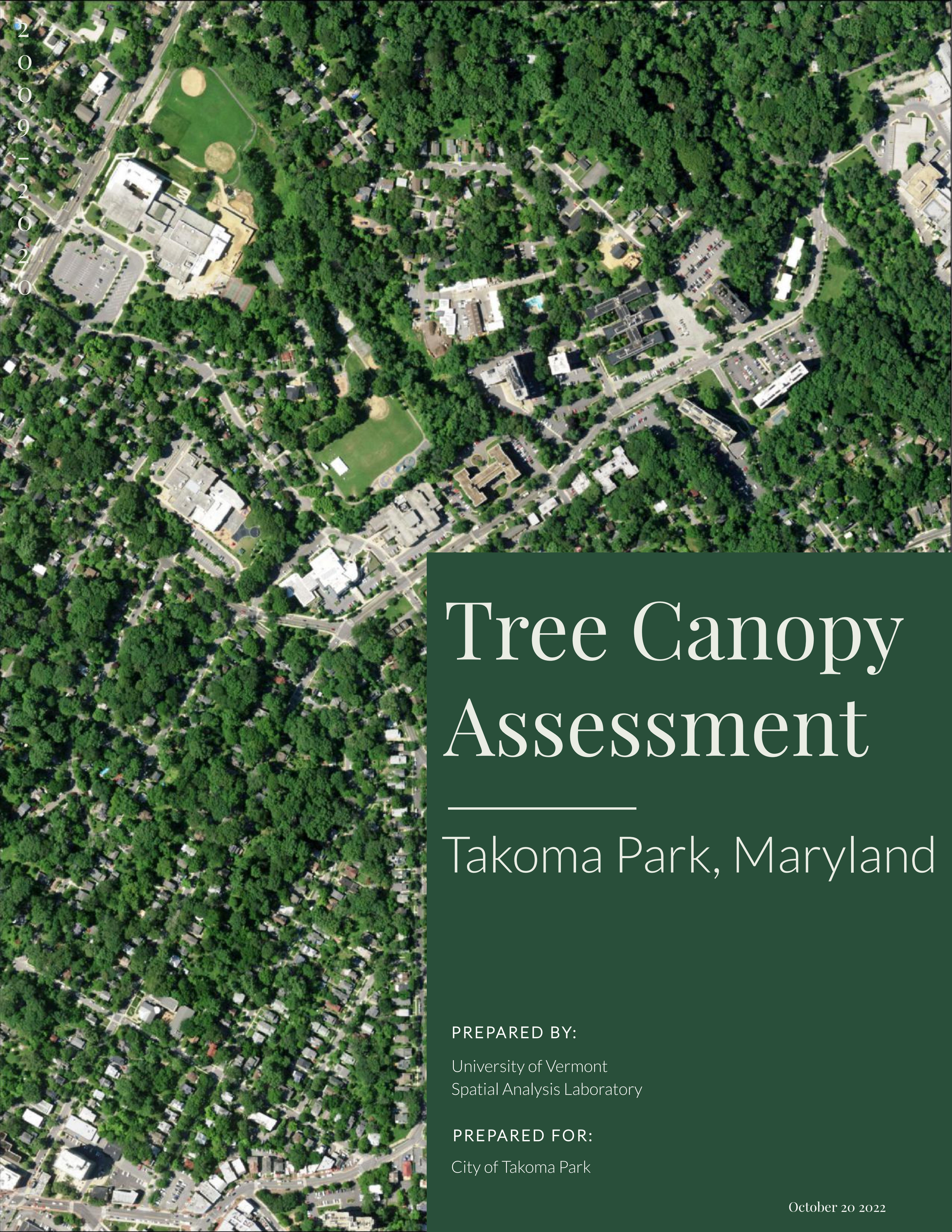


2009–2020

Tree Canopy Assessment

Takoma Park, Maryland

PREPARED BY:

University of Vermont
Spatial Analysis Laboratory

PREPARED FOR:

City of Takoma Park

October 20 2022

THE NEED FOR GREEN

Trees provide essential ecosystem services in Takoma Park, including reducing stormwater runoff, cooling the pavement in the summer, and providing wildlife habitat. In addition, trees are an indispensable part of the city's infrastructure. Research shows that these green assets can improve social cohesion, reduce crime, and benefit mental health. A robust urban forest is crucial to building a more livable and prosperous city while contributing to the health of the Chesapeake Bay Watershed.

As with any community, Takoma Park faces a host of environmental challenges while seeking to balance development and conservation. A healthy and robust tree canopy is crucial for maintaining this balance, providing Takoma Park's residents with a resource that will impact the health and well-being of generations to come.

TREE CANOPY ASSESSMENT

For decades, governments have mapped and monitored their infrastructure to support effective management practices. Traditionally, that mapping has primarily focused on gray infrastructure, including features such as roads and buildings. An accounting of the green infrastructure has been left out.

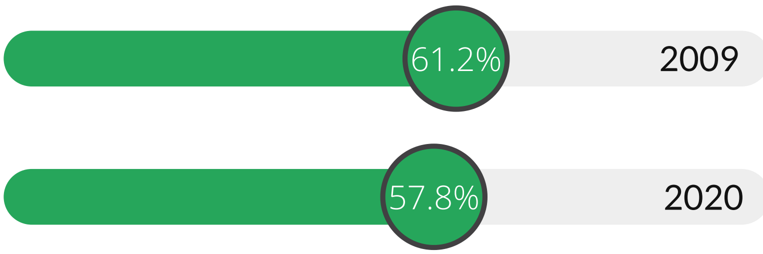
The USDA Forest Service developed Tree Canopy Assessment protocols to help communities better understand their green infrastructure through tree canopy mapping and analytics. Tree canopy is defined as the layer of leaves, branches, and stems that provide tree coverage of the ground when viewed from above.

A Tree Canopy Assessment offers vital information that helps governments and residents chart a greener future by providing them with information on the tree canopy they have, how it has changed, and where there is room to plant trees. Tree Canopy Assessments have been carried out for over 90 communities in North America. This study assessed tree canopy for Takoma Park over the 2009-2020 time period.

TREE CANOPY BY THE NUMBERS

Takoma Park is losing tree canopy. Tree canopy change was computed by mapping the no change, gains, and losses in tree canopy from 2009-2020.

Tree Canopy %



-3.4%

Absolute change in tree canopy

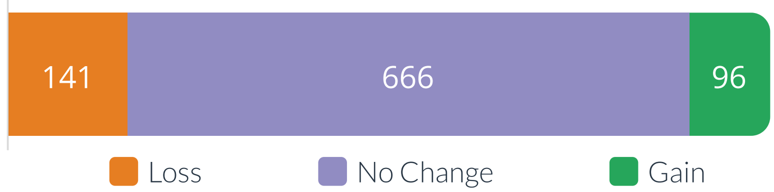
-5.6%

Relative change in tree canopy

141

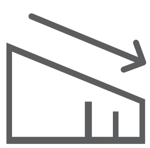
Acres of Loss

Tree Canopy Acres Change

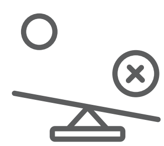


96

Acres of Gain



45 acres of net loss in tree canopy coverage.



Losses in tree canopy are outpacing gains, resulting in a net decrease in tree canopy.

Key Terms

Existing Tree Canopy: The amount of tree canopy present when viewed from above using aerial or satellite imagery.

Possible Tree Canopy - Vegetated: Grass or shrub area that is theoretically available for the establishment of tree canopy.

Possible Tree Canopy - Impervious: Asphalt, concrete or bare soil surfaces, excluding roads and buildings, that are 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).

Measuring Tree Canopy Change

Area Change - the change in the area of tree canopy between the two time periods.

Relative % Change - the magnitude of change in tree canopy based on the amount of tree canopy in first time period.

Absolute % Change - the percentage point change between the two time periods.

FINDINGS

Takoma Park's tree canopy decreased from 2009 to 2020, with a relative loss of 3.4%.

There were 96 acres of tree canopy gained and 141 acres of tree canopy lost from 2009 to 2020.

Although tree canopy decreased, gains have also been observed. For example, the city's investments in tree plantings and maintenance are paying off.

Changes in tree canopy vary throughout the city, from growth in residential trees to mature tree die-off to the removal of forest patches due to construction.

Most of the canopy gains come from fine-scale growth of existing trees, highlighting the importance of preservation efforts.

Despite the overall loss, there are gains indicating that tree planting and preservation efforts are effective and paying dividends as trees mature.

More tree canopy is on residential land than any other land use. Engaged residents who care for and enhance the tree canopy on their land is crucial.

Street trees contribute substantially to the city's overall canopy: 13.4% of Takoma Park's overall tree cover is in ROW (Right of Way) areas.

RECOMMENDATIONS

Preserving existing tree canopy is the most effective means for securing future tree canopy, as loss is an event but gain is a process.

Planting new trees in areas that have high summer temperatures and low tree canopy will enhance ecosystem services and improve equity.

Having trees with a broad age distribution and a variety of species will ensure that a robust and healthy tree canopy is possible over time.

Community education is crucial if tree canopy is to be maintained over time. Residents that are knowledgeable about the value of trees will help the city stay green for years to come.

Integrate the tree canopy change assessment data into planning decisions at all levels of government from individual park improvements, to comprehensive planning and zoning initiatives, to citywide ordinances.

Reassess the tree canopy at 3-5 year intervals to monitor change and make strategic management decisions.

Tree canopy assessments require high-quality, high-resolution data. Continue investing in LiDAR and imagery to support these assessments and other mapping needs.

Field data collection efforts should be used to compliment this assessment as information on tree species, size, and health can only be obtained through on-the-ground inventories.

THE TREE CANOPY ASSESSMENT PROCESS

This project employed the USDA Forest Service's Urban Tree Canopy assessment protocols and made use of federal, state, and local investments in geospatial data. Tree canopy assessments should be completed at regular intervals, every 3-5 years.

