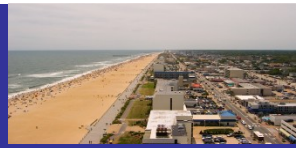
A Report on the City of Virginia Beach, Virginia's Existing and Possible Urban Tree Canopy



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 crucial for 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 theoretically could be established (Possible UTC), is the first step in the UTC goal-setting process.

How Much Tree Canopy?

Based on land cover derived from high-resolution aerial imagery (Figure 1), an analysis of Virginia Beach's urban tree canopy found that more than 58,290 acres of the city were covered by Existing UTC, representing 38% of all land in the city. An additional 53% (82,406 acres) of the city could theoretically be improved (Possible UTC) to support tree canopy (Figure 2). Of the areas for Possible UTC, 11% (17,873 acres) of the city was Possible UTC Impervious and another 42% (64,533 acres) was Possible UTC Vegetation. Possible UTC Vegetation, which includes grass and shrub areas, is more conducive to tree-canopy establishment but expanded tree canopy on Possible UTC Impervious will have a greater impact on water quality.

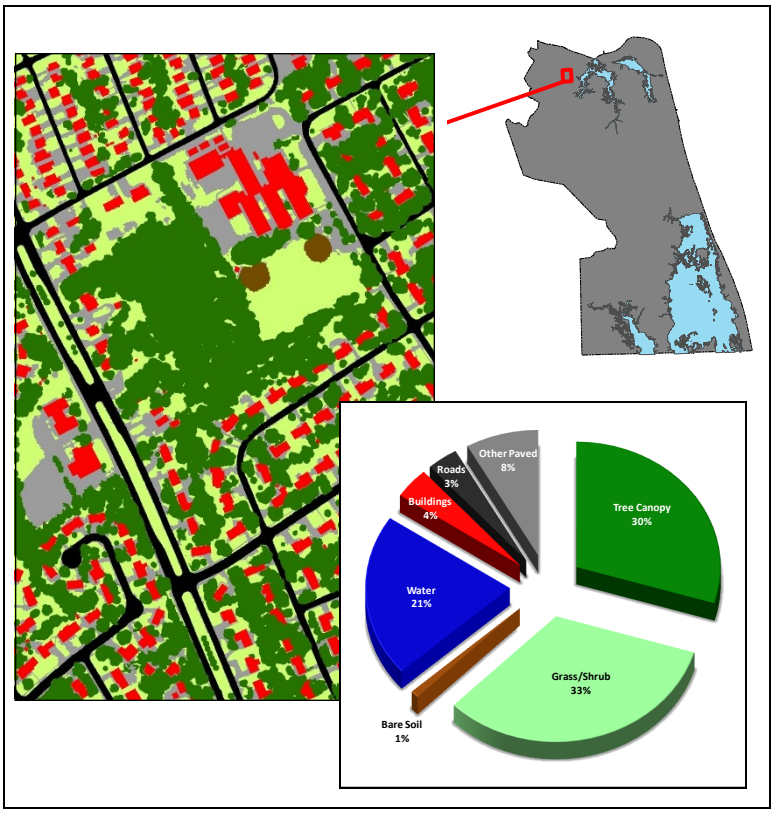


Figure 1: Land-cover classes were derived from high-resolution satellite imagery and then the percentage of each class was calculated for the entire City of Virginia Beach.

Project Background

The analysis of Virginia Beach's urban tree canopy (UTC) was carried out in collaboration with the City of Virginia Beach Department of Parks and Recreation. 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 Virginia Beach. This analysis was conducted based on year 2008 data.

