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

Why is Tree Canopy Important?

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

How Much Tree Canopy Does Bowie Have?

An analysis of Bowie's urban tree canopy (UTC) based on land cover derived from high resolution aerial imagery (Figure 1) found that more than 5099 acres of the city is covered by tree canopy (termed Existing UTC) representing 46% of all land in the city. An additional 38% (4268 acres) of the city could theoretically be improved (Possible UTC) to support tree canopy (Figure 2). Of the areas for Possible UTC, 5% (552 acres) of the city is Impervious Possible UTC and another 33% is Vegetated Possible UTC. Vegetated Possible UTC or grass and shrub areas are much easier for establishing new tree canopy while establishing tree canopy on Impervious Possible UTC will have a greater impact on water quality.

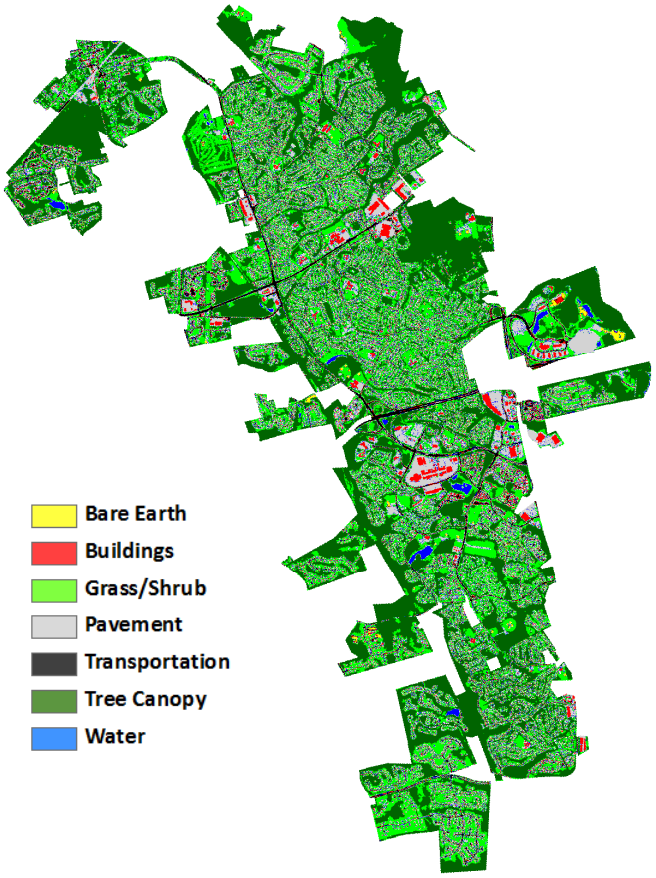

Figure 1: Land cover derived from high resolution aerial imagery for the City of Bowie.

Key Terms

UTC: Urban tree canopy (UTC) 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 UTC: The amount of urban tree canopy present when viewed from above using aerial or satellite imagery.

Possible UTC: The amount of land that is theoretically available for the establishment of tree canopy. Possible UTC excludes areas covered by tree canopy, roads, buildings, and water.

Project Background

The analysis of Bowie's urban tree canopy (UTC) was carried out at the request of the Maryland Department of Natural Resources in collaboration with the City of Bowie. 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 UTC assessment protocols to the City of Bowie. This analysis was conducted based on year 2007 data.

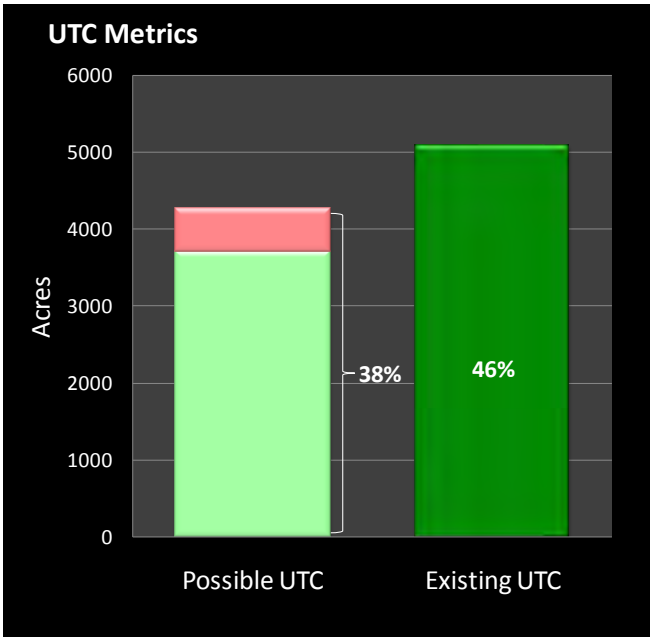

Figure 2: UTC metrics for Bowie based on % of land area covered by each UTC type.