Remotely sensed data forms the foundation of the tree canopy assessment. We use high-resolution aerial imagery and LiDAR to map tree canopy and other land cover features.

The land cover data consists of tree canopy, grass/shrub, bare soil, water, buildings, roads/railroads, and other impervious features.

The land cover data are summarized by various geographical units, ranging from the property parcel to the watershed to the municipal boundary.

These summaries, in the form of tree canopy metrics, are an exhaustive geospatial database that enable the Existing and Possible Tree Canopy to be analyzed.

The tree canopy metrics data analytics provide basic summary statistics in addition to inferences on the relationship between tree canopy and other variables.

The report (this document) summarizes the project methods, results, and findings.

The presentation, given to partners and stakeholders in the region, provides the opportunity to ask questions about the assessment.

The Importance of Good Data

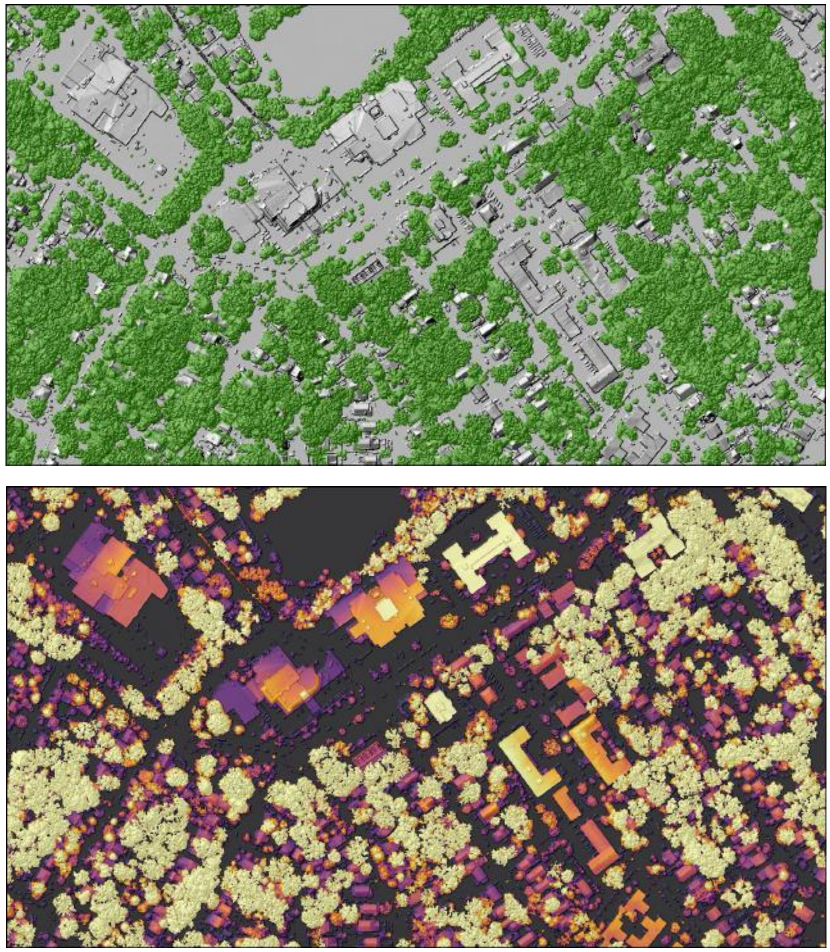
This assessment would not have been possible without investments in high-quality geospatial data, particularly LiDAR. These investments pay dividends for a variety of uses, from stormwater management to solar potential mapping. Good data supports good governance.

MAPPING THE TREE CANOPY FROM ABOVE

Tree canopy assessments rely on remotely sensed data in the form of aerial imagery and light detection and ranging (LiDAR) data. These datasets, which have been acquired by various governmental agencies in the region, are the foundational information for tree canopy mapping. Imagery provides information that enables features to be distinguished by their spectral (color) properties. As trees and shrubs can appear spectrally similar, or obscured by shadow, LiDAR, which consists of 3D height information, enhances the accuracy of the mapping. Tree canopy mapping is performed using a scientifically rigorous process that integrates cutting-edge automated feature extraction technologies with detailed manual reviews and editing. This combination of sensor and mapping technologies enabled the city's tree canopy to be mapped in greater detail and with better accuracy than ever before. From

The high-resolution land cover that forms the foundation of this project was generated from the most recent LiDAR, which was acquired in 2020. Compared to national tree canopy datasets, which map at a resolution of 30-meters, this project generated maps that were over 1,000 times more detailed and better account for all of the city's tree canopy.

Tree Canopy Mapping

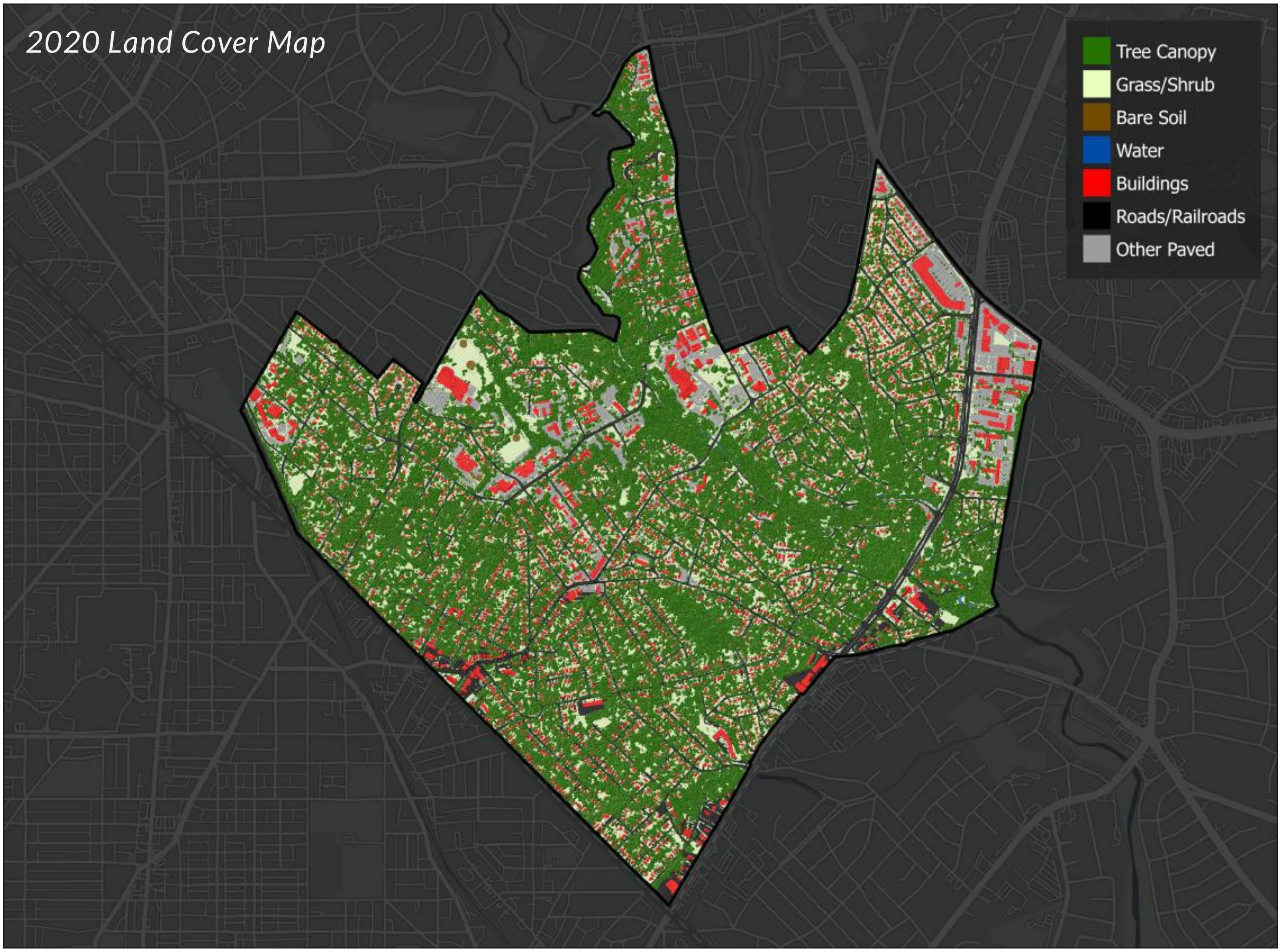


Locations of individual trees and their crowns (top) that were derived from the 2020 LiDAR (bottom).

Land Cover Mapping

High-resolution land cover developed for this project.

LANDCOVER



2020 Land Cover Map

The new 2020 landcover was used in this assessment to quantify existing tree canopy, possible tree canopy - vegetated, possible tree canopy - impervious, and not suitable. The following terminology is used throughout this report.

Key Terms

Existing Tree Canopy: The amount of tree canopy present when viewed from above using aerial or satellite imagery.

Possible Tree Canopy - Vegetated: Grass or shrub area that is theoretically available for **the** establishment of tree canopy.

Possible Tree Canopy - Impervious: Asphalt, **concrete** or bare soil surfaces, excluding roads and buildings, that are 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).

Measuring Tree Canopy Change

Area Change - the change in the **area of** tree canopy between the two time **periods.**

Relative % Change -the magnitude of change in tree canopy based on the amount of tree canopy in 2011.

Absolute % Change - the percentage point change between the two time periods.

Tree Canopy Change Mapping

Tree canopy change mapping is an inherently challenging task. Tree canopies in imagery do not appear in the exact location due to image parallax, making it far easier to map losses, which tend to be larger, more apparent events. This study relied on LiDAR, which is more positionally accurate and excels at identifying losses along with the fine-scale gains that occur on the edges of trees. The mapping would have indicated a loss if only imagery had been used for this study. The examples below show the tree canopy change mapping overlaid on the 2009 LiDAR (left panel) and the 2020 LiDAR (right panel). Tree canopy has a textured, rough appearance. Gains appear smooth in the 2008 imagery, and the canopy does not yet exist. Losses appear smooth in the 2020 LiDAR as the canopy is no longer present.