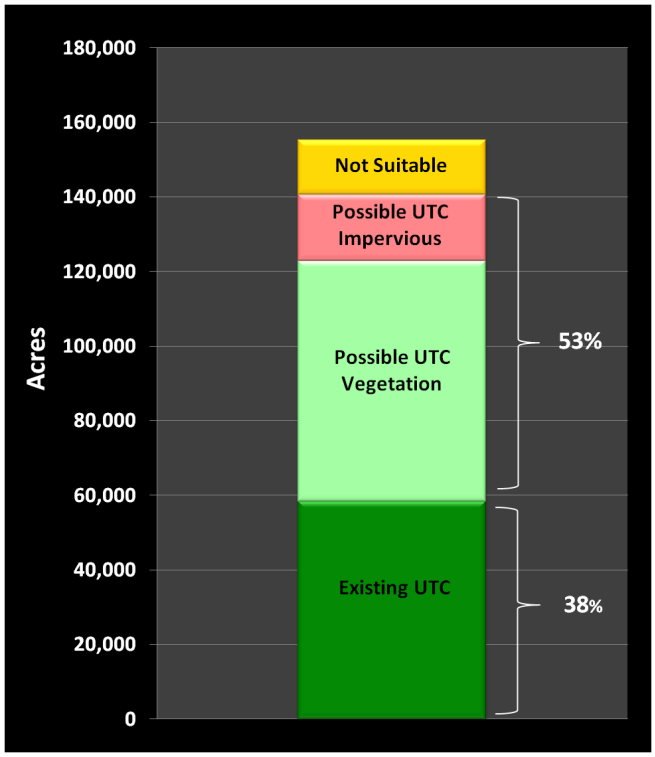


Figure 2: UTC metrics for Virginia Beach based on % of land area covered by each UTC type.

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.
UTC Metrics: UTC summaries (see below) based on various geographies such as parcels or neighborhoods.
Existing UTC: The amount of urban tree canopy present when viewed from above using aerial or satellite imagery.
Possible UTC Impervious: Asphalt or concrete surfaces, excluding roads and buildings, that are theoretically available for the establishment of tree canopy.
Possible UTC Vegetation: Grass or shrub area that is theoretically available for the establishment of tree canopy.

Mapping Virginia Beach's Trees

Prior to this study, the only available estimates of tree canopy for Virginia Beach 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 (3.28ft) aerial imagery acquired in the summer of 2008 (Figure 3b), in combination with 2-ft resolution LiDAR digital surface data from 2004, land cover for the city was mapped with such detail that single trees were detected (Figure 3c). These methods produced a city-wide estimate of 38% UTC while NLCD estimated only 17% tree canopy.