Mapping Bowie's Trees

Prior to this study the only available estimates of tree canopy for Bowie were from the 2001 National Land Cover Dataset (NLCD 2001). While NLCD 2001 is valuable for analyzing land cover at the regional level, it is derived from relatively coarse, 30 meter resolution satellite imagery (Figure 3a). Using high-resolution (1 meter) aerial imagery acquired in the summer of 2007 (Figure 3b), in combination with advanced automated processing techniques, land cover for the city was mapped with such detail that single trees were detected (Figure 3c). NLCD 2001 estimated the city to have only 29% tree canopy, compared to the actual amount of 46%.

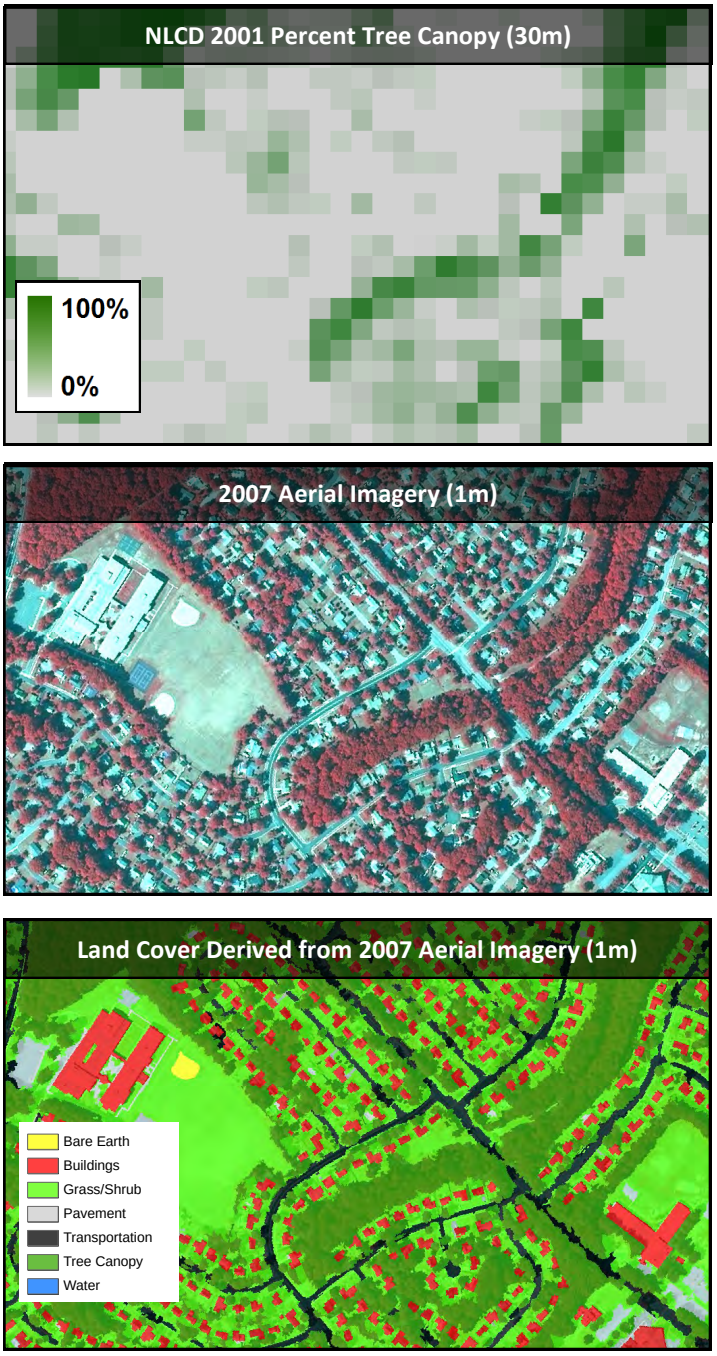

Figure 3a, 3b, 3c: Comparison of NLCD 2001 to high-resolution land cover.