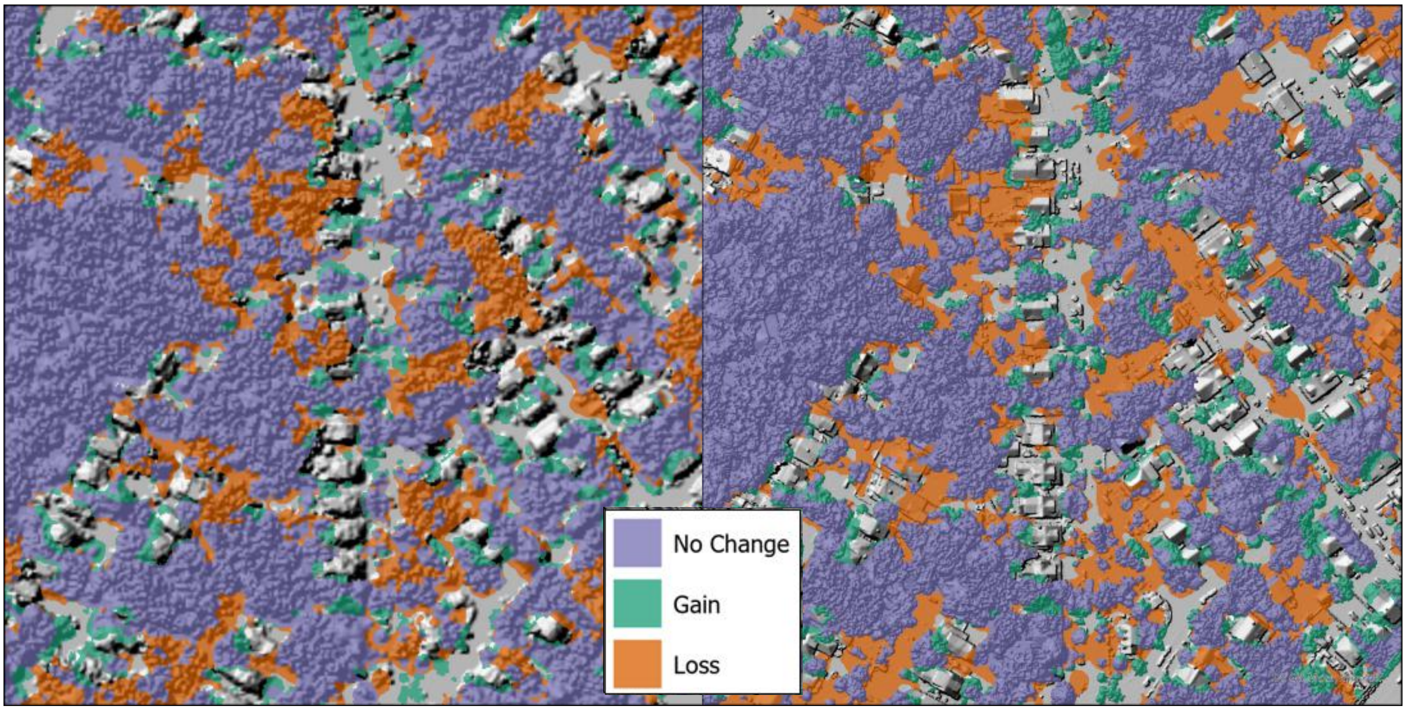


Figure 1. Tree canopy patch loss in the vicinity of Philadelphia Ave and Park Ave. Forest patches can provide important ecosystem services. Mature trees contribute large areas of tree canopy but take decades to replace when lost.

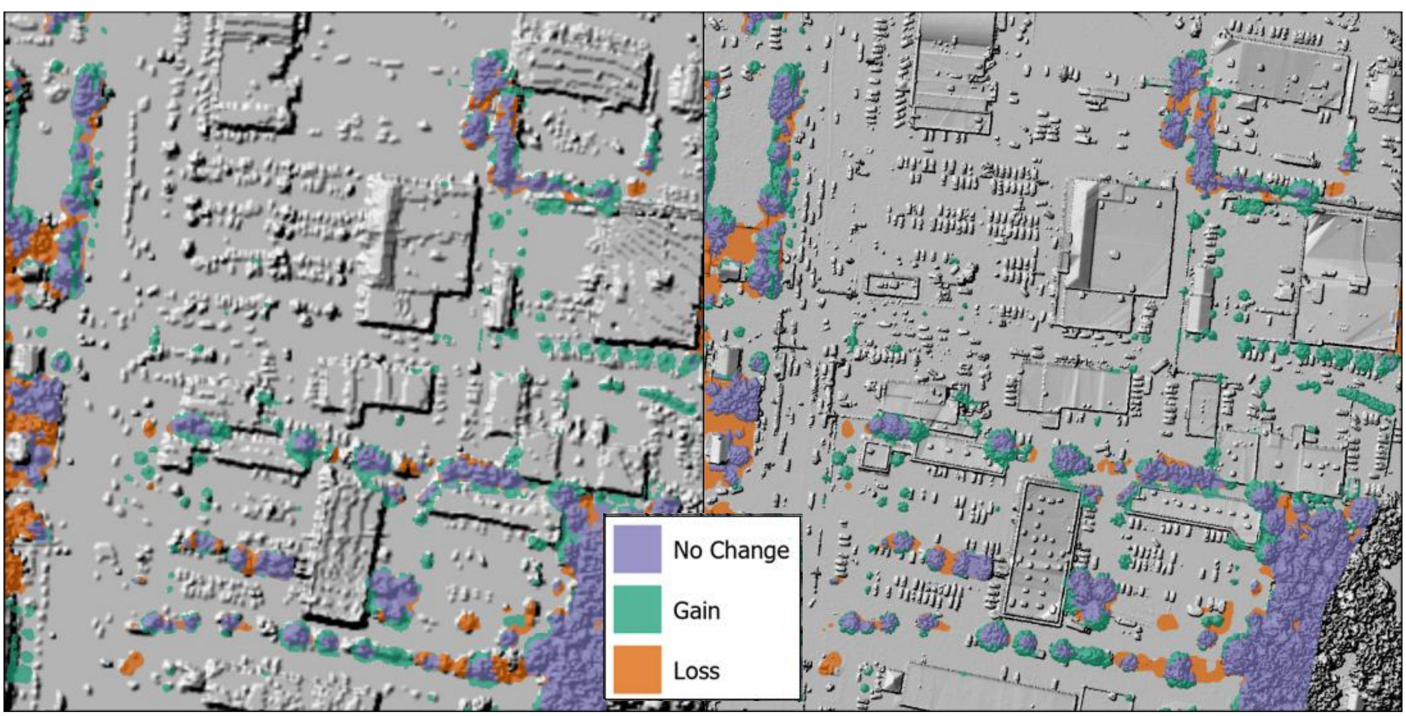


Figure 2. The commercial area around Holton Ln saw large relative gains in tree canopy due to the planting of new street trees. Increasing tree canopy in commercial and industrial zones helps reduce the urban heat island and stormwater runoff in these impervious surface-dominated areas.

Tree Canopy Change Mapping (continued)

The major limitation of LiDAR is that it is acquired under leaf-off conditions during the late fall or early spring. Thus, although it has improved positional accuracy, it tends to underestimate tree canopy slightly. This issue is more apparent in 2014 LiDAR, which is less detailed, and less of a factor in the higher-resolution 2018 LiDAR. This study employed techniques to address these issues. Still, it is likely that at least a portion of the canopy gain mapped, particularly the canopy associated with smaller trees, was present in 2014. Thus, the gains result from growth out beyond a four-year period.