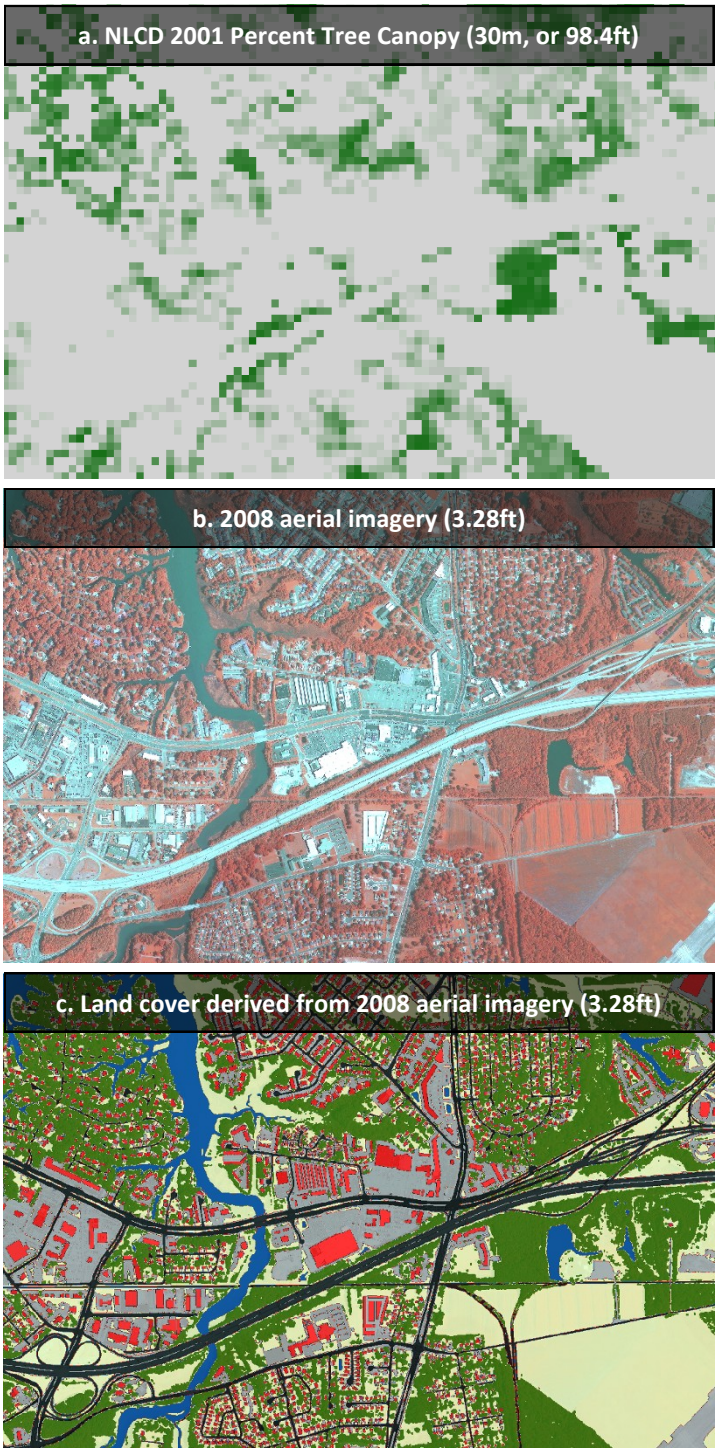


Figure 3a, 3b, 3c: Comparison of NLCD 2001 to high-resolution land cover.

Parcel & Land Use Summary

Following computation of Existing and Possible UTC, 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 percentages of Existing UTC and Possible UTC (UTC area / area of the parcel).

A city-wide land-use layer was then used to summarize UTC by land-use category (Figure 5, Table 1). The Tax Exempt category contains the most Existing UTC by both total area and percent land-use category, followed by Single Family Residential (urban) and Vacant Land. These categories, along with Agricultural Undeveloped, also contain large volumes of Possible UTC Vegetation. The largest volumes of Possible UTC Impervious occur in the Tax Exempt, Single Family Residential (urban) and Commercial and Industrial categories. Note that the Tax Exempt category includes extensive areas owned by the Federal government and devoted to military reservations. This category also includes other publicly-owned lands (e.g., state parks).

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

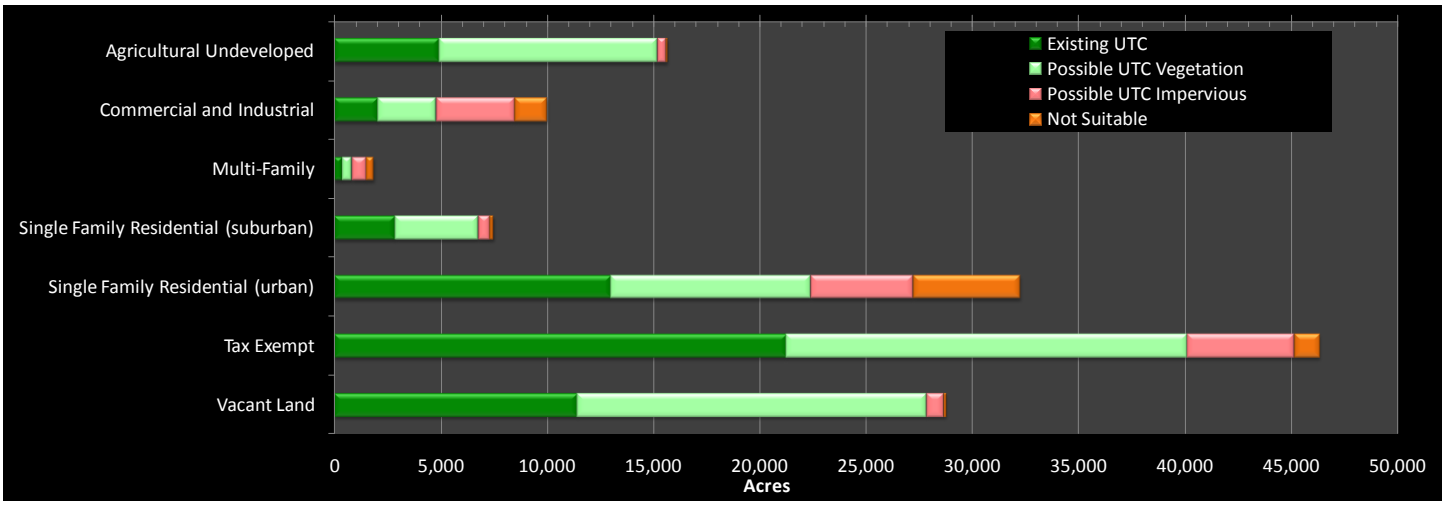


Figure 5: UTC metrics summarized by land use.

