Tree Canopy Report: Greater Bridgeport, CT

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 yields many benefits to communities such as improving water quality, saving energy, lowering summer temperatures, reducing air pollution, enhancing property values, providing wildlife habitat, facilitating social and educational opportunities, and create aesthetic benefits[1]. Establishing a tree canopy goal is essential for communities seeking to improve their green infrastructure. A tree canopy assessment is the first step in urban forest planning, providing estimates for the amount of tree canopy currently present in a county as well as the amount of tree canopy that could theoretically be established.

[1]National Research Council. *Urban Forestry: Toward an Ecosystem Services Research Agenda: A Workshop Summary*. Washington, DC: The National Academies Press,2013.

How Much Tree Canopy Does Greater Bridgeport Have?

An analysis of the Greater Bridgeport area based on land cover data derived from high-resolution aerial imagery and LiDAR (Figure 1) found that 50,072 acres of the study area were covered by tree canopy (termed Existing TC), representing 56% of all land in the study area (Figure 2). An additional 33% (28,910 acres) of the county's land area could theoretically be modified to accommodate tree canopy (termed Possible TC). In the Possible TC category, 24% (21,418 acres) of total land area was classified as Vegetated Possible TC and another 8% as Impervious Possible TC (7,492 acres). Vegetated Possible TC, or grass/shrub, is more conducive to establishing new tree canopy, but establishing tree canopy on areas classified as Impervious Possible TC will have a greater impact on water quality and summer temperatures.

Figure 1: Study area and example of the land cover derived from high-resolution imagery for this project.

Project Background

The goal of the project was to apply the USDA Forest Service's Tree Canopy Assessment protocols to the Greater Bridgeport area. The analysis was conducted using imagery and LiDAR data acquired in 2013. The Spatial Analysis Laboratory (SAL) at the University of Vermont's Rubenstein School of the Environment and Natural Resources carried out the assessment in collaboration with Greater Bridgeport Regional Council (GBRC) and the USDA Forest Service. Funding for this project was provided by an America the Beautiful grant.

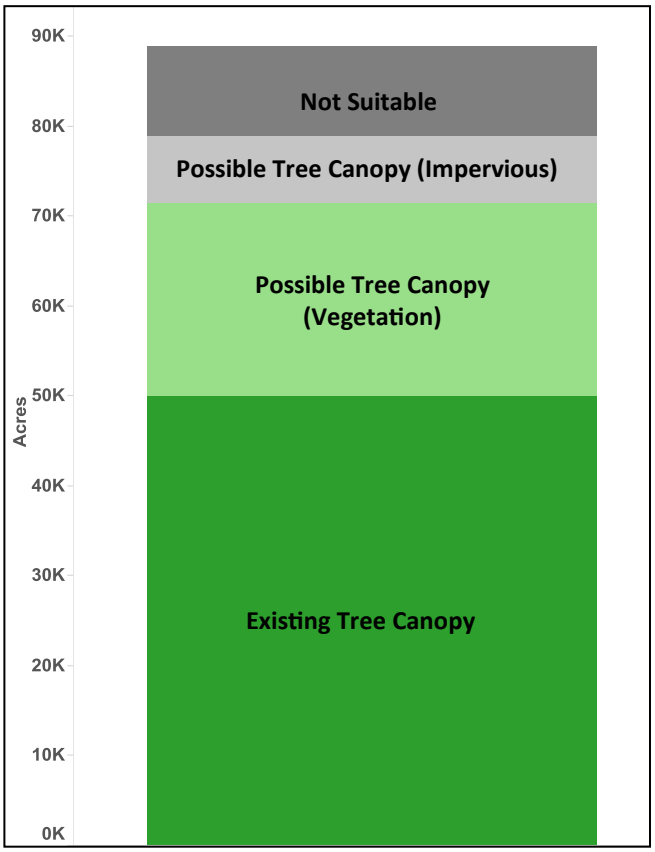

Figure 2: Tree Canopy metrics for the Greater Bridgeport study area based on % of land area covered by each TC type.

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 urban 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.
Not Suitable: Areas where it is highly unlikely that new tree canopy could be established (primarily buildings and roads).

Mapping Greater Bridgeport's Trees

A previous estimate of tree canopy for Greater Bridgeport, derived from the 2011 National Land Cover Database (NLCD 2011), was 48%, much lower than the 56% obtained in this study (based on the total study area, including water). This large difference was attributable to the low resolution of NLCD 2011 (Figure 3a), which only accounted for relatively large patches of tree canopy. Using high-resolution imagery (Figure 3b) and LiDAR acquired in 2013, in combination with advanced automated processing techniques, land cover for Greater Bridgeport was mapped with such detail that individual trees were detected (Figure 3c).

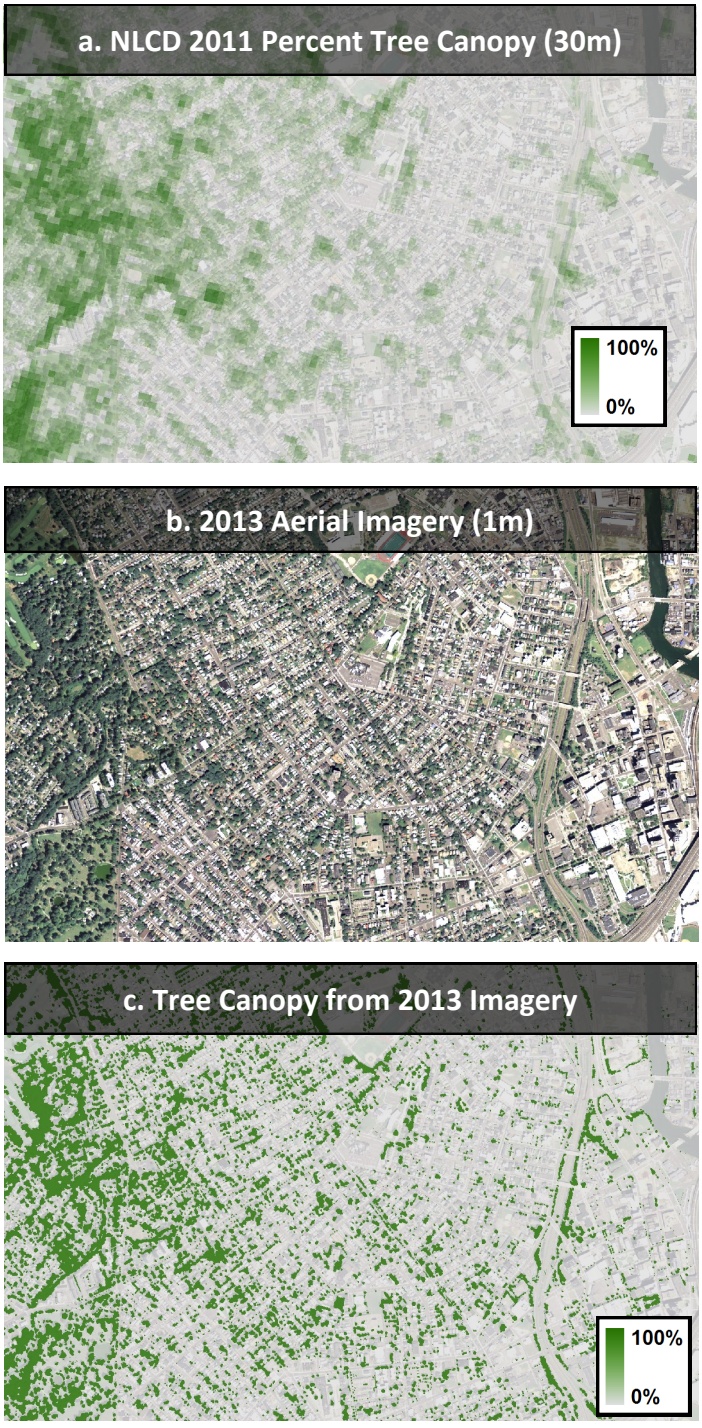

Figure 3: Comparison of NLCD 2011 (a) to high-resolution imagery (b) and tree canopy (c) derived for this study.

Parcel Summary

After land cover was mapped for the study area, Tree Canopy (TC) metrics were summarized for each property in the study area's parcel database (Figure 4). Existing TC and Possible TC metrics were calculated for each parcel, both in terms of total area (square footage) and as a percentage of the land area within each parcel (TC area divided by land area of the parcel). The resulting data can be used to assess the tree canopy and tree planting opportunities for every property in the Greater Bridgeport area.

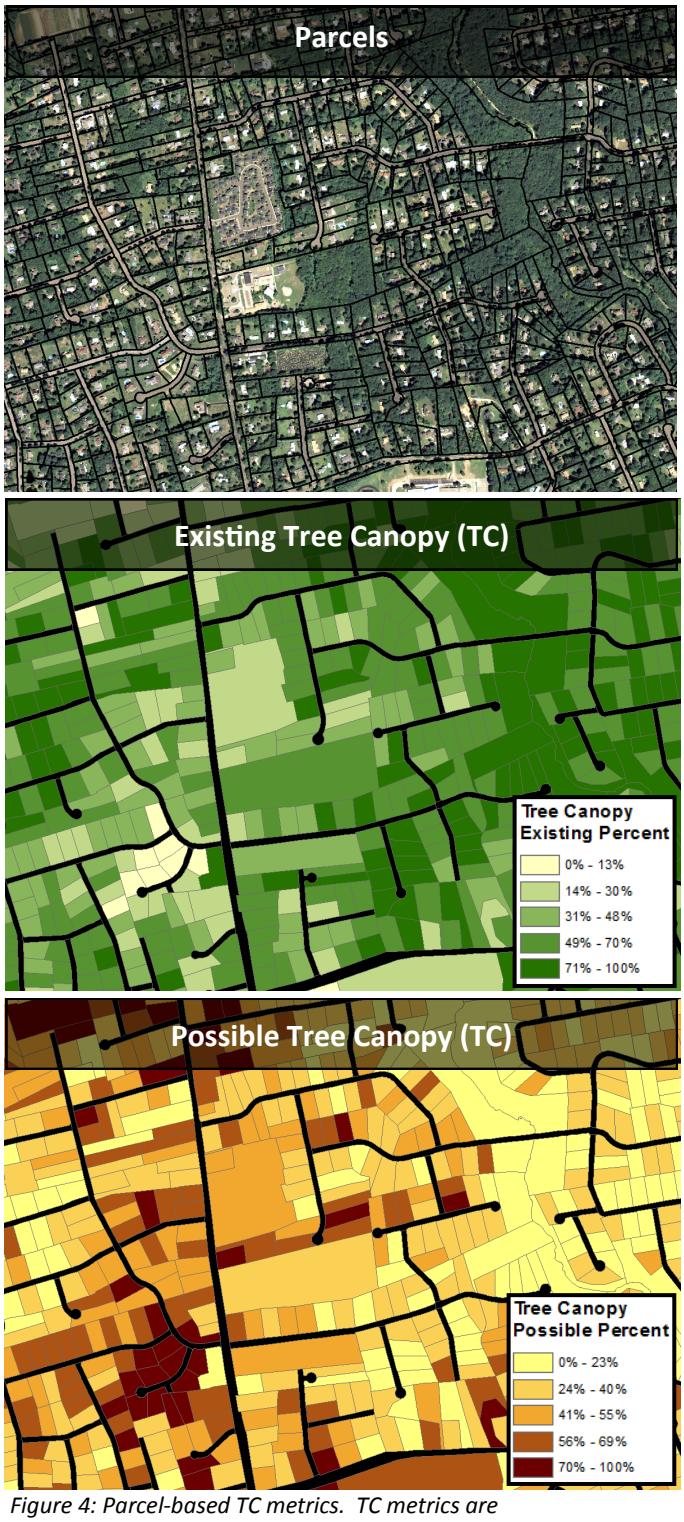

Figure 4: Parcel-based TC metrics. TC metrics are generated at the parcel level, allowing each property to be evaluated according to its Existing TC and Possible TC.