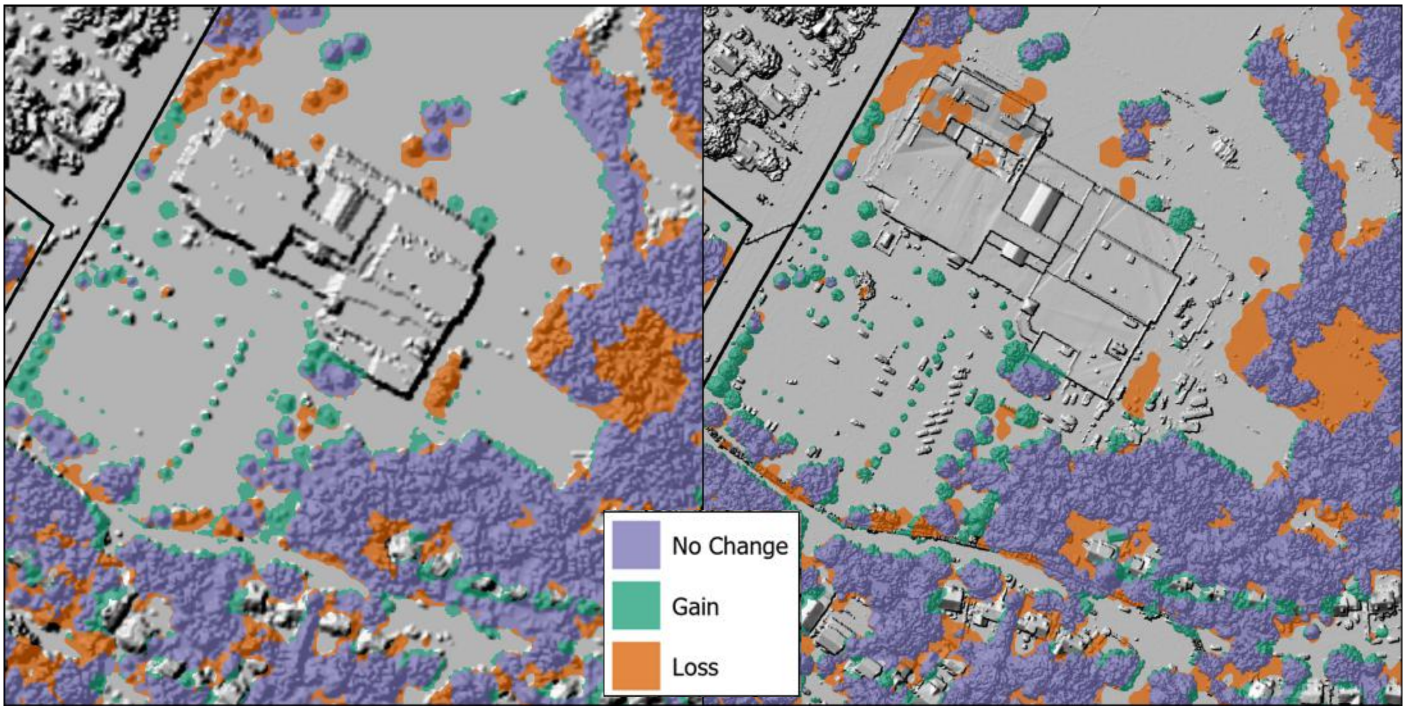


Figure 3. Forest patches were removed for new construction in the area of Takoma Park Middle School and the Takoma Park Dog Park. Gains can be noted along the edges of existing trees but are most pronounced in recently planted trees.

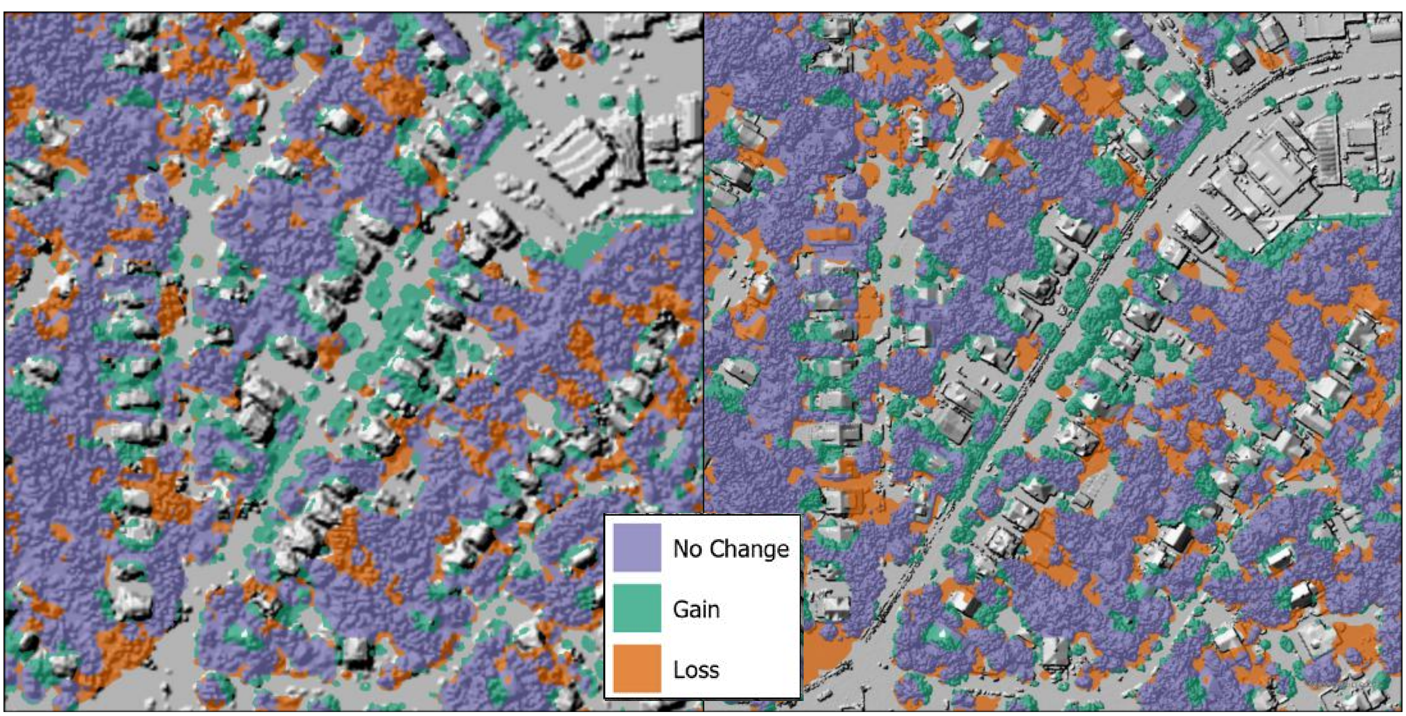


Figure 4. Although the trees planted along Carroll Ave trees were present in 2009, their growth resulted in large relative gains in canopy for this area and contributed to a slight net tree canopy gain in multi-family residential areas.

PATTERNS OF CHANGE

Numerous factors contribute to the wide range of tree canopy change patterns of Takoma Park. These include zoning, land use history, urban density, and landowner decisions. The examples that follow illustrate how these factors influence canopy change. Examining patterns and processes over the past decade can provide insights into how the canopy may change in the future.

Forest Patch Loss

Urban forest patches provide essential ecosystem services including to wildlife habitat and reduced runoff. Forest patches can be removed in a matter of days and take decades to rebuild.

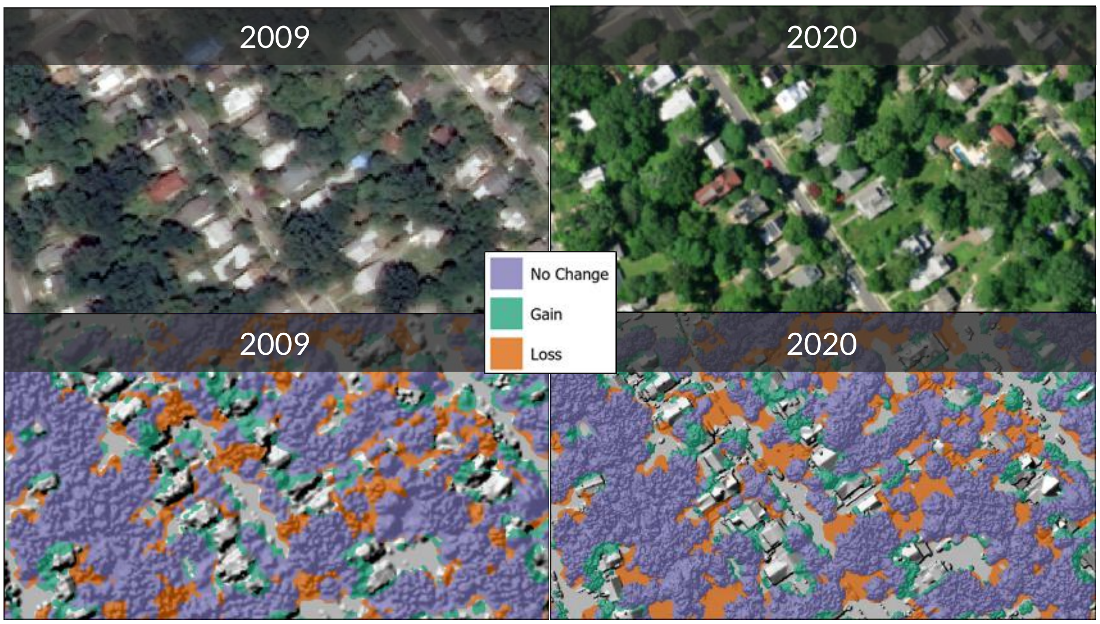


Figure 1. Loss of forest patches was widespread, possibly due to die off of mature oaks that had large canopies. An example is seen in the area around Sycamore Ave.

Forest Patch Loss

Single Family Residential Area

Mature oak die-off

Street Tree Growth

Tree planting and natural succession are slow but important processes for increasing urban tree canopy.

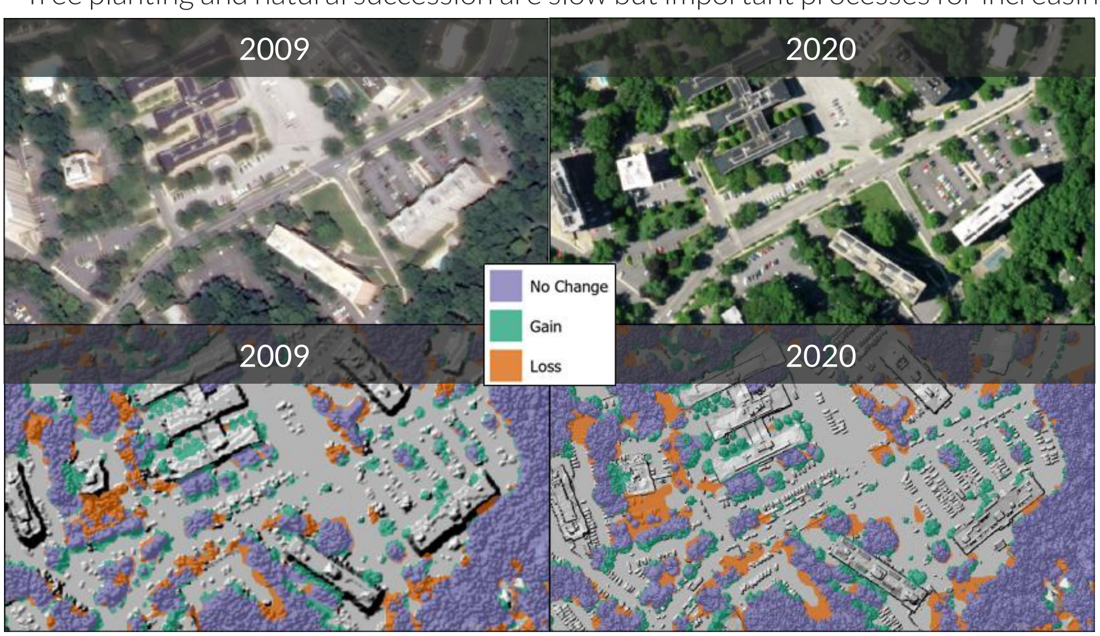


Figure 2. Natural growth and street tree plantings in ROW areas increased tree canopy in the multi-family residential area around Ritchie Ave and Maple Ave .