Land Use	Existing UTC			Possible UTC Vegetation			Possible UTC Impervious		
	% Land	% Category	% UTC Type	% Land	% Category	% UTC Type	% Land	% Category	% UTC Type
Agricultural Undeveloped	3%	32%	9%	3%	65%	16%	0%	2%	1%
Commercial and Industrial	1%	20%	4%	1%	27%	4%	3%	37%	6%
Multi-Family	0%	21%	1%	0%	25%	1%	0%	34%	1%
Single Family Residential (suburban)	2%	38%	5%	1%	52%	6%	0%	7%	1%
Single Family Residential (urban)	9%	40%	23%	3%	29%	15%	3%	15%	8%
Tax Exempt	15%	46%	38%	6%	41%	30%	4%	11%	8%
Vacant Land	8%	40%	20%	5%	57%	26%	1%	3%	1%

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

The % Land Area value of 9% indicates that 9% of Virginia Beach's land area is tree canopy in areas where the land use is "Single Family Residential (urban)."

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

The % Land Use value of 40% indicates that 40% of "Single Family Residential (urban)" 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 23% indicates that 23% of all Existing UTC lies in areas of "Single Family Residential (urban)" land use.

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

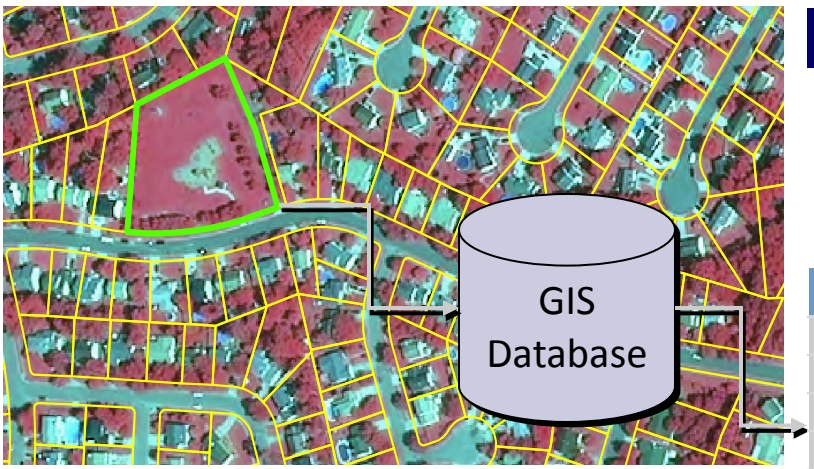


Figure 6: GIS-based analysis of parcel-based UTC metrics for decision support. In this example, GIS is used to select an individual parcel. The attributes for that parcel, including the parcel-based UTC metrics, are displayed in tabular form, providing instant access to relevant information.

Decision Support

The parcel-based UTC metrics were integrated into the city's existing GIS database. Decision makers can use GIS to find specific UTC metrics for a parcel or set of parcels (Figure 6). This information can be used to estimate the amount of tree loss in a planned development or to set UTC improvement goals for an individual property.

Attribute	Value
Land Use	Tax Exempt
Owner	City of Virginia Beach
Mailing Address	2401 Courthouse Dr
Existing UTC	18%
Possible UTC	82%
Possible UTC—Vegetation	74%
Possible UTC—Impervious	8%