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 area of Existing and Possible UTC was computed along with the percent of Existing UTC and Possible UTC (UTC area / area of the parcel).

An updated land use layer was generated using the city's parcel's layer in combination with the 2007 aerial imagery. This land use layer was used to summarize UTC by land use category (Figure 4). For each land use category UTC metrics were computed as a percentage of all land in the city (% Land), as a percent of land area by zoning land use category (% Category) and as a percent of the area for the UTC type (% UTC Type). For example, land designated as "housing" has the most Existing UTC in raw acreage (29% by % Land), but in terms of the percent of the land use type occupied by tree canopy, land designated for "culture and recreation" (60% by % Category) has the most (Table 1).

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

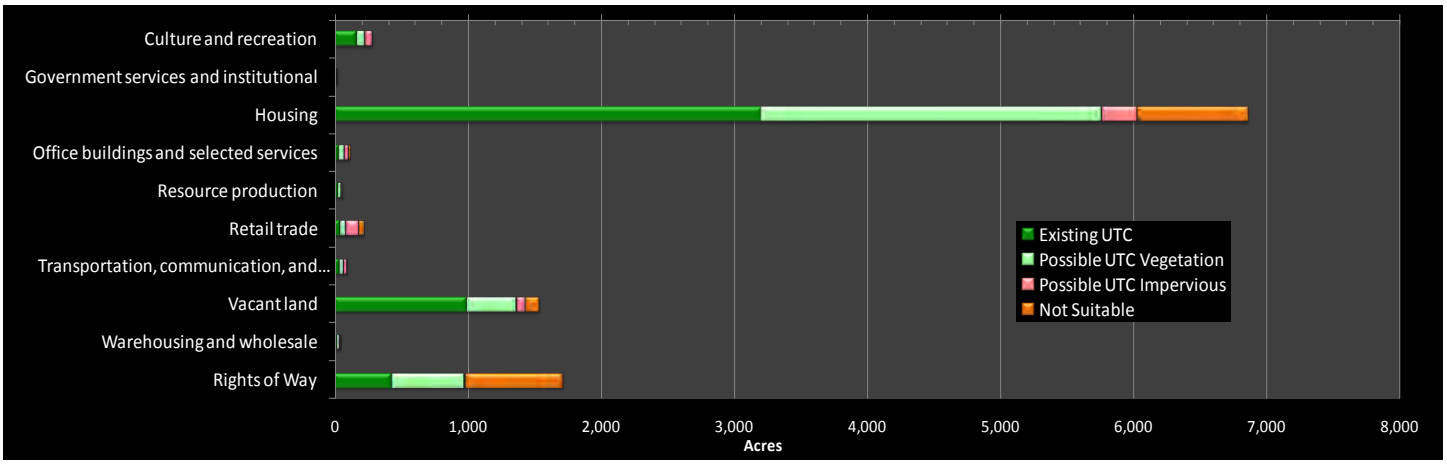

Figure 5: UTC metrics summarized by parcel land use.

Land Use	Existing UTC			Possible UTC Vegetation			Possible UTC Impervious		
	% Land	% Category	% UTC Type	% Land	% Category	% UTC Type	% Land	% Category	% UTC Type
Culture and recreation	2%	60%	4%	1%	20%	2%	0%	19%	2%
Government services and institutional	0%	38%	0%	0%	43%	0%	0%	2%	0%
Housing	29%	47%	70%	23%	37%	81%	2%	4%	9%
Office buildings and selected services	0%	31%	1%	0%	31%	1%	0%	23%	1%
Resource production	0%	45%	1%	0%	43%	1%	0%	7%	0%
Retail trade	0%	20%	1%	0%	20%	1%	1%	42%	3%
Transportation, communication, and utilities	0%	38%	1%	0%	34%	1%	0%	21%	1%
Vacant land	9%	65%	22%	3%	24%	12%	1%	4%	2%
Warehousing and wholesale	0%	49%	1%	0%	28%	0%	0%	11%	0%
Rights of Way	4%	25%	10%	5%	32%	17%	0%	0%	0%

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

The % Land Area value of 29% indicates that 29% of Bowie's land area is tree canopy in areas where the land use is "housing."