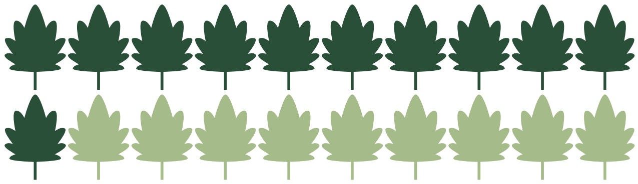
Tree canopy gain

Multi-Family Residential Area

Tree Planting

TREE CANOPY METRICS

57.8% *of Takoma Park's land is covered by tree canopy*



Tree canopy metrics provide insights into the distribution and factors influencing tree canopy and canopy change. The metrics were computed using GIS and summarized the Existing Tree Canopy, Possible Tree Canopy, and Tree Canopy Change at various geographical units of analysis, ranging from land property parcels to neighborhood boundaries.
**Please refer to page 3 for definitions.*

Existing Tree Canopy

Takoma Park is a mosaic of landscapes, including parks, commercial areas, and suburban residential lands. This patchwork leads to uneven distribution of tree canopy. A grid of 2-acre hexagons was used to visualize the distribution of tree canopy. Across the city, canopy coverage within these hexagons ranges from less than 1% to over 90%. Higher amounts of tree canopy are present in parks and established residential areas—the lowest amounts of tree canopy exist in the industrial and commercial districts.

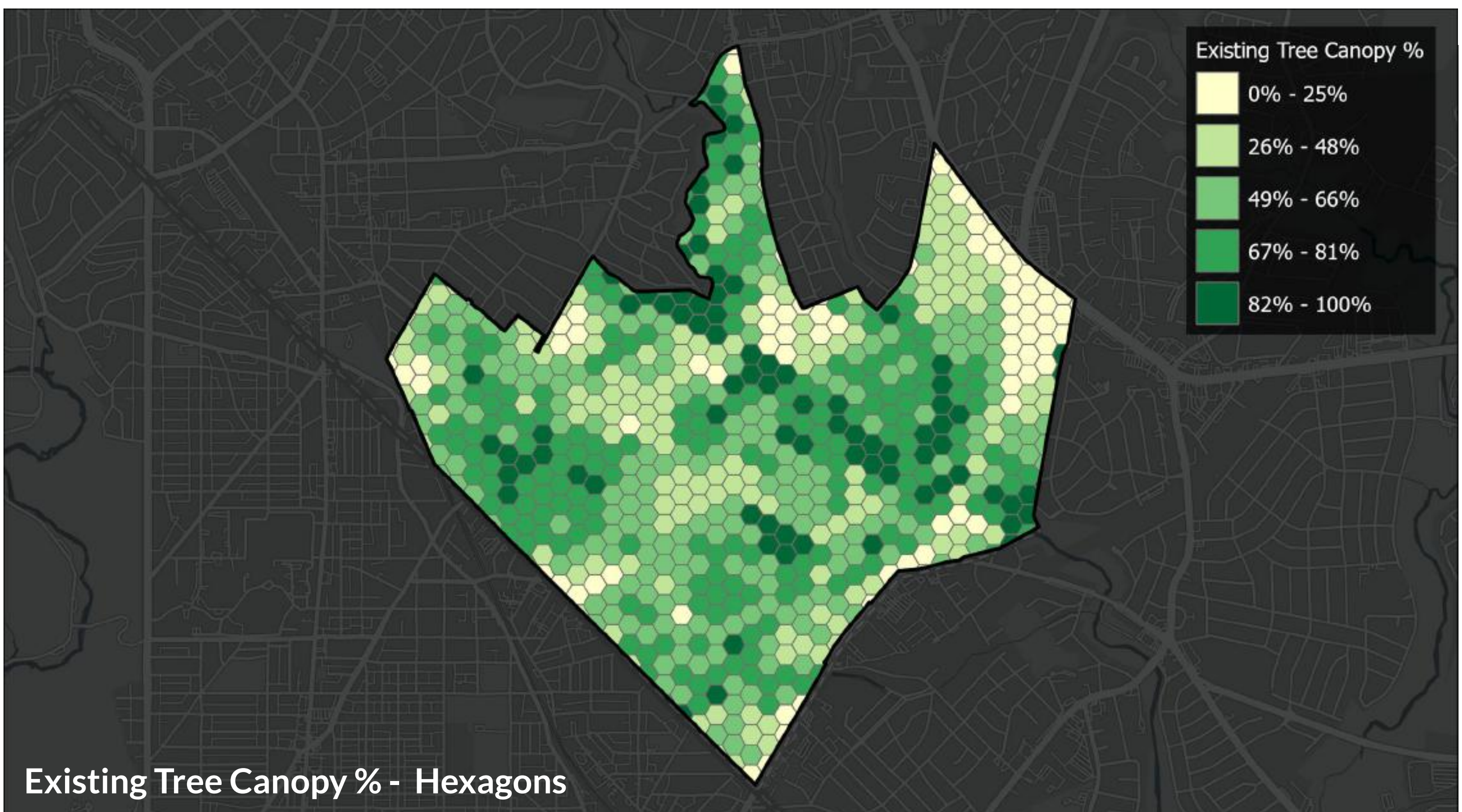


Figure 3. Tree Canopy was calculated by dividing the amount of tree canopy by the land area, which excludes water. Using hexagons as the unit of analysis provides a standard mechanism for visualizing the distribution of tree canopy without the constraints of other geographies that have unequal area (e.g., neighborhoods).

Possible New Tree Canopy

There is available space in Takoma Park to expand the tree canopy. In this assessment, any areas with no trees, buildings, roads, or bodies of water are considered Possible-Vegetation and represent locations in which trees could theoretically be established without having to remove hard surfaces. Many factors go into deciding where a tree can be planted with the necessary conditions to flourish, including land use, landscape conditions, social attitudes towards trees, and financial considerations. Examples include golf courses and recreational fields.

The Possible-Vegetation category should serve as a guide for further field analysis, not a prescription of where to plant trees. With about 200 acres of land, comprising nearly 15% of the city's land base falling into the Possible-Vegetation category, there remain significant opportunities for planting trees and preserving canopy that will improve the city's total tree canopy in the long term. It is also important to note that in Takoma Park, planting trees in areas with higher impervious cover will significantly impact the urban heat island. A small planting patch in a parking lot can grow a tree with a large enough canopy to cover a wide area.