Land Use & Land Cover

To examine the relationship between land use and land cover, the total area for each land use class from the parcel database was summarized and the percent of vegetated cover (trees, grass, and shrubs) in each land use category was computed by dividing by the total land area (Figure 5). This analysis provides an understanding of how "green" each land use class is. The largest single land use category is Residential, followed by Transportation and Utilities. Agriculture and Entertainment and Recreation are the most green classes, both having 96% of their land covered by vegetation. At the low end, Commercial land uses have 43% of their land covered by vegetation. Any steps that Greater Bridgeport can take to green up the area will help reduce storm water runoff and reduce the urban heat island effect. The strategy for greening will likely differ by land use class. Examples include tree give away programs for residents, conservation easement along riparian buffers in agricultural areas, and zoning regulations limiting the amount of impervious surfaces in commercial areas.

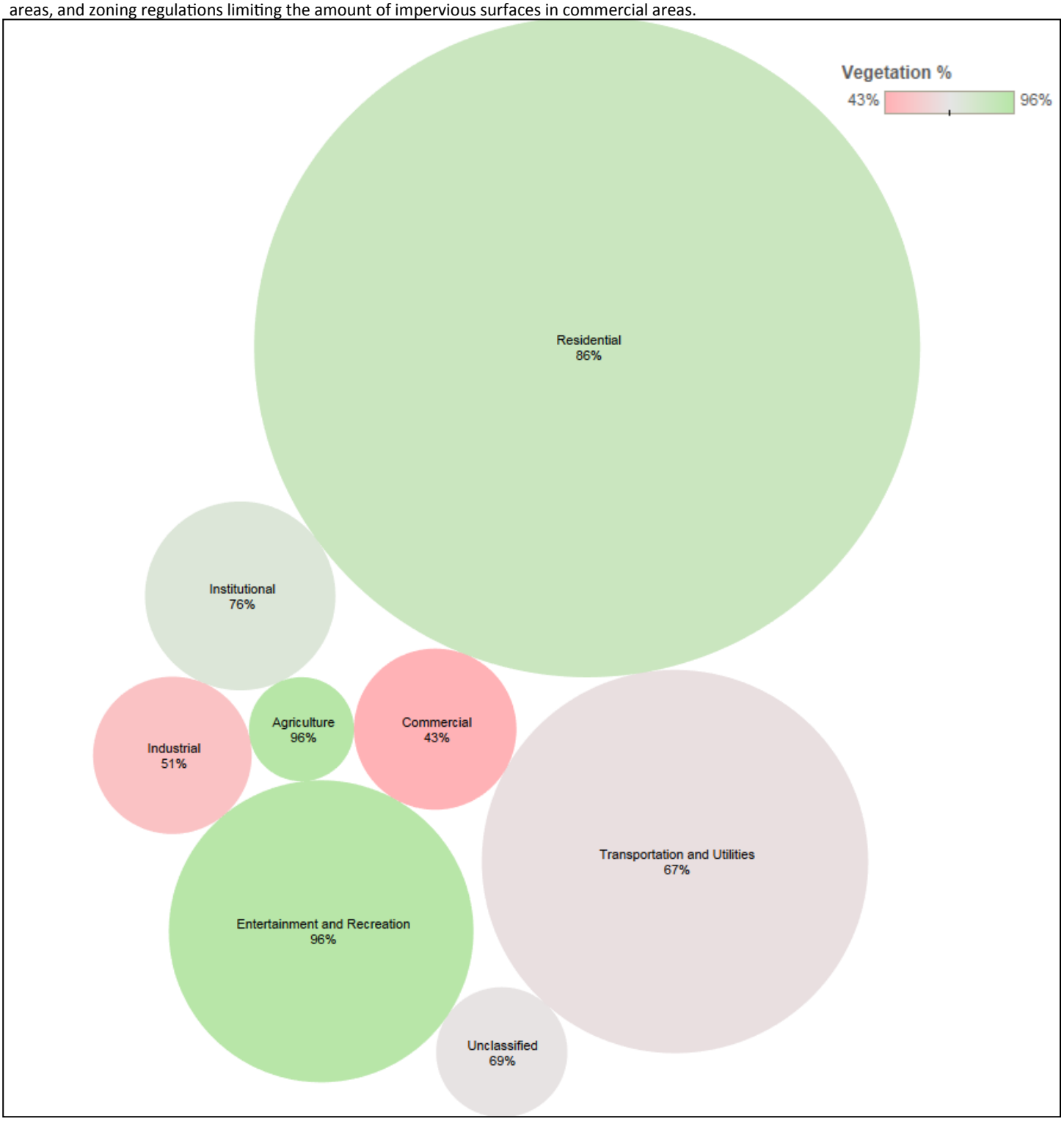

Figure 5: Percent of vegetated cover for each land use class in relation to total land area. The size of the circle represents the total land area, the color gradient represents the percentage of vegetation. Percentages are calculated based on the amount of vegetation relative to land area (i.e. water is excluded).

Land Use

Tree Canopy metrics were also computed for each parcel's land use in the study area. Residential is the dominant land use in the Greater Bridgeport region and thus, not surprisingly, this land use has the most Existing and Possible Tree Canopy by total area (Figure 6). On average, 59% of Residential land is covered by tree canopy. Entertainment and Recreation land, which is the second highest overall land use in the region, has a higher percentage of its land covered by tree canopy at 70%. Institutional land has the greatest percentage of its land available for establishing new tree canopy with 48% Possible TC. For all land uses there is an inverse relationship between Existing Tree Canopy and Possible Tree Canopy (Figure 7). This indicates that land uses with large amounts of tree canopy generally have less room to plant new trees, but this relationship does not always hold true in the more urbanized areas where select parcels with low Existing Tree Canopy also have low Possible Tree Canopy.

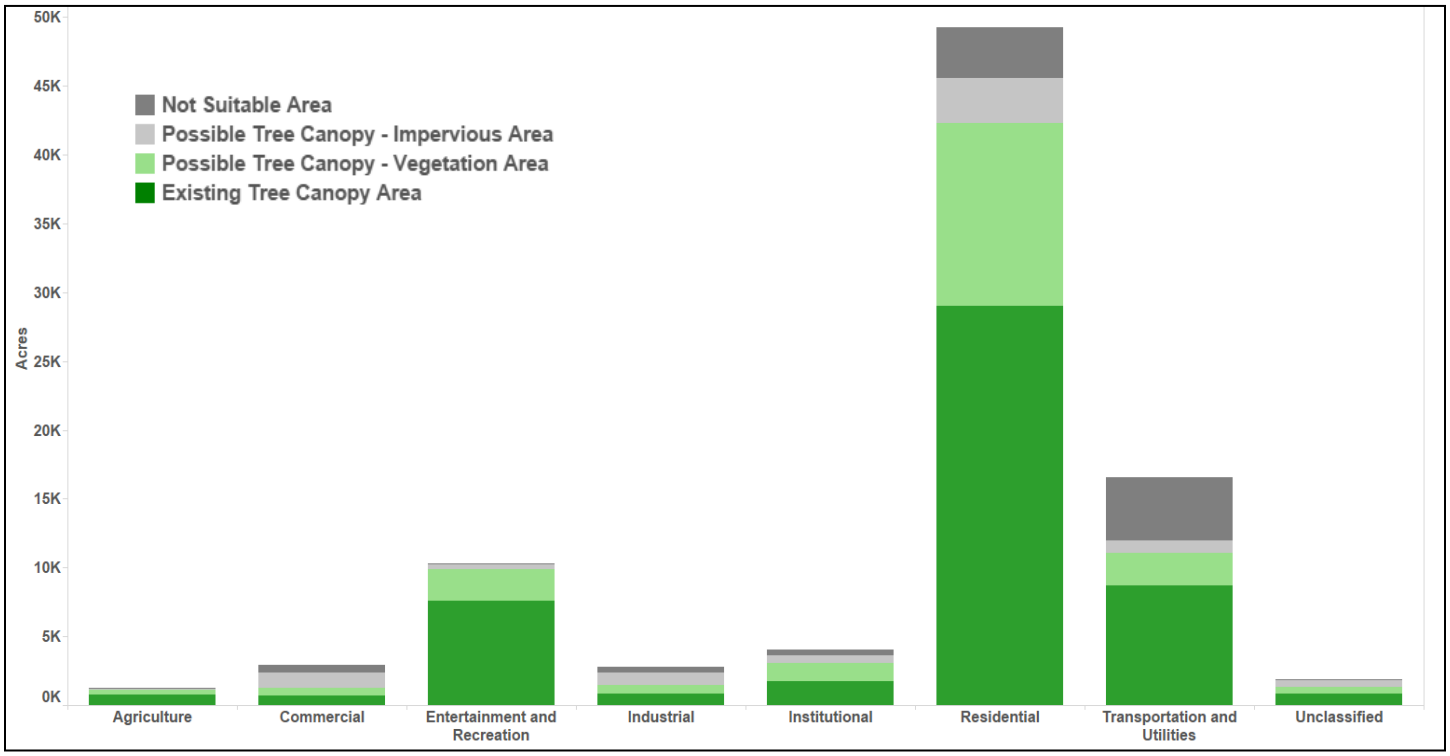

Figure 5: Tree canopy metrics derived from the parcel dataset summarized by land use.