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

The % Land Use value of 47% indicates that 47% of "housing" 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 70% indicates that 70% of all Existing UTC lies in areas of "housing" land use.

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

Decision Support

The parcel-based UTC metrics were integrated into the city's existing GIS database. Decision makers can use GIS to find out specific UTC metrics for a parcel or set of parcels. This information can be used to estimate the amount of tree loss in a planned development or set UTC improvement goals for an individual property.

Attribute	Value
Parcel ID	7513
Land Use	Housing
Legal Square Footage	122,687.1
Existing UTC Area	6,038.6
Existing UTC	5%
Possible UTC Area	106,239.8
Possible UTC	87%
Possible UTC - Vegetation	58%
Possible UTC - Impervious	29%

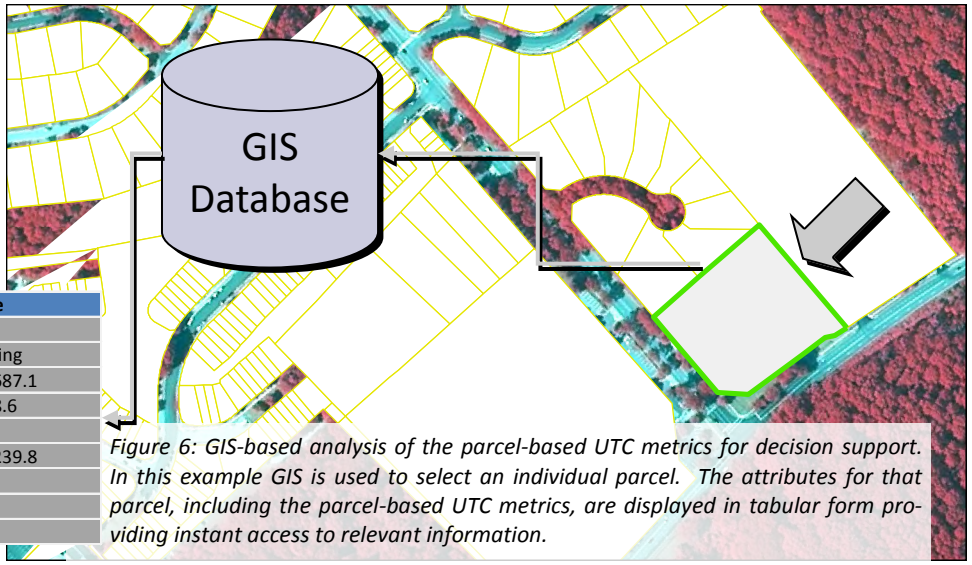

Figure 6: GIS-based analysis of the parcel-based UTC metrics for decision support. In this example GIS is used to select an individual parcel. The attributes for that parcel, including the parcel-based UTC metrics, are displayed in tabular form providing instant access to relevant information.

Conclusions

- Bowie's urban tree canopy is a vital city asset; reducing storm-water runoff, improving air quality, reducing the city's carbon footprint, enhancing quality of life, contributing to savings on energy bills, and serving as habitat for wildlife.
- Occupying 46% of the city's land area, Bowie clearly has above average tree canopy, both in the state of Maryland and in comparison to cities of similar size.
- Given the city's relatively high amount of tree canopy the city's chief challenge will be preserving its trees and forests for future generations though maintenance and regeneration.
- Bowie should consider establishing a UTC goal. Such a goal should not be limited to increasing the city's overall tree canopy, it should focus on increasing tree canopy in those parcels or blocks that have the least Existing UTC and highest Possible UTC. This targeted effort can be performed using the UTC parcel database that was produced as part of this assessment.
- Existing tree canopy is relatively low in rights-of-ways (4%). Thus a "street trees" initiative should be employed to increase tree canopy in these areas.
- With Existing UTC and Possible UTC summarized at the parcel level and integrated with the City's GIS database, individual parcels and subdivisions can be examined and targeted for UTC improvement.
- Of particular focus for UTC improvement should be parcels within the city that have large contiguous impervious surfaces. These parcels contribute high amounts of runoff, degrading water quality. The establishment of tree canopy on these parcels will help to reduce runoff during periods of peak overland flow.
- By ownership type, it is Bowie's residents that control the largest percentage of the city's tree canopy. Programs that educate residents on tree stewardship and incentives provided to residents that plant trees are crucial if Bowie is going to sustain its tree canopy in the long term.
- Increases in UTC will be most easily achieved on vacant land, governmental land, and in the rights of way. These land uses have a relatively high percentage of Possible UTC and these are lands where the City can most readily implement policy.
- Parcels where the land use is "retail trade" have a disproportionately low amount of their land covered by tree canopy (0%). Incentive or regulatory measures should be employed to encourage retailers to increase tree canopy on their property. This will improve water quality, and according to one study, improve business.