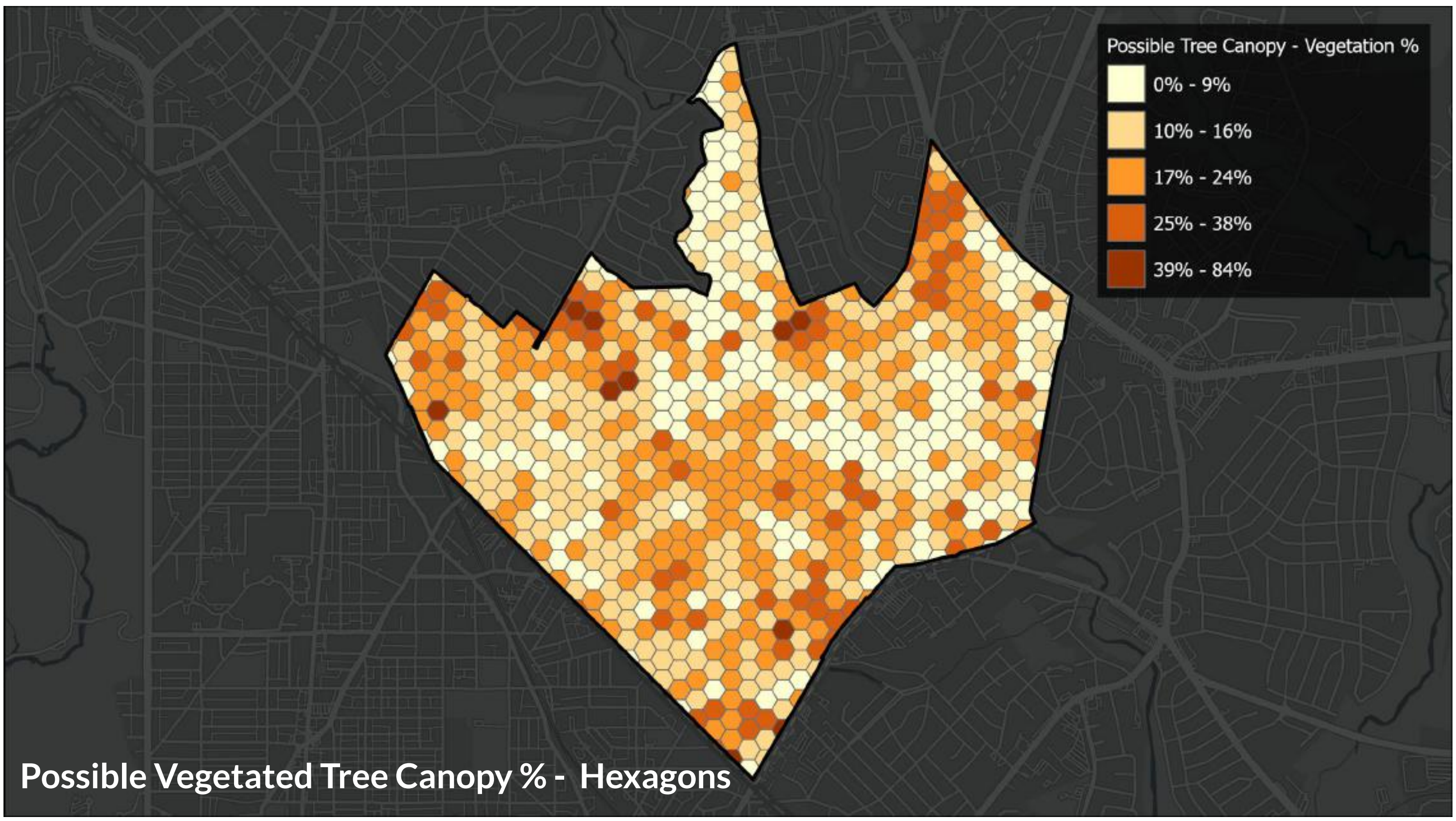


Figure 4. Possible Tree Canopy consisting of non-treed vegetated surfaces summarized by 2-acre hexagons. These vegetated surfaces that are not currently covered by tree canopy represent areas where it is biophysically feasible to establish new tree canopy. It may be financially challenging or socially undesirable to establish new tree canopy on much of this land. Examples include golf courses, recreational and agricultural fields. Maps of the Possible Tree Canopy can assist in strategic planning, but decisions on where to plant trees should be made based on field verification. Surface, underground, and above surface factors ranging from sidewalks to utilities can affect the suitability of a site for tree canopy planting.

Canopy Change Distribution — Absolute % Change

Takoma Park has experienced a net decrease in tree canopy, but not all areas have experienced loss. Die off of mature oaks resulted in the loss of large patches of tree canopy. Mature trees with large crowns contribute substantially to tree canopy and take decades to grow, so their loss creates large, localized declines in tree canopy. Even though there was evidence of tree loss throughout the city, planting efforts, preservation programs, and natural growth helped offset losses and stem decline. Canopy begets canopy as almost all trees gain canopy on an annual basis.

The trajectory of Takoma Park's tree canopy in the future is uncertain. There are both environmental and anthropogenic risks facing canopy cover. Invasive species could pose a serious threat if not identified and controlled early. Natural events such as storms can have a mixed impact on the canopy. In conserved areas, tree canopy will return through natural growth, but in urbanized areas, trees lost to storms will need to be replanted.

Since 2018, Takoma Park has faced losses of mature oak trees due to weather-related stress, insects, and disease. Of the 141 acres of tree canopy loss the city faced between 2009 and 2020, 44.8 acres seem to have been lost since 2018. The fact that nearly one third of the city's total tree canopy loss occurred in the two year period between 2018 and 2020 speaks to the severity of the oak tree die-offs and its impact on the city's overall tree canopy. Managing these risks will be key to achieving canopy growth.

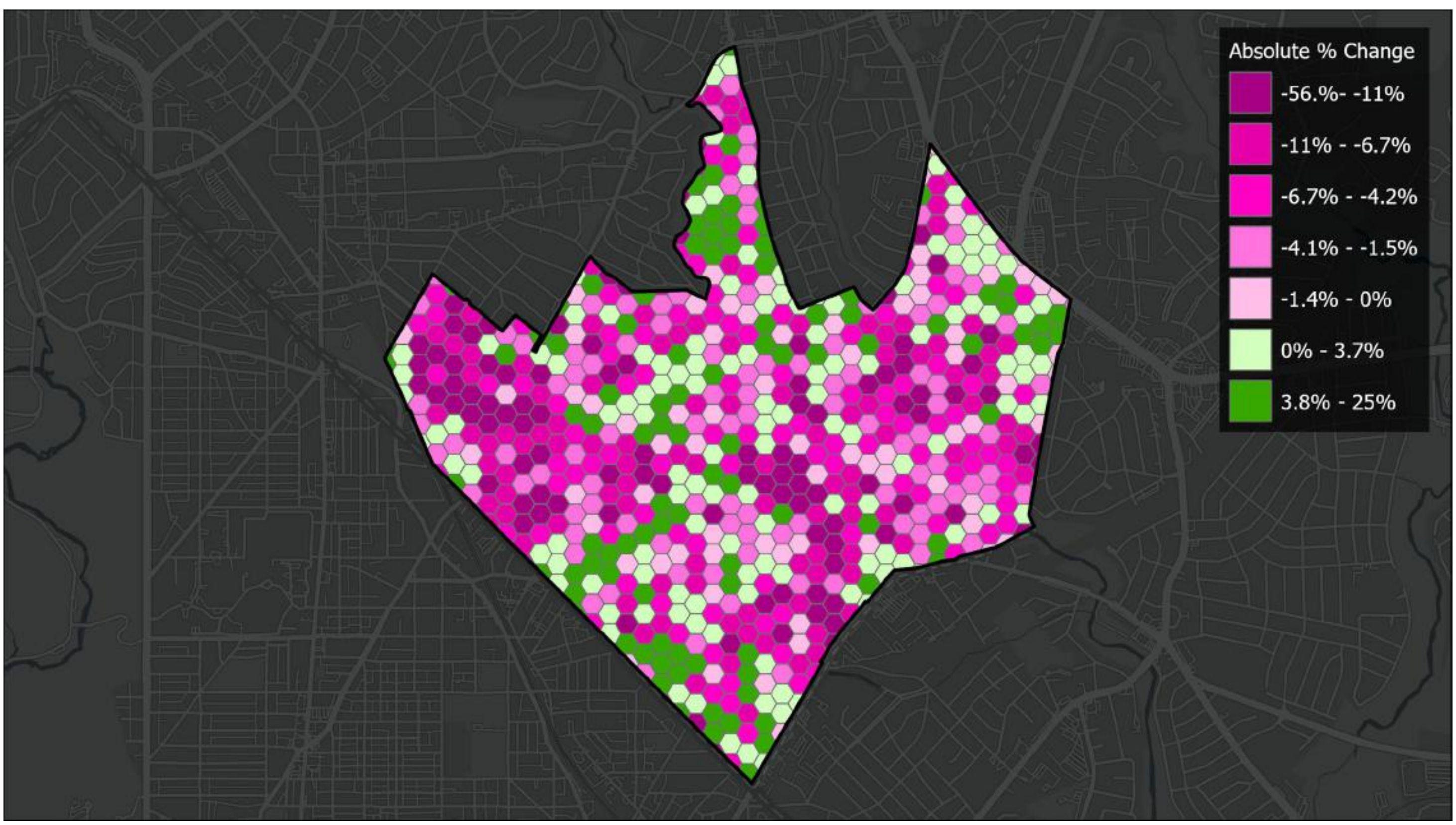


Figure 5: Tree canopy change summarized by 2-acre hexagons. Darker greens indicate greater gain, while darker purple reflects higher amounts of loss.

Canopy Change Distribution — Relative % Change

The magnitude of tree canopy change across Takoma Park can be measured by the relative tree canopy change over the 2009-2020 period. The relative change is calculated by taking the tree canopy area in 2009, subtracting the tree canopy area in 2020, then dividing this number by the area of tree canopy in 2009. Areas with the greatest change indicate that the canopy is markedly different in 2020 as compared to 2009. In some of the commercial and urbanized areas with little tree canopy in 2009, the growth of street trees resulted in a sizeable relative gain. Conversely, the removal of trees as a result of construction in sparsely treed areas resulted in substantial relative reductions in tree canopy.

The greatest relative gains in tree canopy were in locations where new plantings were carried out on areas with little tree canopy to begin with. Just as forest patches provide valuable ecosystem services, such as wildlife habitat, so do individual trees. In areas with low tree canopy, an individual tree can provide a refuge from the sun while watching a baseball game, shade cars in a parking lot or help to reduce homeowner air conditioning costs. Though growing conditions in ROW areas can be tough, they are a tool to increase canopy in low coverage areas. Natural growth can provide gains in areas with robust canopy, but in areas with low canopy, such as commercial spaces, tree plantings are an important part of a long-term plan to increase tree canopy.

Figure 6: Tree canopy change metrics summarized by 2-hectare hexagons. Relative tree canopy is calculated by using the formula (2009-2020)/2020. Colors are categorized by data quantiles. Darker greens indicate greater relative gain, while darker purple reflects a higher magnitude of loss.

Land Use

Understanding the location and land-use types that tree canopy falls into is important information for coordination and planning purposes. Tree canopy cover was calculated in terms of percent of the land area within each land-use (Figure 13), and as a percent of Takoma Park's total tree cover area (Figure 12) to determine what proportion of Takoma Park's overall tree canopy is found in each land-use.

The majority of Takoma Park's tree canopy (62%) falls in Single Family Detached units. Yet these areas saw a decrease of more than 35 acres of tree canopy between 2009 and 2020. Rights-of-way ROW areas are the second largest contributor to Takoma Park's overall tree canopy (13.4%), though ROW growing environments are often inhospitable due to proximity to roads and powerlines. Parks closely follow ROW, making up 12.3% of Takoma Park's tree canopy. Multi-Family units are the next greatest contributor at 5.9%, followed by Institutional/Community Facility units at 3.8%. These land-uses make up relatively large proportions of the city's total land area (7.2% and 7.5% respectively) and present an opportunity to increase overall tree cover as well as access to greenspaces. Industrial units have only 6% tree canopy coverage and make up only 0.2% of the city's tree cover but saw a 164% relative increase in tree cover from 2009 to 2020. This is an example of how that individual trees can have an outsized impact on urban cooling, stormwater runoff, and aesthetics.