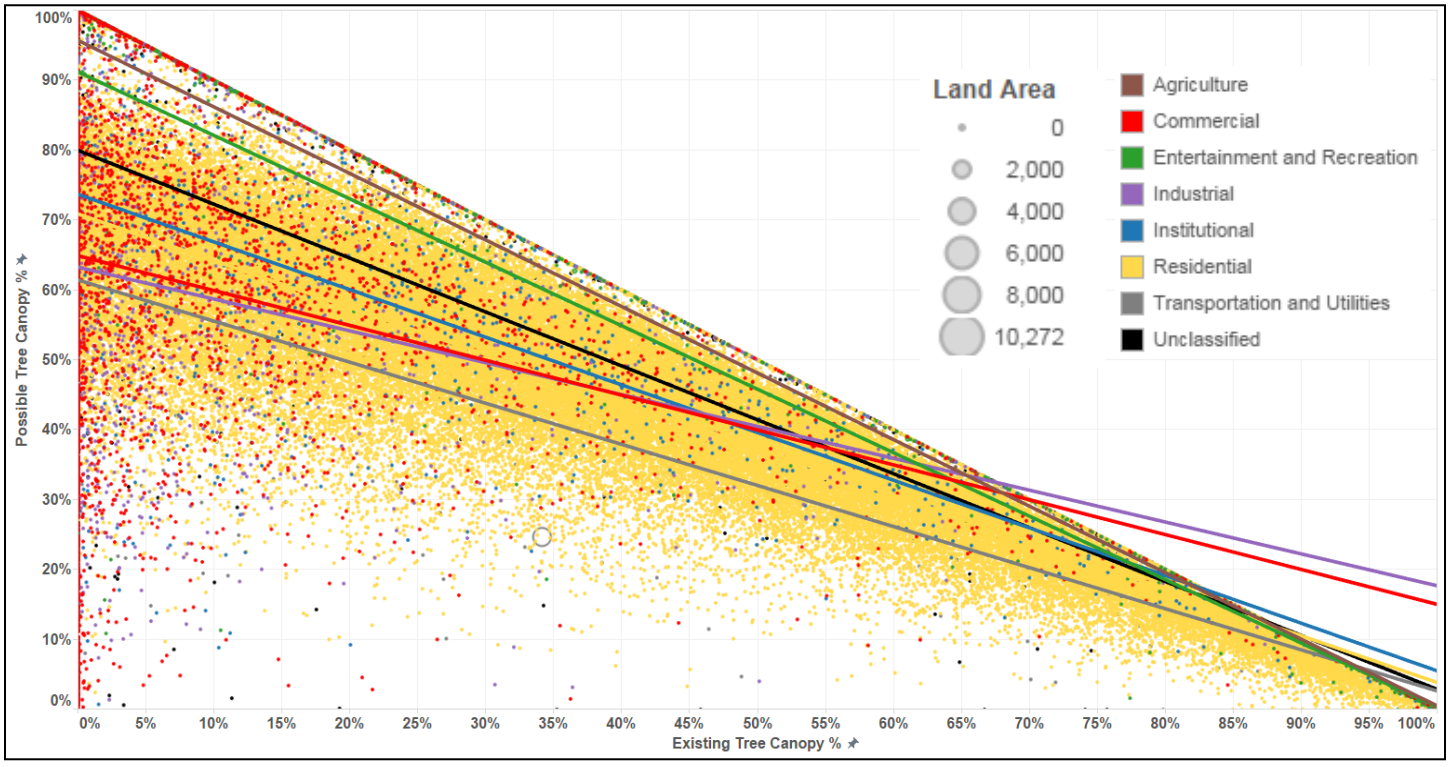

Figure 6: Relationship between Existing Tree Canopy and Possible Tree Canopy for each parcel in the Greater Bridgeport study area.

Urban Heat Island Effect

A well-known benefit of trees is their ability to reduce ground-surface temperatures, both by direct shading and retention of soil moisture. In areas where tree canopy has been removed, surface temperatures can be substantially higher than adjacent forested areas. The effect may be most pronounced in areas with extensive impervious surfaces, which absorb and hold thermal radiation from the sun. Analysis of recent thermal data (Landsat, October 3, 2014) illustrated this effect in the Greater Bridgeport region (Figure 8). This relationship was further confirmed by plotting surface temperature versus Existing Tree Canopy (Figure 9). A statistically significant inverse relationship exists between tree canopy and surface temperature providing clear evidence that trees help to reduce the urban heat island effect. The large forest patches in the western and northern portions of the study area results in substantially lower temperatures. Areas in and around the City of Bridgeport with limited Existing Tree Canopy have much higher surface temperatures.

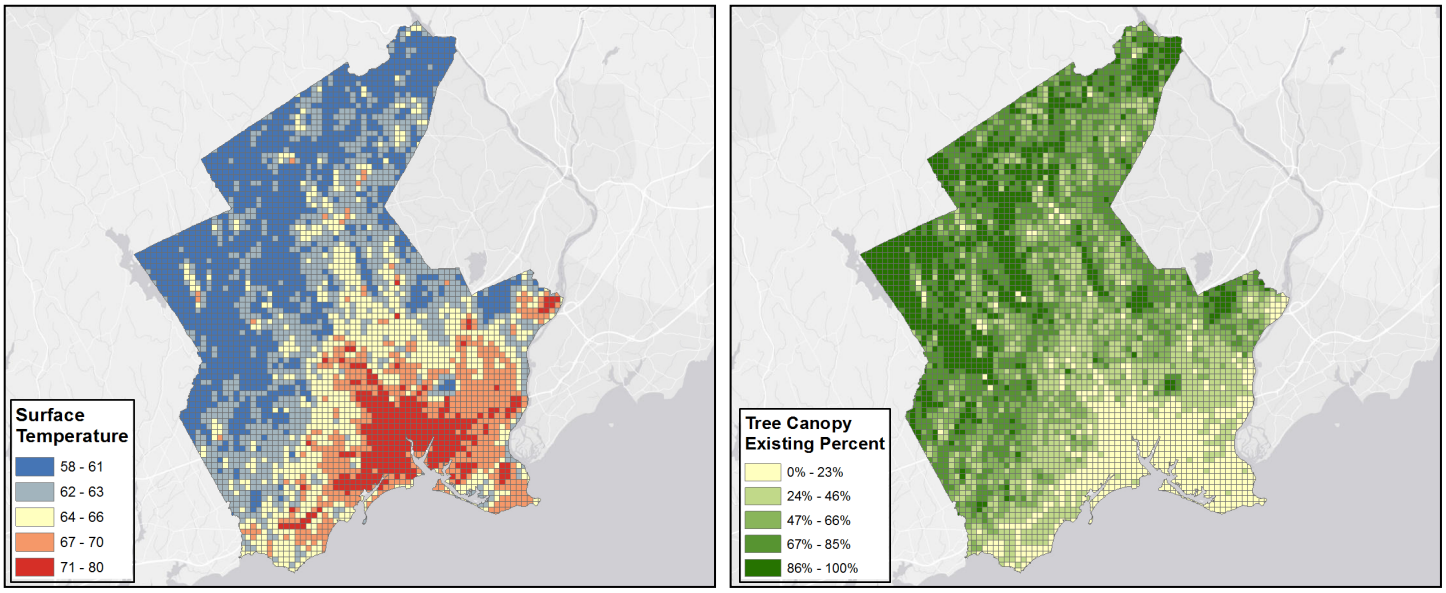

Figure 8: Surface temperature, degrees Fahrenheit on October 3, 2014 (left) in comparison with Existing Tree Canopy (right).

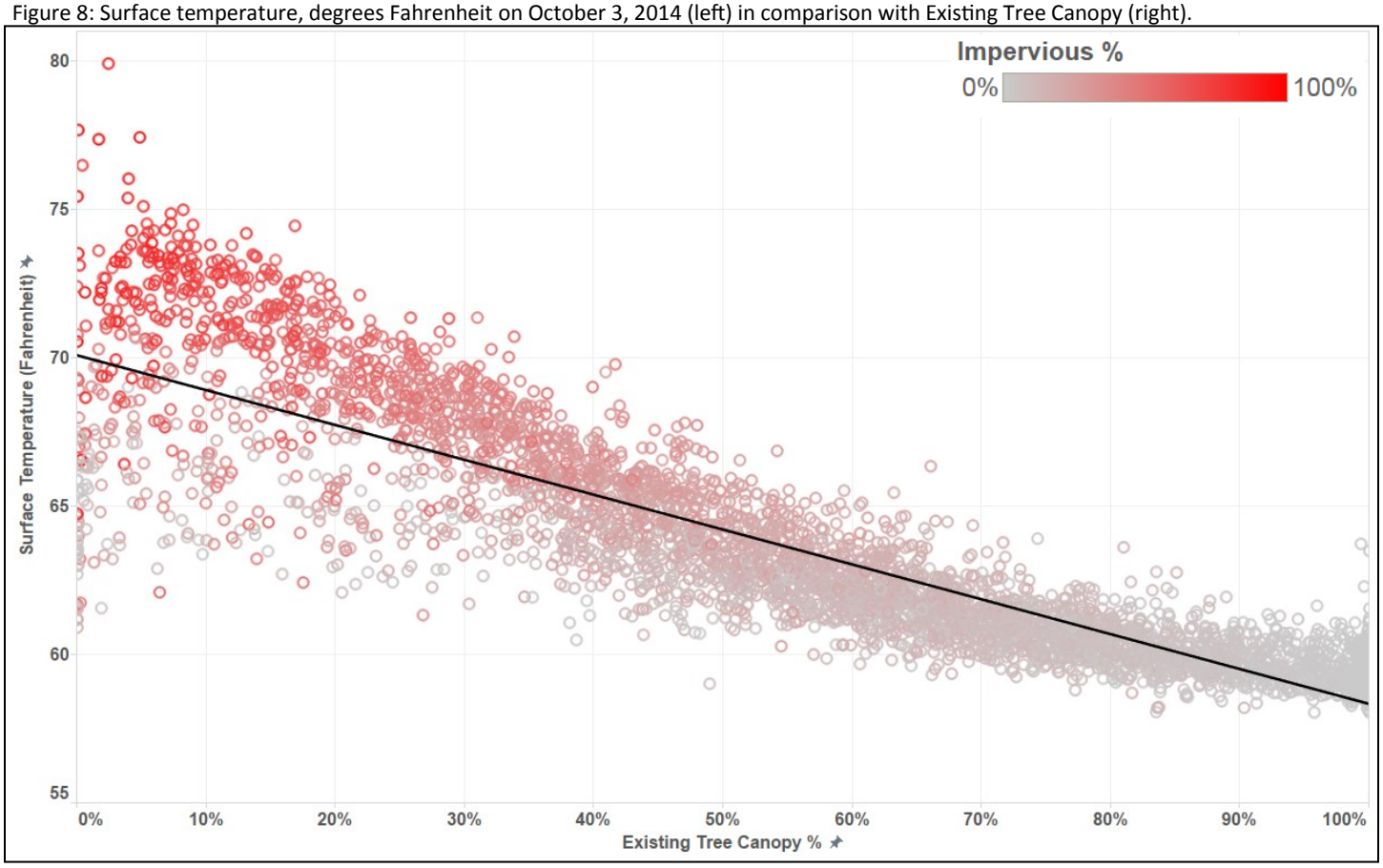

Figure 9: Surface temperature in relation to percent tree canopy. Each circle represents a 1000ft grid cell. A 1000ft x 1000ft grid was overlaid on the region and for each grid cell the percent tree canopy, percent impervious, and average surface temperature were summarized. Surface temperature was derived from Landsat satellite imagery acquired on October 3, 2014 .

