that are owned by the government or institutions will likely offer the best opportunities for UTC enhancement.
6. The relatively low amount of Existing UTC combined with the high Possible UTC in commercial and industrial areas indicates that there is a considerable need to green these land use types. Increasing the UTC on industrial and commercial land could help to fragment the connected impervious surfaces and improve water quality and aesthetics. This is particularly important given the proximity of some these highly impervious parcels to Lake Champlain.

Figure 6: Urban open land with a large amount of Possible UTC in the low lying vegetation category.

Figure 7: Industrial land with a large amount of Possible UTC in the impervious category

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