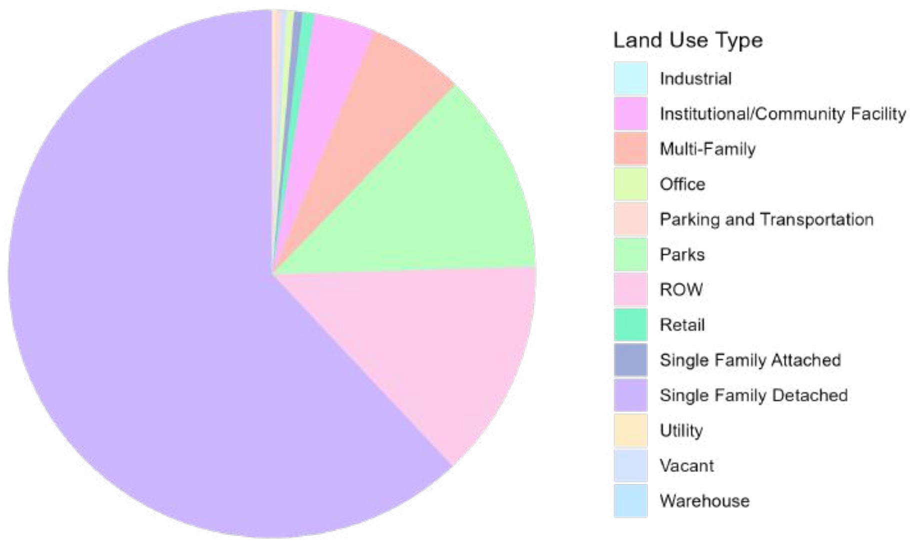


Figure 7: Takoma ParkTree Canopy Distribution by Land Use type.

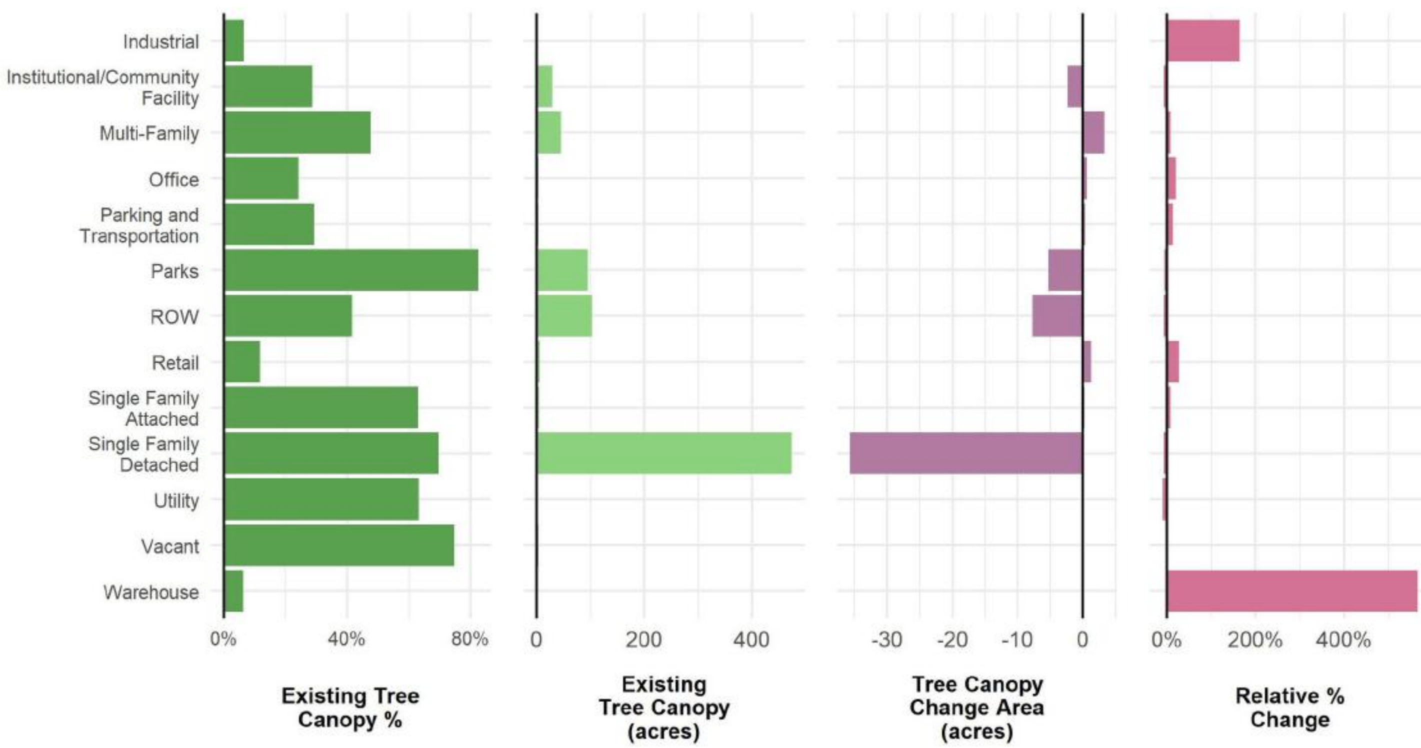


Figure 8: Tree canopy and change metrics by Land Use

Wards

Takoma Park is divided into six wards, each represented by a council member. These administrative boundaries are a useful way to summarize tree canopy and draw comparisons between parts of the city.

All of Takoma Park's wards saw both losses and gains in tree canopy. Ward 5 was the only one to see a net increase in tree canopy between 2009 and 2020, with a gain of 0.6 acres, making for a relative percent change of 0.7%. Ward 2 had both the largest tree canopy in terms of acreage (186 acres) and the highest coverage in terms of percent of land area (66.7%), followed by Ward 1 with 172 acres of tree canopy, covering 60.7% of the ward. However, Wards 1 and 2 also saw the largest area of lost tree cover (16.5 and 16.3 acres respectively) making for the highest relative percent losses at 8.7% for Ward 1 and 8% for Ward 2. Wards 3, 4, and 6 saw similar but less extreme trends.

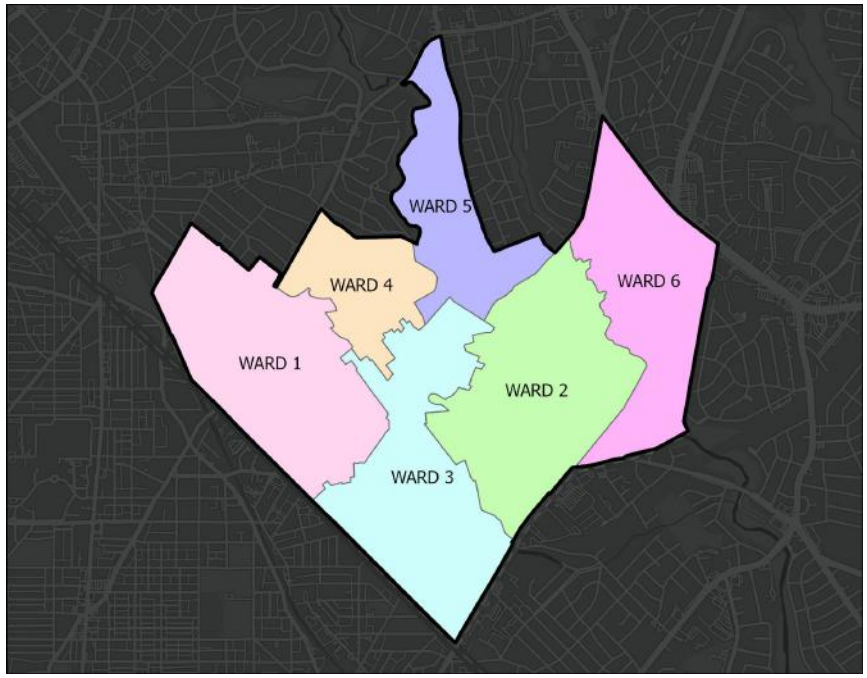


Figure 10: City of Takoma Park official wards.