Neighborhoods

Tree canopy metrics were computed for each neighborhood in Greater Bridgeport. Easton Town Center has the largest land area, the most Existing Tree Canopy area and the highest Existing Tree Canopy percentage (81%) in the Greater Bridgeport study area (Figure 10). Aspetuck/ Easton has the second highest percentage of Existing Tree Canopy 79% (Figure 11). The Enterprise Zone and the East Side, which primarily encompass urban areas with low tree canopy, have relatively low percentages of Existing Tree Canopy at 6% and 7%, respectively. In terms of establishing new tree canopy, Lordship the South End have 78% and 67% of their land area classified as Possible Tree Canopy. Lordship contains large areas of marshland and the airport which will constrain tree planting opportunities. The South End represents an excellent neighborhood to focus on for tree planting projects. It contains relatively large amounts of Possible Tree Canopy Vegetation and Possible Tree Canopy Impervious, with large open fields and an industrial land uses with few trees.

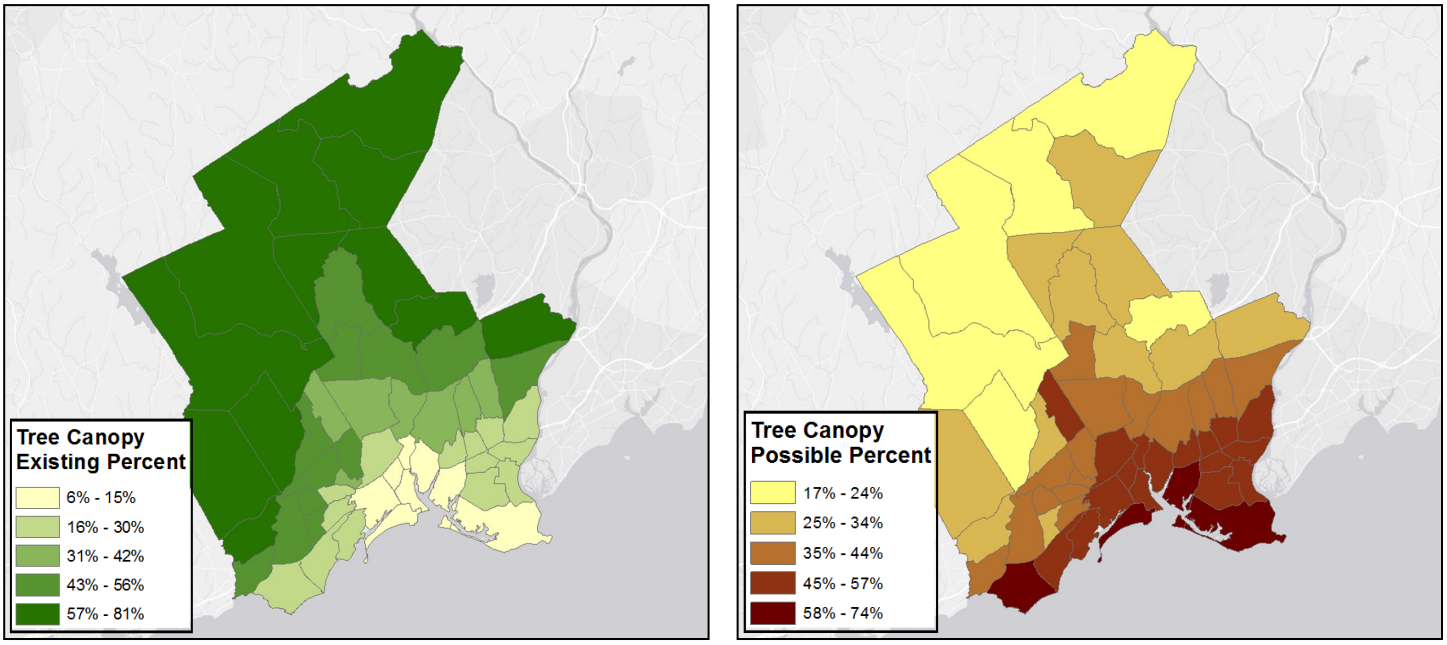

Figure 10: Percent Existing Tree Canopy by neighborhood (left) in comparison to Percent Possible Tree Canopy by neighborhood (right).

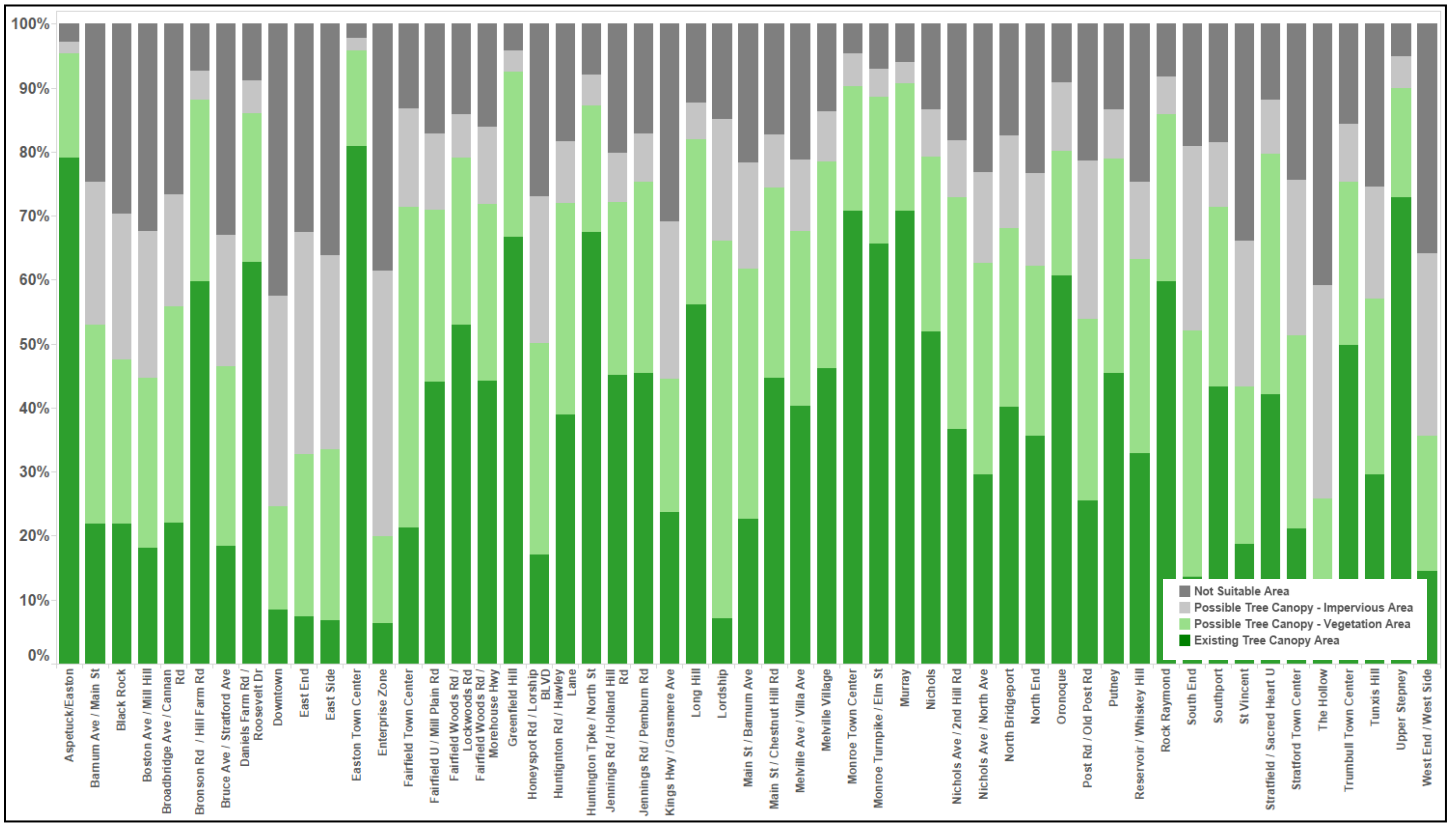

Figure 11: Comparison of Existing and Possible Tree Canopy by neighborhood in the Greater Bridgeport area.

Watersheds

Existing and Possible Tree Canopy were summarized by watersheds within Greater Bridgeport (Figure 12). Saugatuck River Watershed has the highest percentage of Existing Tree Canopy (93%). This watershed is largely forested and has comparatively little urban development. Lewis Gut Watershed has the highest percentage of Possible Tree Canopy (68%) and the lowest Existing Tree Canopy percentage (11%). Lewis Gut Watershed encompasses the airport and a large area of marshland, making efforts to increase tree canopy in some areas of the watershed challenging. Mill River Watershed represents an excellent watershed to focus on for tree planting projects as it contains relatively large amounts of Possible Tree Canopy Vegetation on Residential lands (Figure 13).

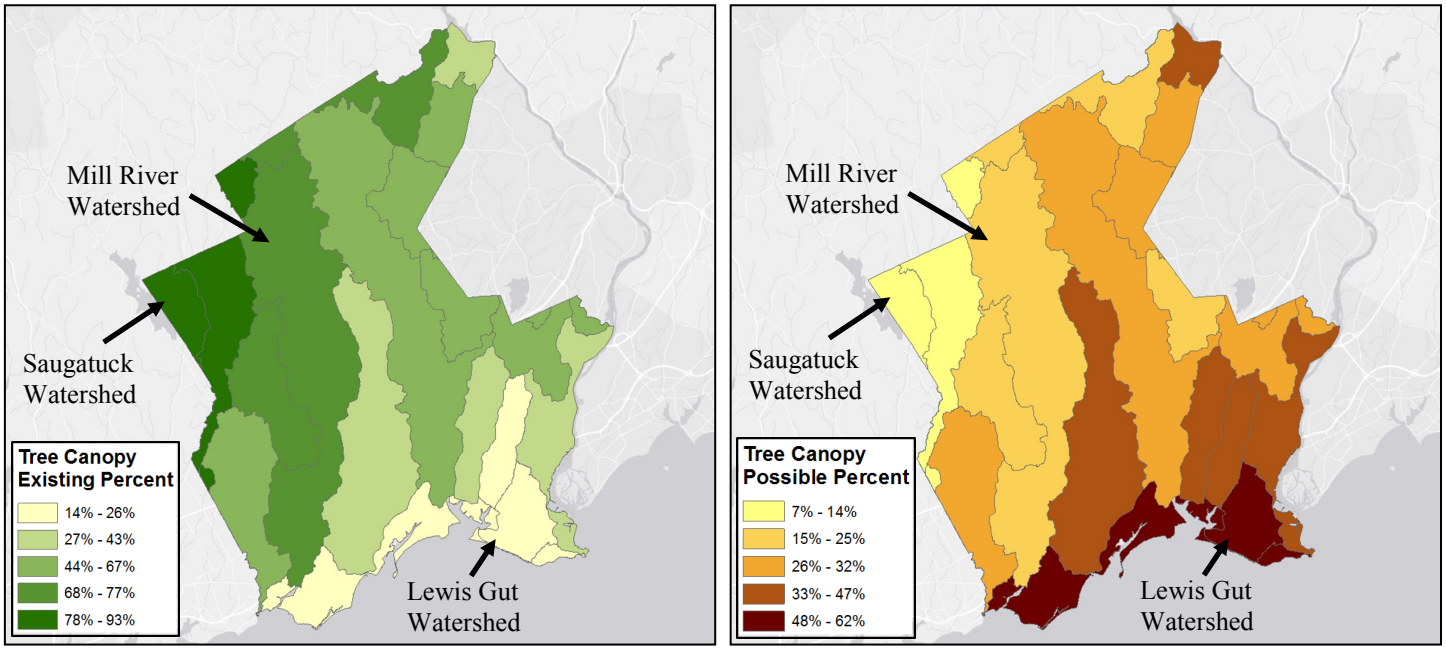

Figure 12: Percent Existing Tree Canopy by watershed in comparison to Percent Possible Tree Canopy by watersheds.