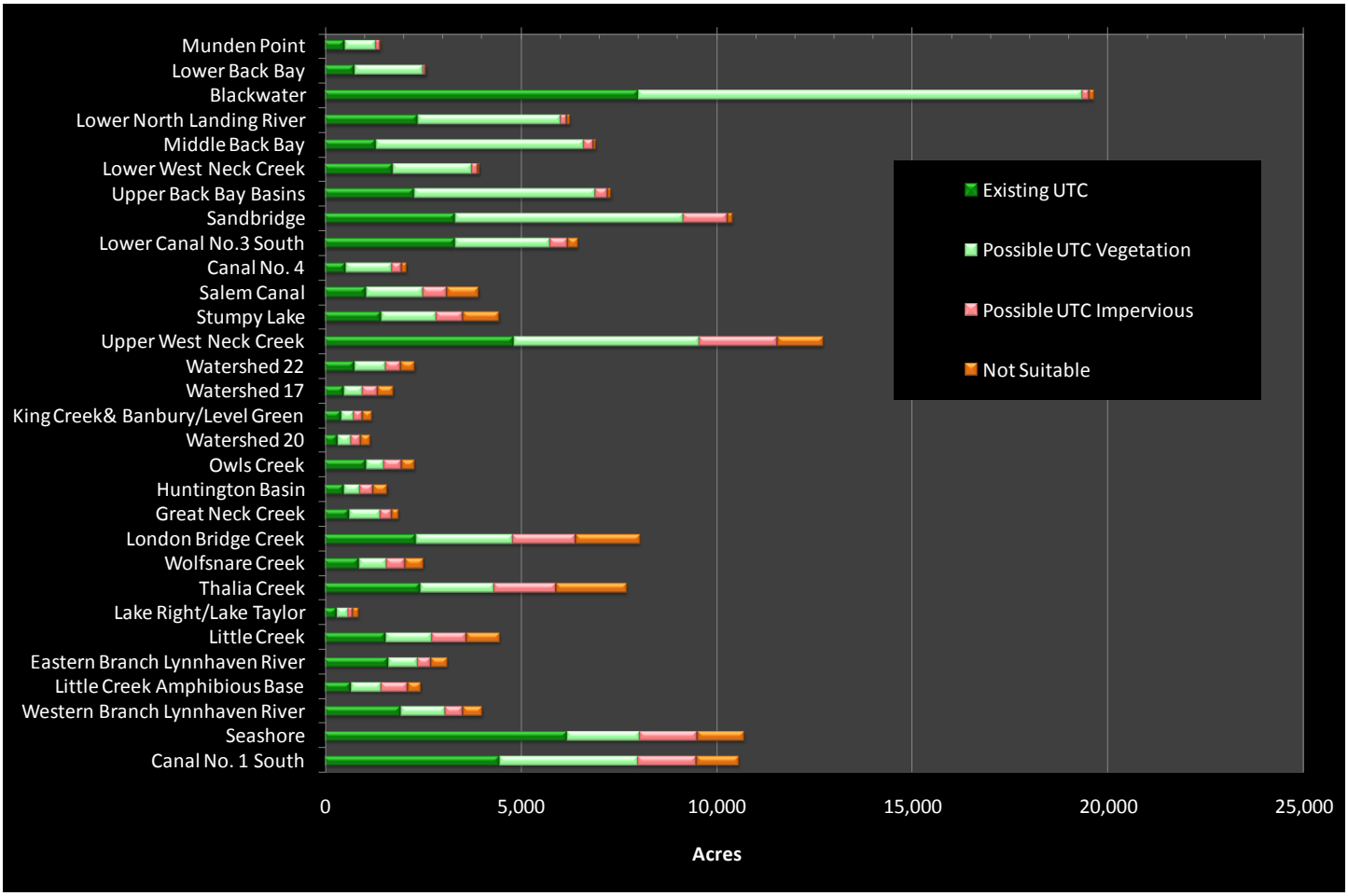


Figure 7: UTC metrics for Virginia Beach summarized by watershed.