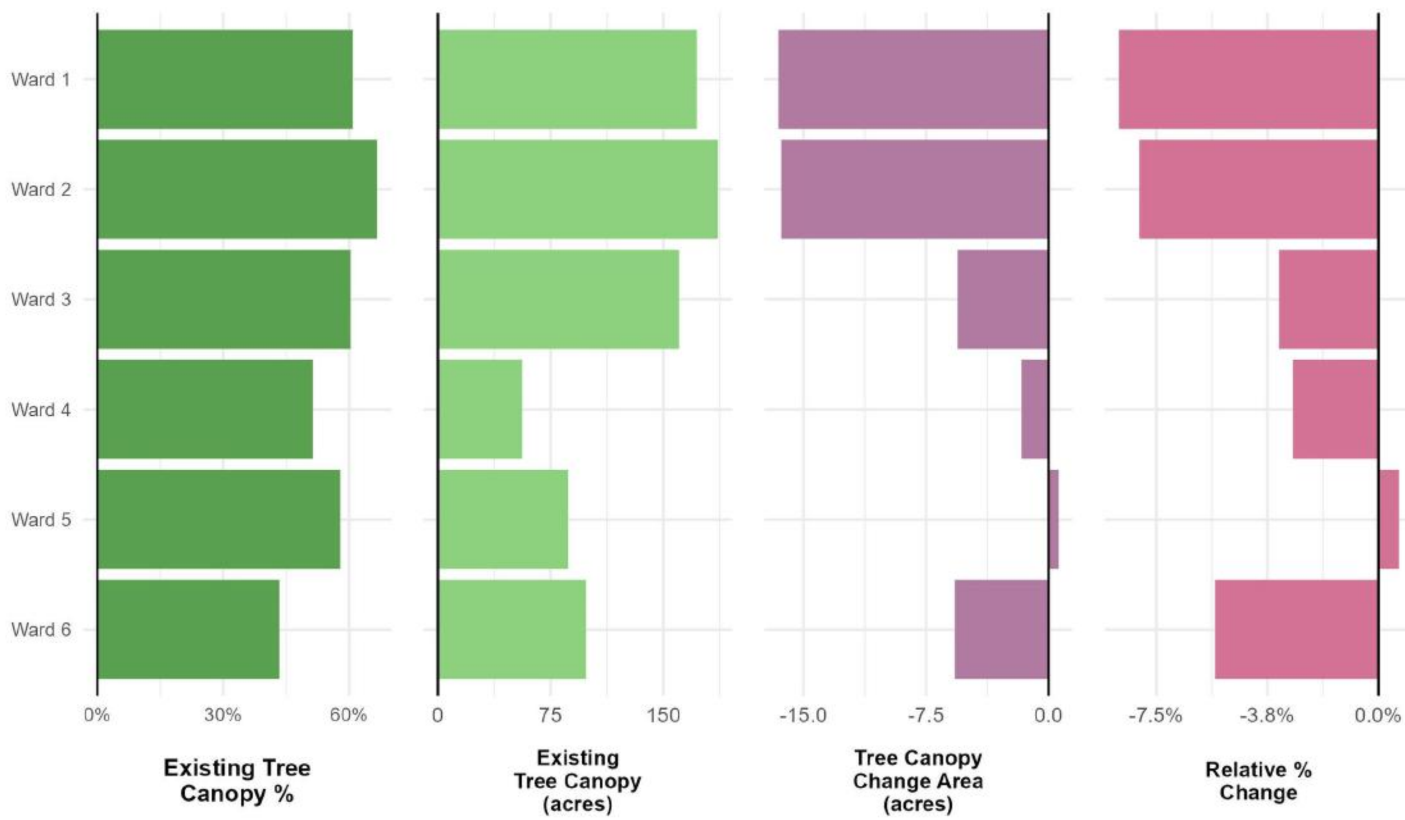


Figure 11: Tree canopy and change metrics by Ward

TREE COUNT

38,000+

Takoma Park has over thirty-eight thousand individual trees in the city, an estimate that was derived from the 2020 LiDAR data.

Tree Crowns & Centroids

Trees, particularly individual ones located in parks, on streets, on college greens, and on residential lands, require attention, care, and maintenance to thrive. In addition to quantifying the town's tree canopy acreage and percent coverage, this study produced an estimate of the number of individual trees in Takoma Park. This analysis was performed using the 2020 LiDAR data. While not a replacement for field-based inventories, LiDAR provides a unique advantage in that all of Takoma Park's trees can be counted. With Takoma Park having an estimated over 38,000, it is important that tree maintenance remains a high priority for land managers. Tree maintenance and care activities will ensure that these critical green infrastructure assets thrive in a challenging urban environment.

Figure 12. Tree centroids (dots) and tree crowns (circles) mapped from the 2020 LiDAR. Tree mapping from LiDAR involves finding relative high points for each tree, then tracing down until a height inflection point is reached, marking the edge of the crown. This approach to individual tree mapping is most accurate where there is a clear differentiation in tree crowns and is less accurate in forested stands where crowns may overlap.

Height

Canopy height is essential for understanding the vertical structure of Takoma Park's urban forest. Height can also be used as a reasonable proxy for age. The location, crown radius, and height of trees were estimated by applying an automated tree detection algorithm to the 2020 LiDAR data. Takoma Park has a relatively evenly structured urban forest. This bodes well for the long-term viability of the city's tree canopy as it is less likely that large portions of the tree canopy

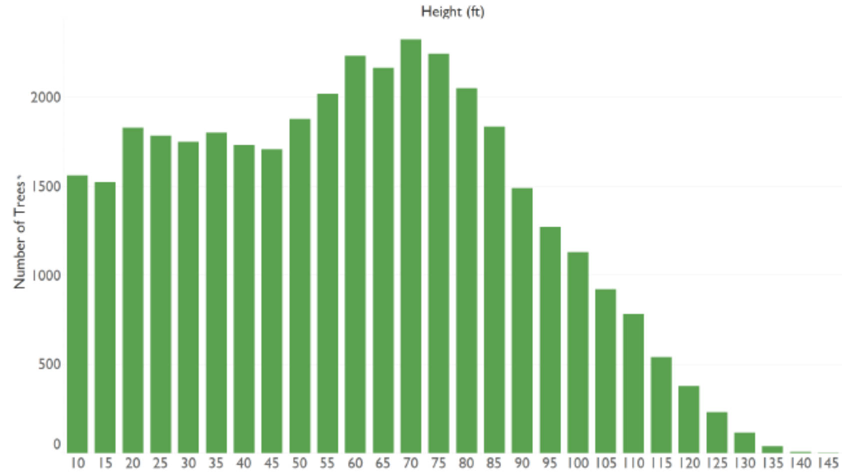


Figure 13: Histogram of the tree canopy height displaying the number of trees . Bins are 5 foot height intervals

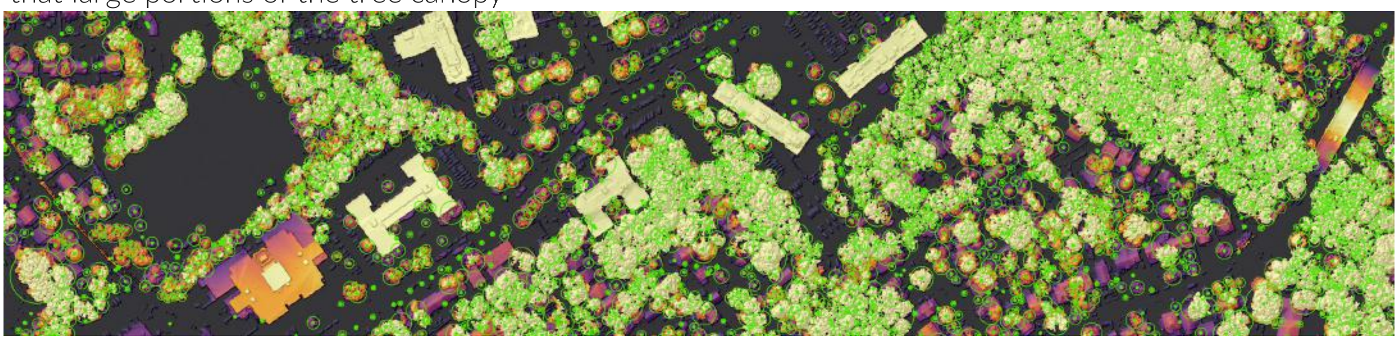


Figure 14. Tree locations (points) and tree crowns (circles) overlaid on the 2020 LiDAR.

Land Use Tree Count

60% of the city's individual trees are located on residential single-family detached land, followed by rights-of-way (ROW) at 15% and parks at 12%. The tree canopy area summaries also found that single-family detached was the highest but the area of tree canopy in the ROW was lower. While trees in the ROW may contribute less canopy, there are over 5,700 of them providing key buffering capacity against the heat island and stormwater runoff.

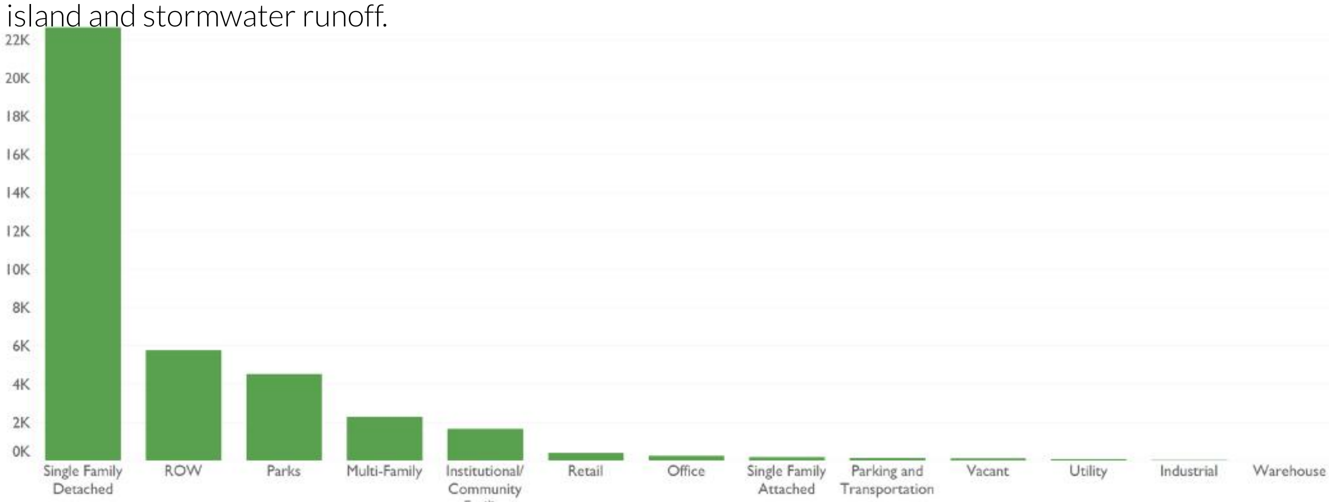


Figure 15. Tree counts summarized by land use type.

This assessment was carried out by the University of Vermont Spatial Analysis Lab. The methods and tools used for this assessment were developed in partnership with the USDA Forest Service. The source data used for the mapping came from the City of Takoma Park, Maryland, the USDA, and the USGS. The project was funded by the City of Takoma Park. Additional support for data analytics came from a Catalyst Award from the Gund Institute for Environment at the University of Vermont. Computations were performed on the Vermont Advanced Computing Core supported in part by NSF award No. OAC-1827314.

Report Authors
Jarlath O'Neil-Dunne
Mayra Rodriguez
Marie Bouffard

Tree Canopy Assessment Team
Ernie Buford
Anna Royar
Kelly Schulze
Livia Kovacevic
Griffin Shelor

City of Takoma Park Contact
Marty Frye
Urban Forest Manager
Public Works
City of Takoma Park
31 Oswego Avenue
Silver Spring, MD 20910