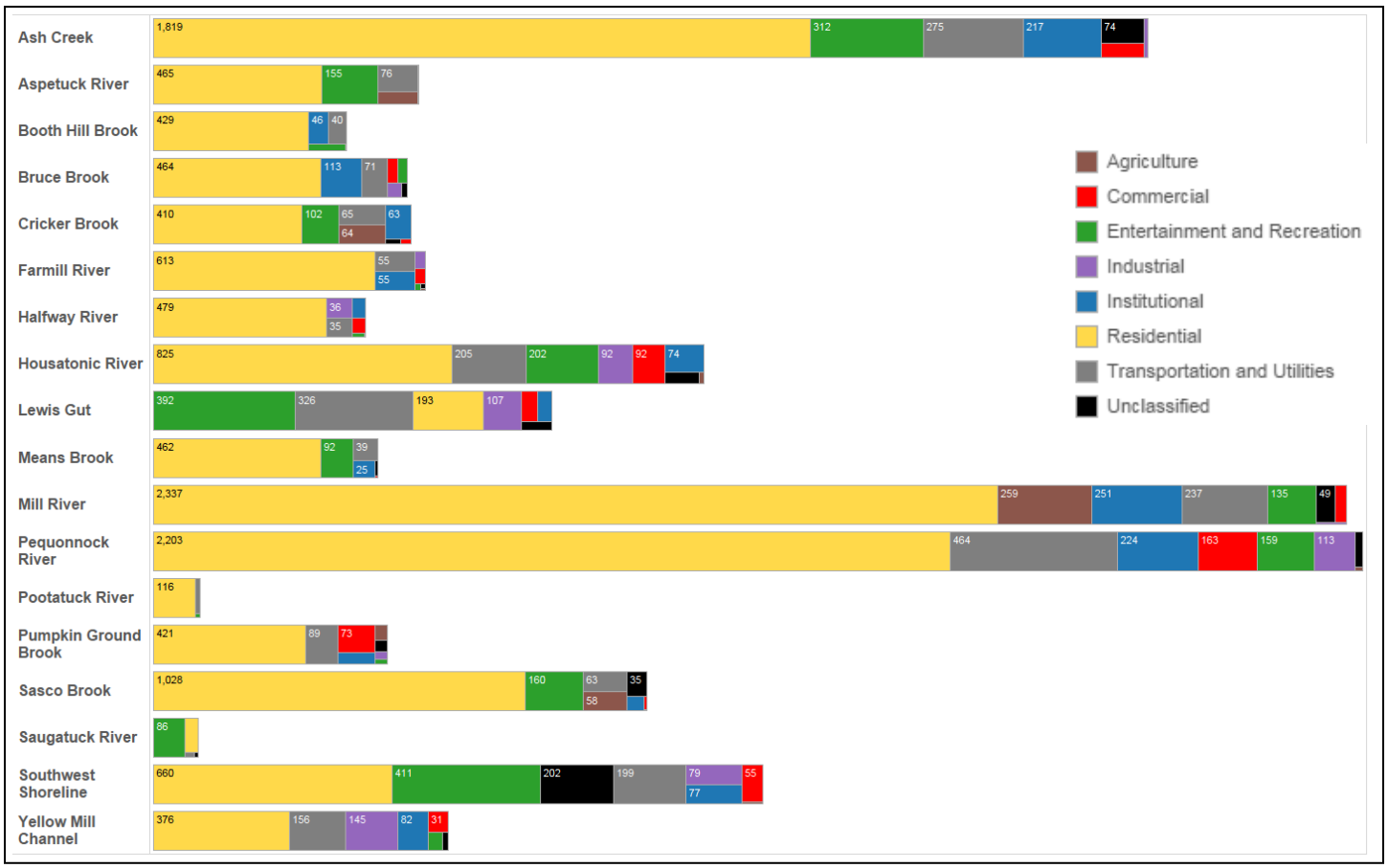

Figure 13: Total area (Acres) of Possible Tree Canopy Vegetation for each watershed in Greater Bridgeport and summarized by land use.

Riparian Areas

Environmental analyses are also possible at finer scales, including assessment of Existing and Possible Tree Canopy in riparian corridors. When vegetated with contiguous tree canopy, these ecologically-important landscape features are known to reduce runoff and protect habitats for a diversity of aquatic and riparian wildlife. For this analysis, rivers, streams, and other water bodies were buffered by 100 feet and tree canopy metrics computed (Figure 14). The stream buffers were then intersected with the land use (Figure 15). It is apparent that riparian corridors in the Greater Bridgeport study area are largely forested (Figure 14). Within the riparian areas, which total is 17,618 acres, 74% is Existing Tree Canopy and 22% is Possible Tree Canopy (Figure 15). Residential, Entertainment, and Recreation land uses contain the largest areas of Possible Tree Canopy, suggesting that opportunities exist for further tree canopy improvements.

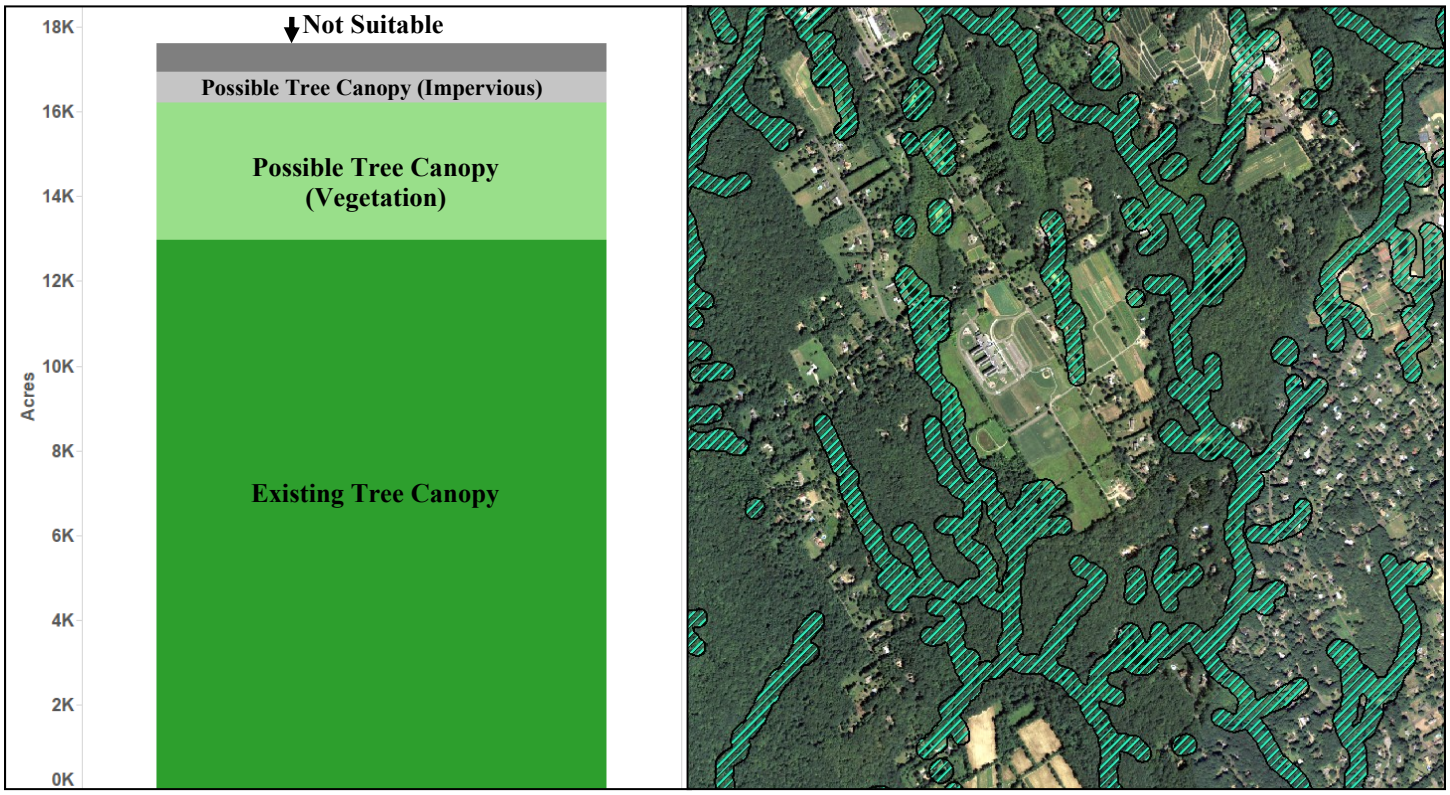

Figure 14: Tree Canopy Metrics summarized by 100 foot riparian buffer.