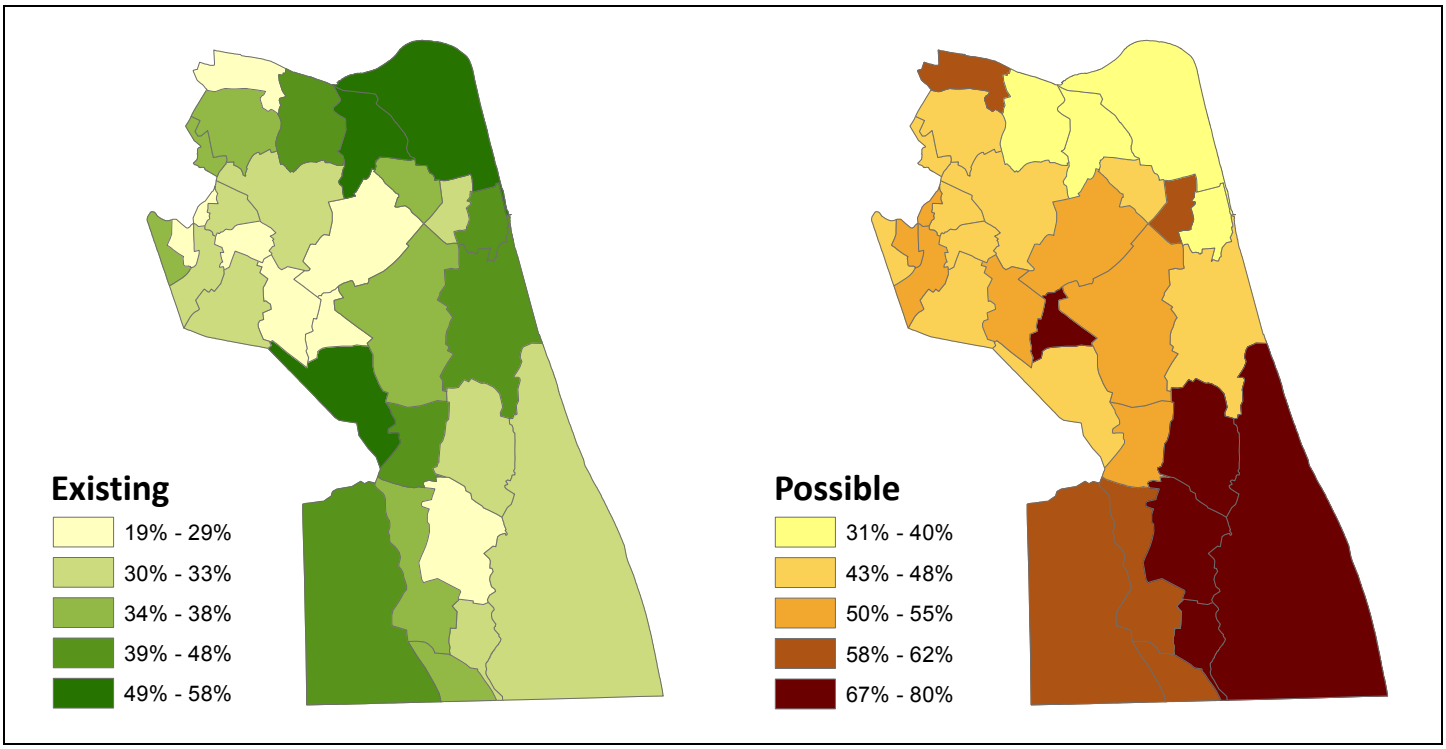


Figure 8: Existing and possible UTC for watersheds.

Conclusions

- Virginia Beach's urban tree canopy is a vital city asset that reduces stormwater runoff, improves air quality, reduces the city's carbon footprint, enhances quality of life, contributes to savings on energy bills and serves as habitat for wildlife.
- In general, Virginia Beach has proportionately more tree canopy than dense urban centers (e.g., New York, Providence) but has less UTC than some small– to medium-sized cities (Figure 9).
- Virginia Beach should consider establishing a UTC goal. This goal should not be limited to increasing the city's overall tree canopy, but should also focus on increasing tree canopy in 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.
- 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 that have large, contiguous impervious surfaces. These parcels contribute high volumes of runoff, which degrade water quality. The establishment of tree canopy on these parcels will help reduce runoff during periods of peak overland flow.
- Virginia Beach's residents control a substantial proportion of the city's tree canopy. Programs that educate residents on tree stewardship and provide incentives for planting trees are crucial if Virginia Beach is going to sustain its tree canopy in the long term.
- Increases in UTC will be most easily achieved on properties in the Vacant Land and Tax Exempt land-use categories. These categories have high proportions of Possible UTC, and the city can most readily implement policy on the lands they encompass. However, it is important to note that Federally-owned military lands, which constitute a large part of the Tax Exempt category, may not be feasible or appropriate for tree-planting efforts (e.g., air bases).
- Watershed-level analysis can help target tree planting efforts (Figures 8 and 9). For example, the Canal No.4 watershed, with 68% Possible UTC, contains public parks and golf courses where theoretically trees could be planted.
- With 38% Possible UTC, transportation rights-of-way present another opportunity to increase tree canopy. A "street trees" initiative could be employed to increase canopy in ROWs.
- UTC summaries for planning areas and stormwater management zones could be used to target tree planting and stewardship efforts and to address water-quality issues in different sections of the city.
- A large area of wetlands exists in the Grass/Shrub class. Further delineation of these areas into a separate wetland land-cover classes would affect UTC metrics, particularly the Possible UTC Vegetation category.