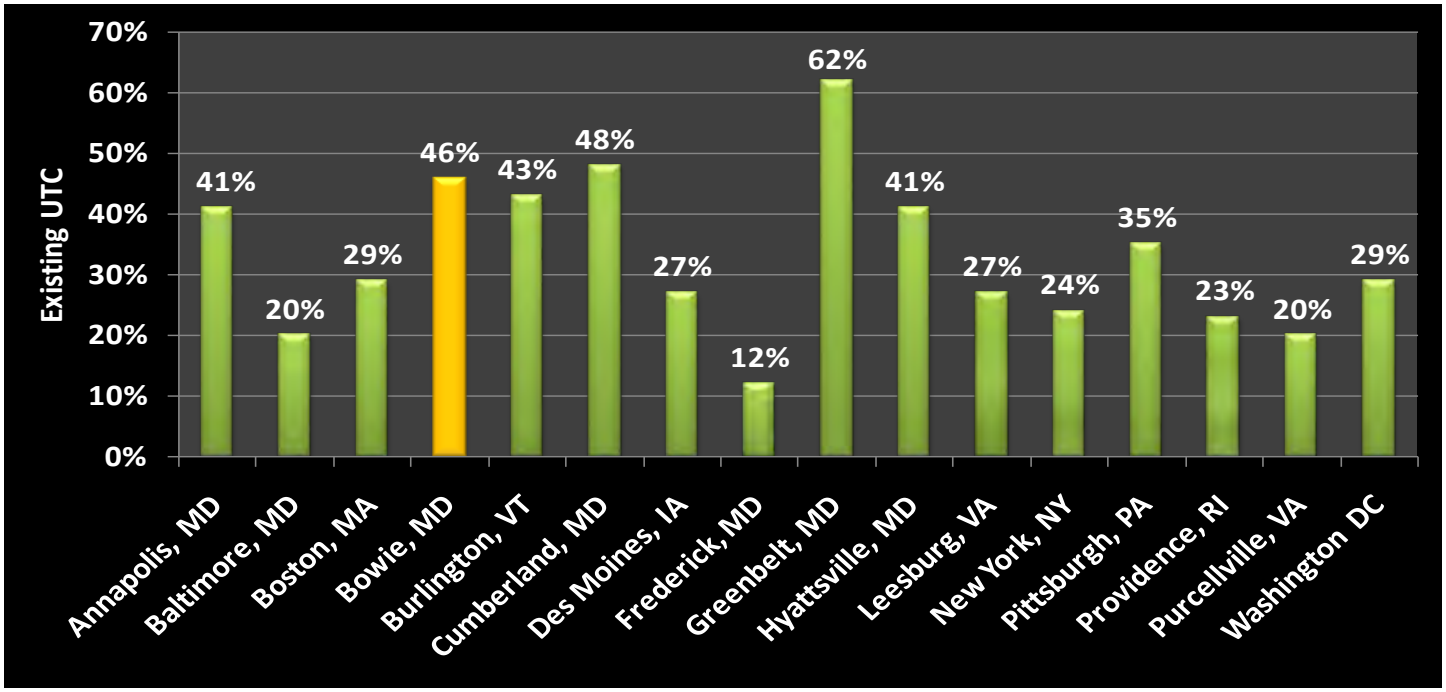

Figure 7: Comparison of Existing UTC with other selected cities that have completed UTC assessments.

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Additional Information

The study was conducted with funding from the Maryland Department of Natural Resources. More information on the UTC assessment project can be found at the following web site.