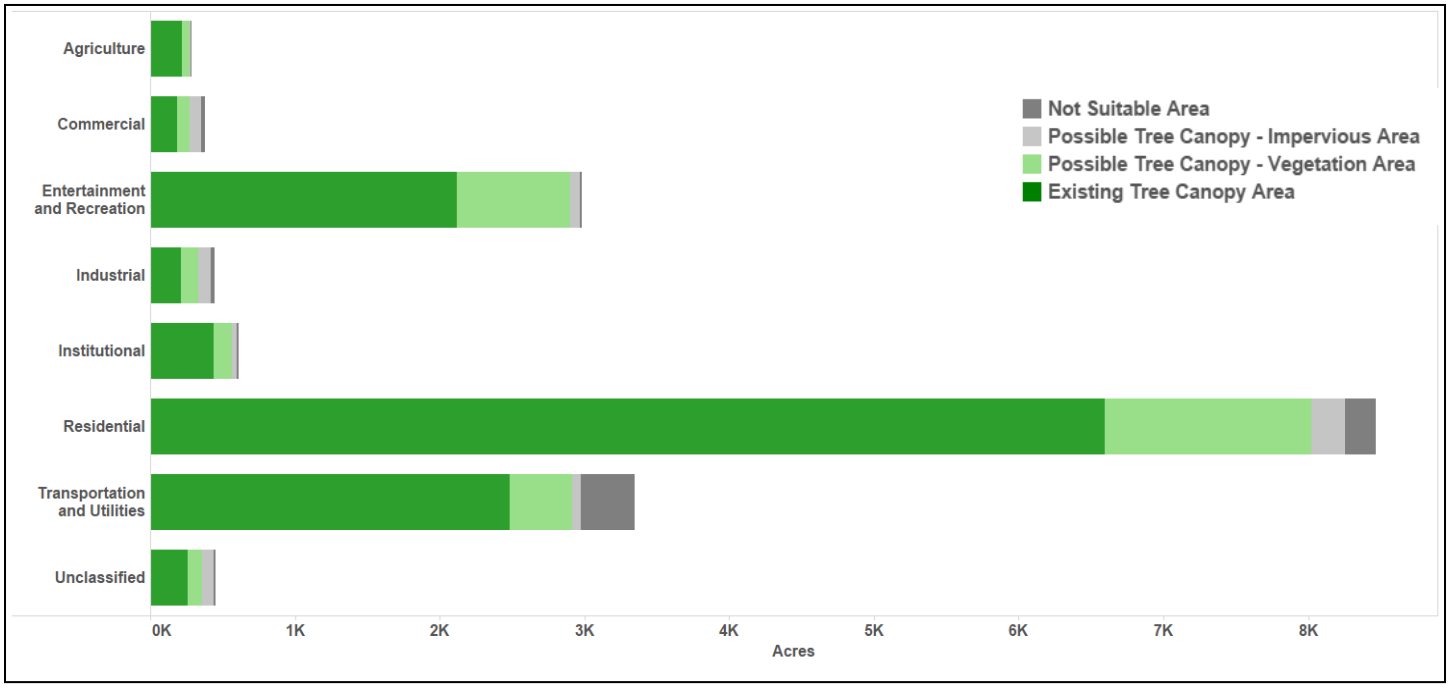

Figure 15: Tree Canopy Metrics broken down by land use for riparian buffer areas in the Greater Bridgeport study area. The length of each bar represents the area in acres of Existing Tree Canopy, Possible Tree Canopy, and areas that are not suitable for planting trees.

Urbanization

Tree Canopy Metrics were computed for the Urbanization Gradient, which is a measure of how developed each Census block group is. A majority of the Principal Urban Centers, the most urbanized block groups) are located in the City of Bridgeport (Figure 16). Metro cities is the largest of the Urbanization categories, containing 60% Existing Tree Canopy (Figure 17). Principal Urban Centers and Urban Outskirts have low Existing Tree Canopy percentages of 23% and 24%, respectively. Opportunities exist to plant trees in these areas with both having relatively high percentages of Possible Tree Canopy at 47% and 51%, respectively. As the Urbanization classification changes from urban to rural it would be expected that the Existing Tree Canopy percentage would increase, however, this is not the case in the Greater Bridgeport study area. Metro Cites have more than double the percentage of Existing Tree Canopy (60%) than Urban Outskirts. The Metro Cities in the Greater Bridgeport region contain long established residential areas with robust patches of urban tree canopy, where the Urban Outskirts contain new housing developments with large lawns and few trees (Figure 18).

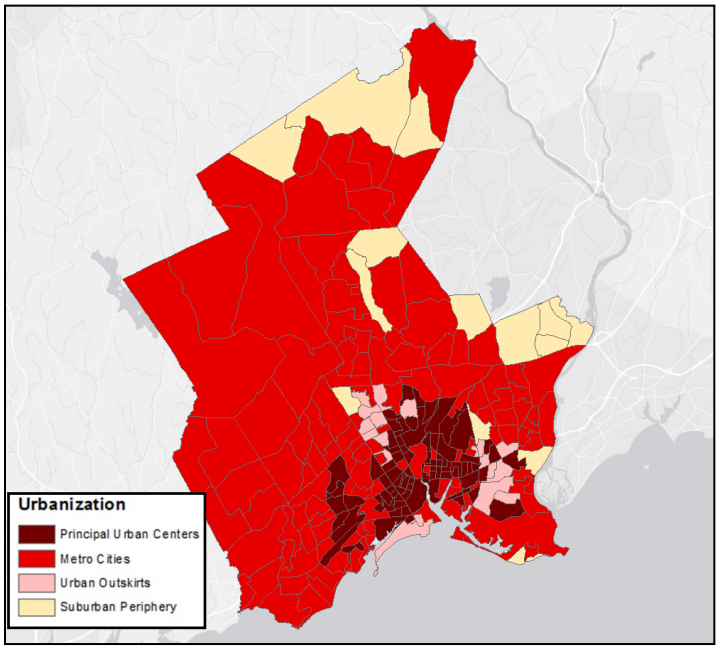

Figure 16: Urbanization Gradient displayed by Census block group.

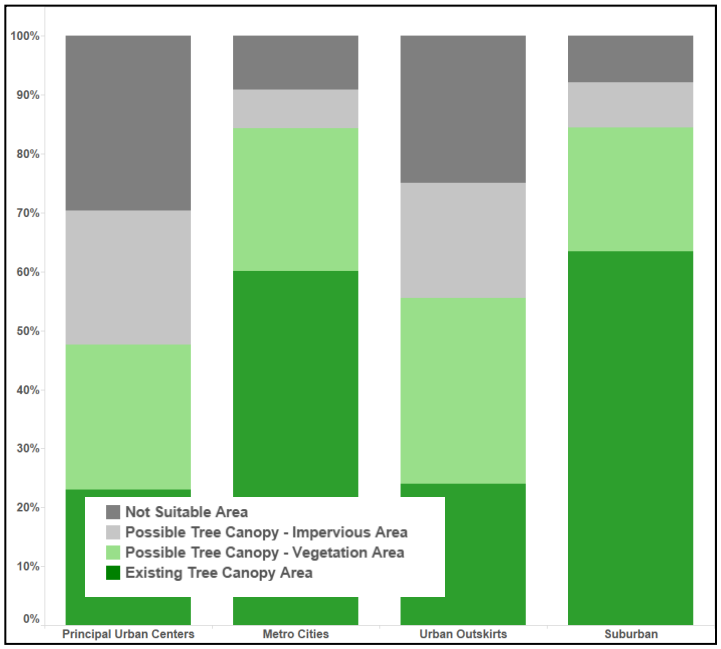

Figure 17: Tree Canopy Metrics percentages by urbanization group.

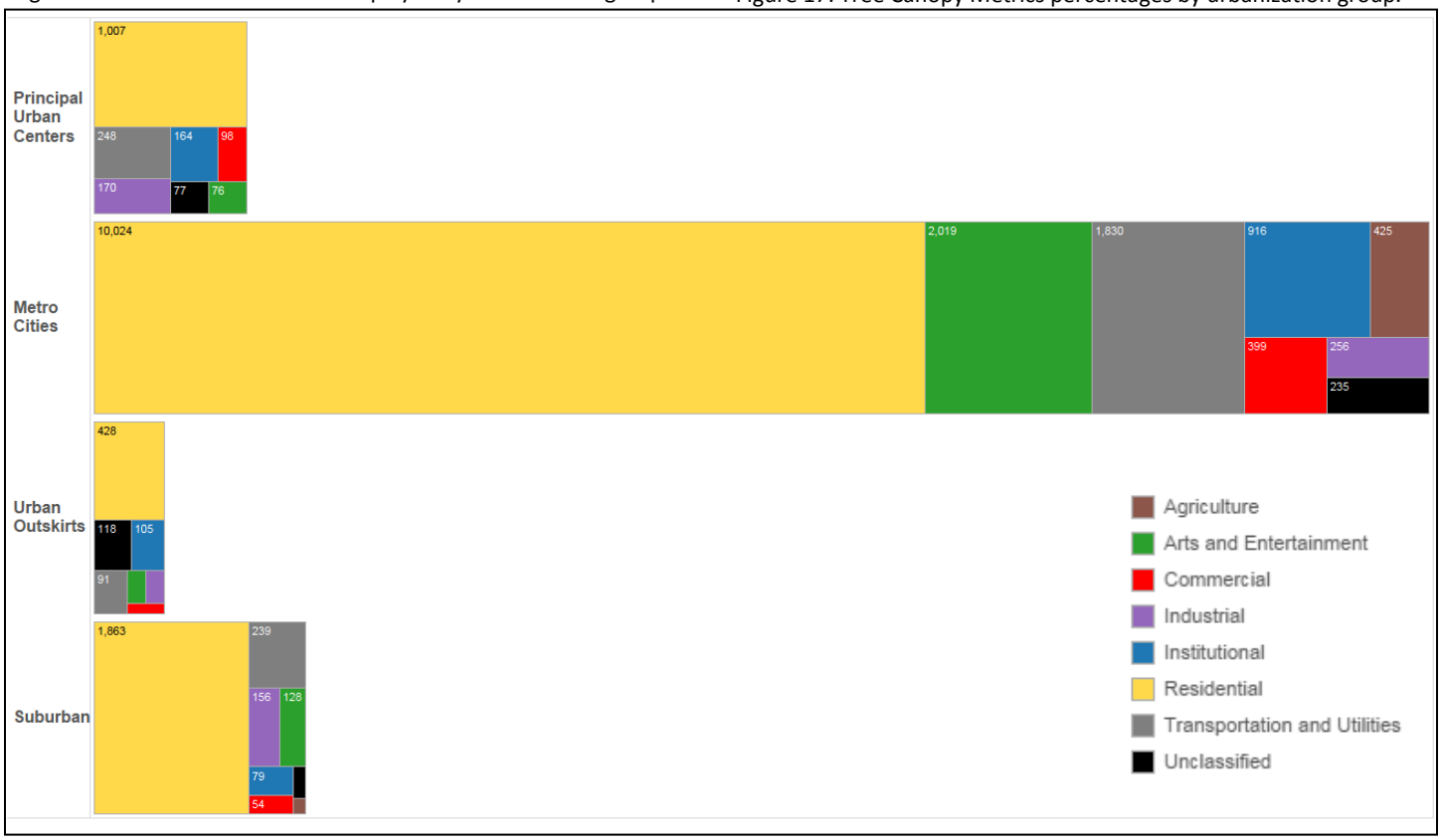

Figure 18: Total area (Acres) of Possible Tree Canopy Vegetation for each Urbanization Group and summarized by land use.