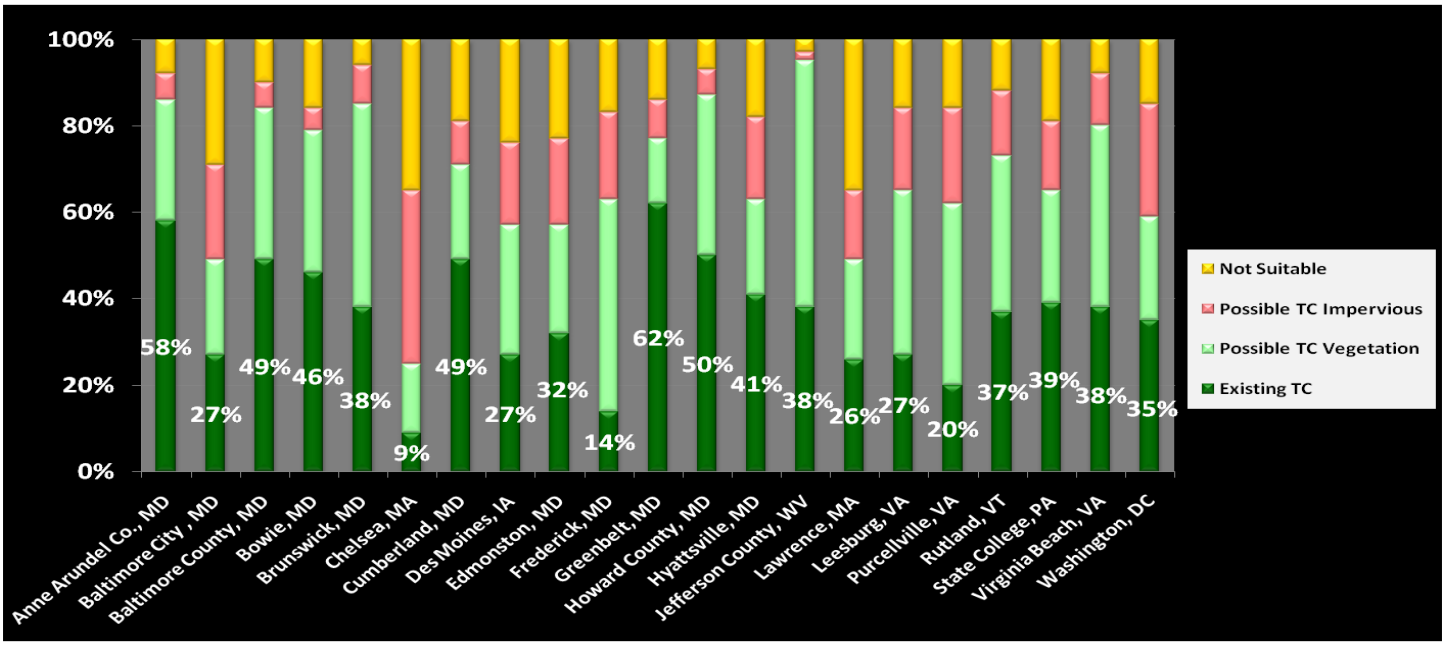


Figure 9: Comparison of Existing UTC with other selected cities that have completed UTC assessments.

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Additional Information

The study was conducted with funding from the City of Virginia Beach Department of Parks & Recreation, Virginia's Department of Forestry and Department of Conservation and Recreation and the USDA Forest Service.

More information on the UTC assessment project can be found at the following web site: **http://nrs.fs.fed.us/urban/utc/**

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