Greater Bridgeport Life Style Analysis

Tree Canopy Metrics were computed for each LifeMode group by Census block group in the Greater Bridgeport region (Figure 19). Segments within a LifeMode group share an experience such as being born in the same time period or a trait such as affluence The data used to classify each group was created by ESRI using data from the Census. High Society encompasses the largest area and has the highest percentage of Exiting Tree Canopy in the Greater Bridgeport study area with 42,885 acres and 68% (Figure 20). This group, which is the wealthiest of the LifeMode groups, is located primarily in less developed suburbs. Upscale Avenues has the highest percentage of Possible Tree Canopy Vegetation with 37%. Global Roots has the highest percentage of Possible Tree Canopy with 53%, but 30% is Possible Tree Canopy Impervious, making tree planting difficult in these areas. Global Roots represents less affluent multicultural families who live in the inner city of Bridgeport. Within each Life Style group Residential land uses have the most area of Possible Tree Canopy Vegetation, making the residents of the Greater Bridgeport area essential to the success of tree planting projects. For more information on each LifeMode group, please visit: http://www.esri.com/library/brochures/pdfs/tapestry-segmentation.pdf.

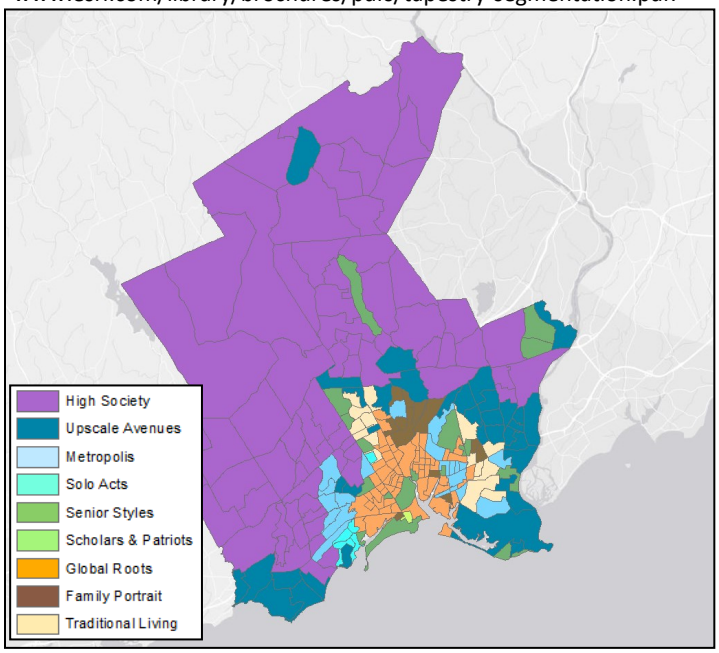

Figure 19: Life Style groups displayed by Census Block Group.

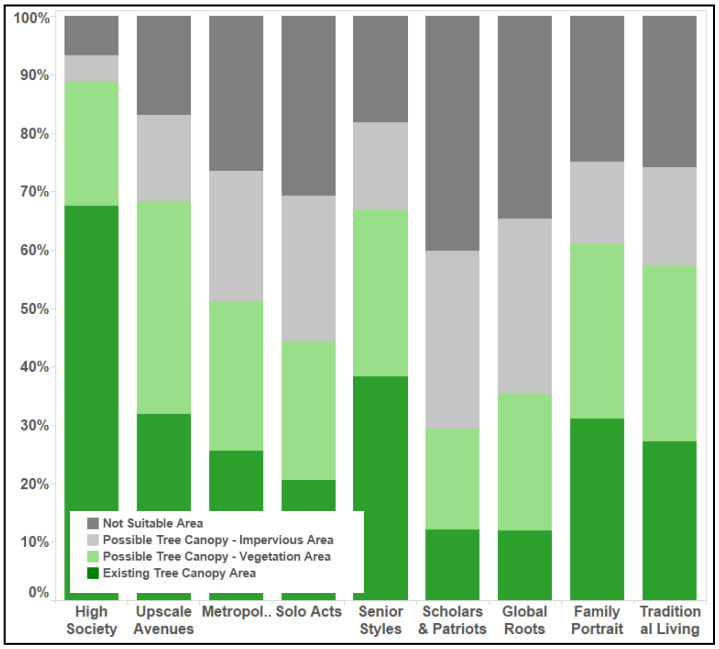

Figure 20: Tree Canopy Metrics percentages by Life Style Group.

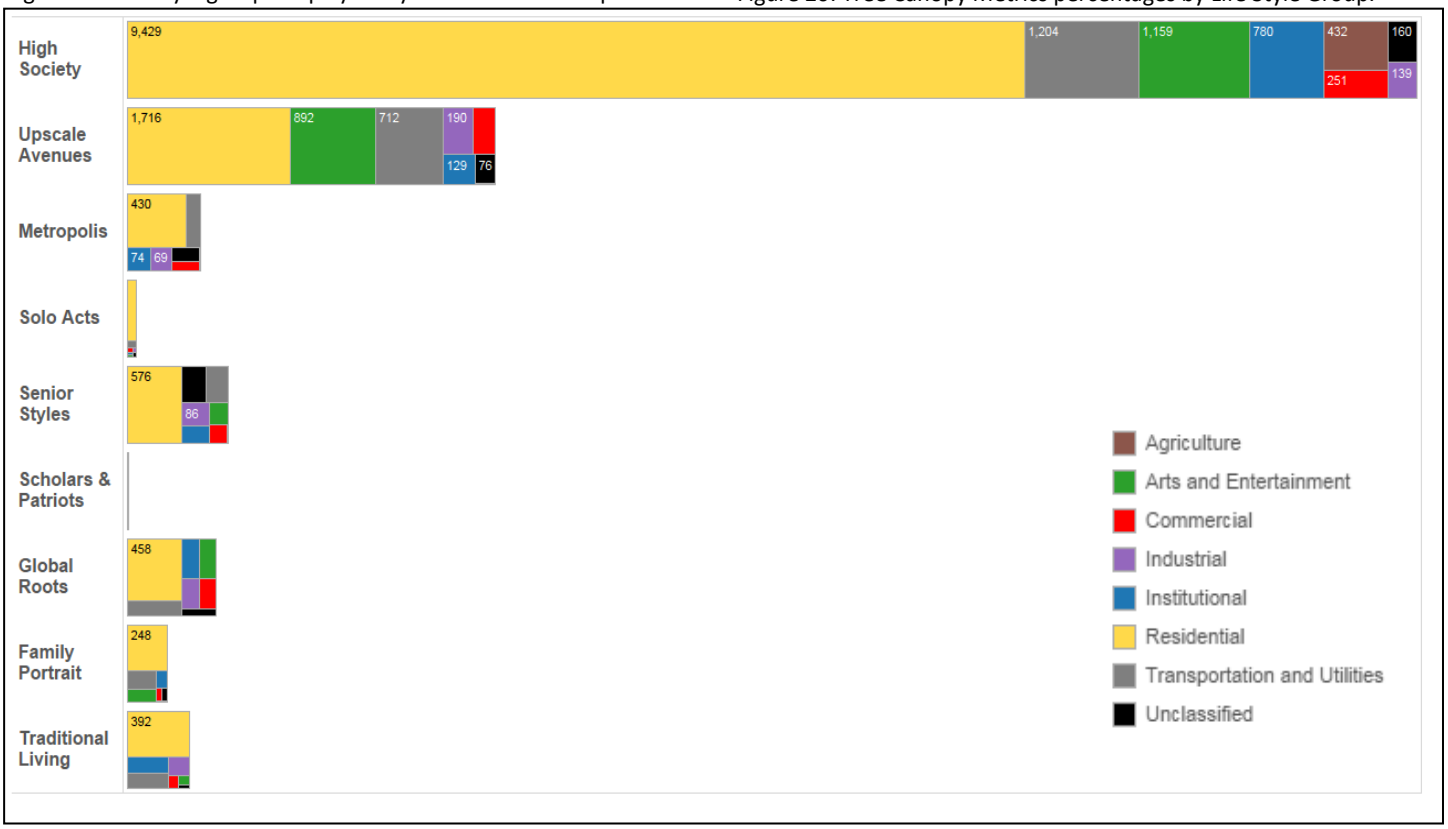

Figure 21: Total area (Acres) of Possible Tree Canopy Vegetation for each Life Style group in Greater Bridgeport and summarized by land use.

Rights-of-Way Analysis

Tree Canopy Metrics were computed for the Municipal rights-of-way (ROW) and the State ROW. ROW refers to "non-parcel" land, essentially street rights-of-way (Figure 22). The ROW have 33% Existing Tree Canopy in comparison to the 56% for the entire study area (Figure 23). Additional Tree Canopy could theoretically be established on 25% of the ROW. Municipal ROW are twice the size of the State ROW, but both have similar proportions of Existing Tree Canopy and Possible Tree Canopy (Figure 24). Large areas of the Possible Tree Canopy - Vegetation in the State ROW are located in the median and on the sides of highways and road, which could make improving tree canopy difficult. Although the Municipal ROW contains less Possible Tree Canopy, most of the ROW are located in residential neighborhoods, making the residents key to improving tree canopy along the ROW.

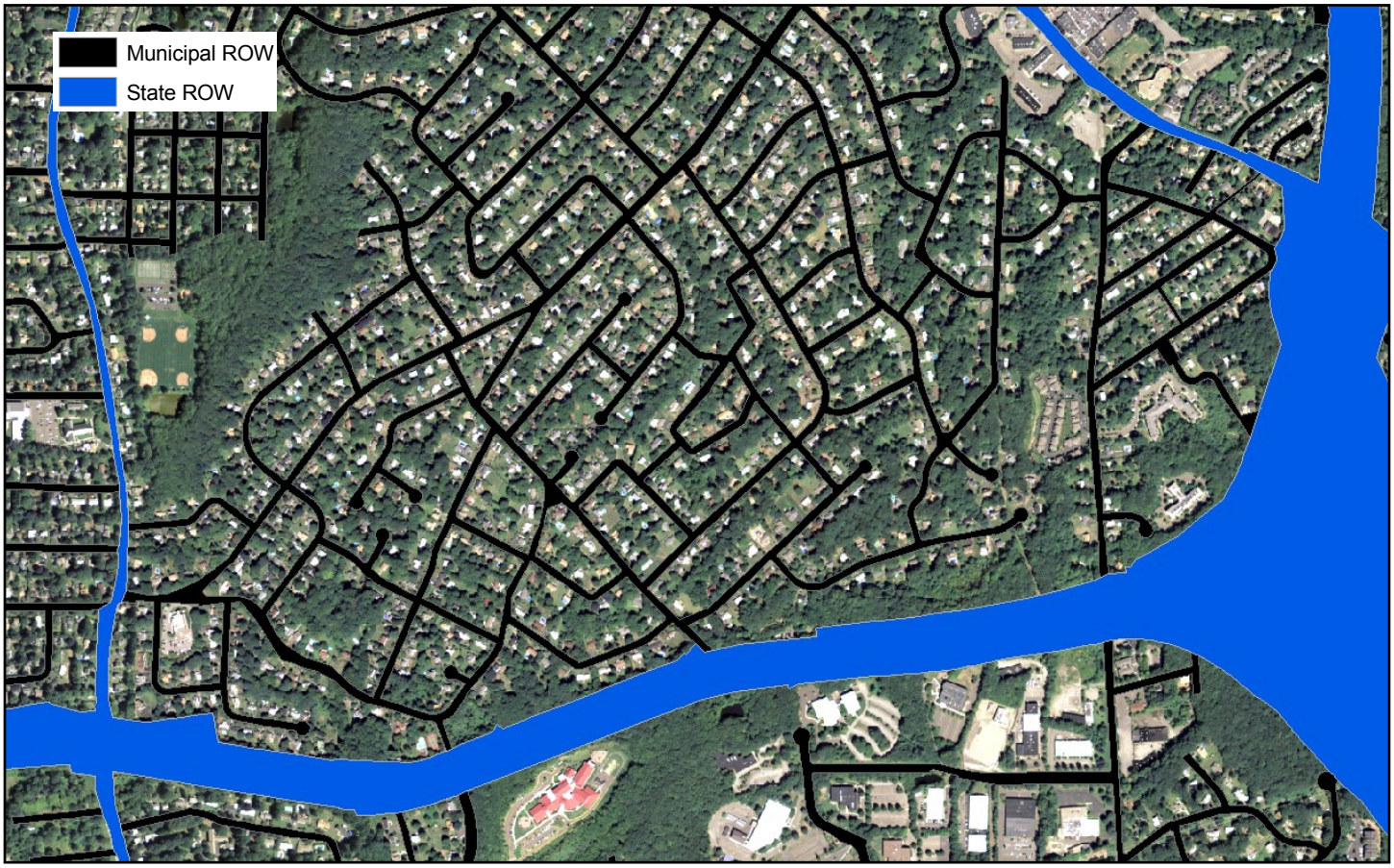

Figure 22: ROW for the Greater Bridgeport region.

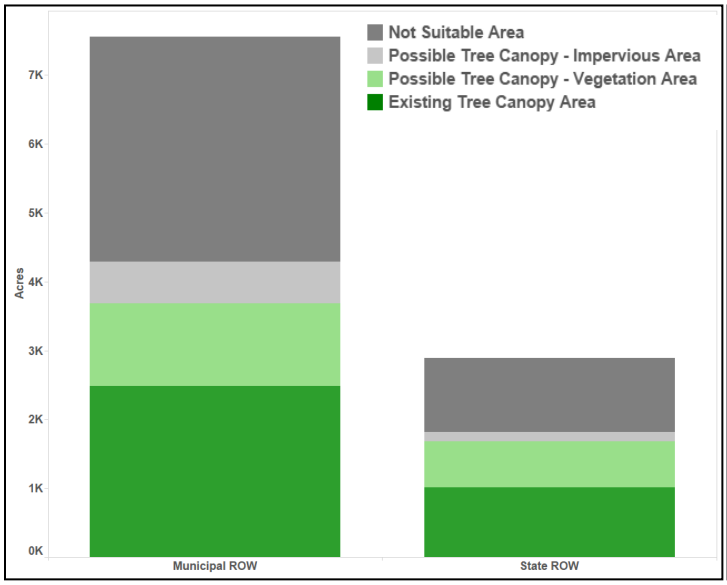

Figure 23: Tree Canopy Metrics by ROW.

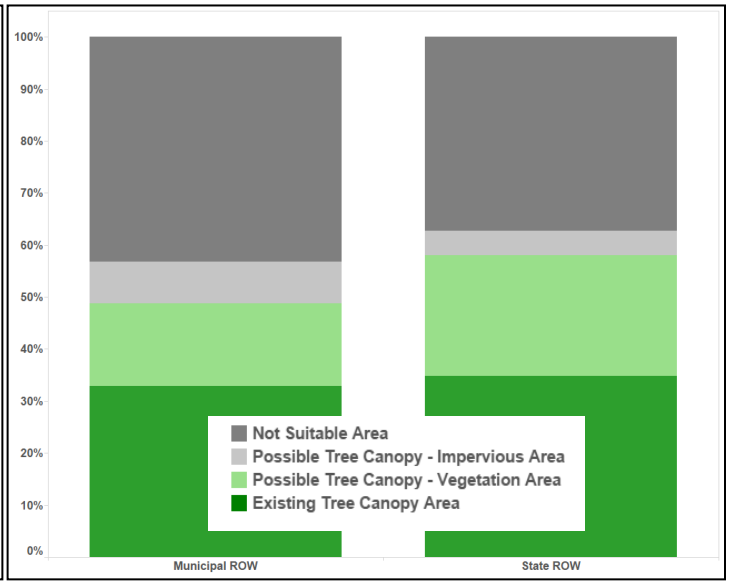

Figure 24: Tree Canopy Metric percentages by ROW.

Conclusions

- Tree canopy in the Greater Bridgeport region is a vital asset that reduces storm water runoff, improves air quality, reduces the borough's carbon footprint, enhances quality of life, contributes to savings on energy bills, and serves as a habitat for wildlife.
- Greater Bridgeport should consider setting tree canopy goals, not only for increasing the overall tree canopy but to focus on increasing tree canopy in urban areas that have low Existing Tree Canopy and high Possible Tree Canopy.
- Tree canopy has a clear impact on surface temperature. Greening up the Greater Bridgeport region will help reduce summer temperatures, thereby reducing energy use and saving businesses money.
- Greater Bridgeport's residents are key to preserving existing tree canopy along with any efforts to increase tree canopy, as residential land is the single largest land use type. More tree canopy is on residential land than any other land use type, and there is more room to plant trees on residential land than any other land use type.
- Despite the dominance of residential land use within the study area, all land use types have vegetated or impervious surfaces, that if improved, could yield additional tree canopy.
- In the Urbanization gradient, Principle Urban Centers and Urban Outskirts should be focused on for increasing greenness. Both categories contain large proportions of Residential land located on Possible Tree Canopy-Vegetation, making residents of Greater Bridgeport an important step in the process of increasing tree canopy.
- This type of limited but strategic tree planting is pertinent to all land-use types that contain vegetated or impervious surfaces; many opportunities exist for expanding tree canopy for all land use types. For example, other potential sites include road medians, sidewalks, driveways, storage areas, large expanses of lawn, and brushy vegetation. Under the right circumstances, these sites could be modified to support additional trees.
- When planning tree planting projects, the LifeMode groups should be reviewed for the Greater Bridgeport region. If working in an area classified as Global Roots, consider the residents native language and culture. Residents of the more youthful LifeMode groups such as, Solo Acts and Scholars and Patriots might be great targets for tree planting projects.

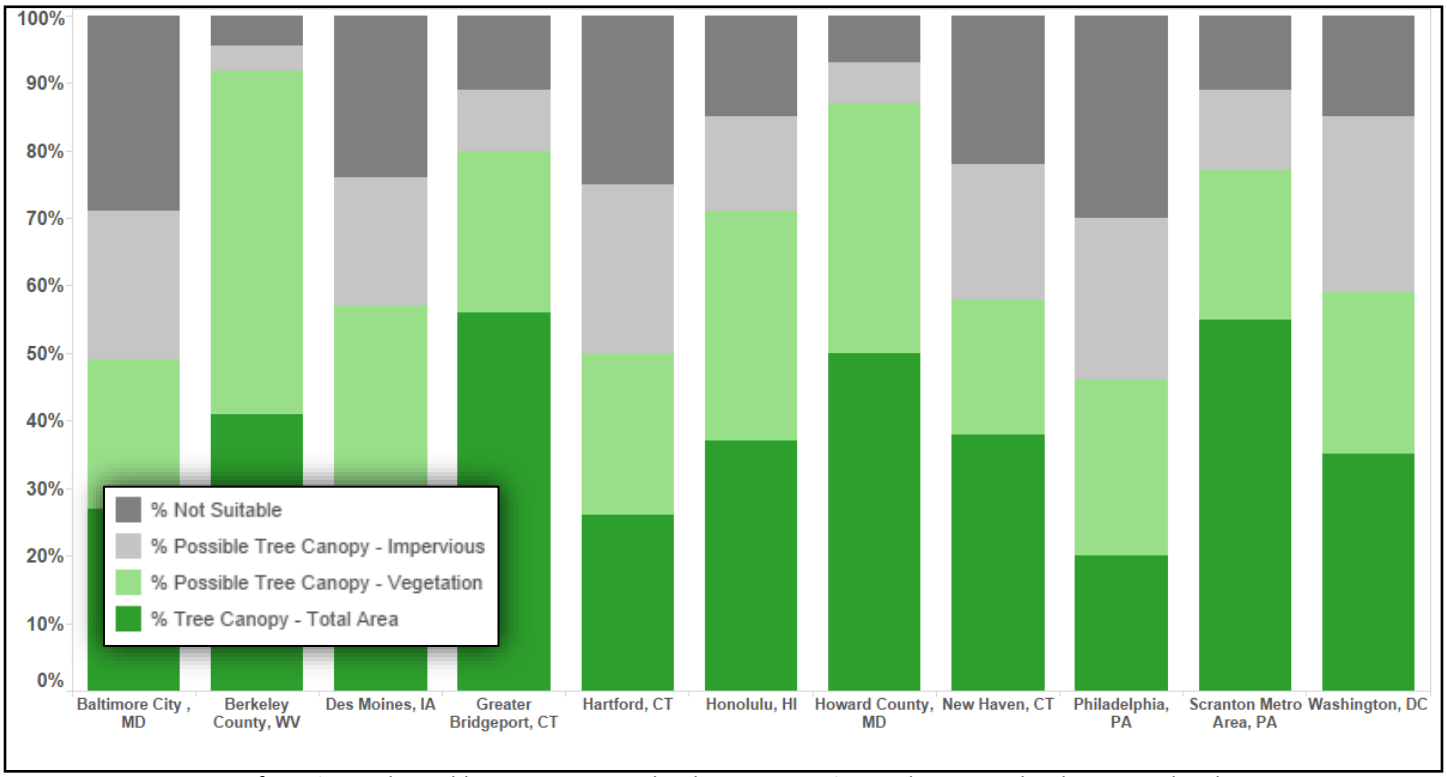

Figure 25: Comparison of Existing and Possible Tree Canopy with other communities similar in size that have completed Tree Canopy Assessments.

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Additional Information

For more info on the Urban Tree Canopy Assessment please visit **http://nrs.fs.fed.us/urban/UTC/**

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