COMMUNITY CANOPY

ASSESSMENT

HICKORY,
NORTH CAROLINA
MARCH | 2024

Funding for this project was provided in part through an Urban & Community Forestry Grant from the North Carolina Forest Service, Department of Agriculture and Consumer Services, in cooperation with the USDA Forest Service, Southern Region.

EXECUTIVE SUMMARY

PURPOSE AND METHODS

Tree canopies are constantly changing. Growth and plantings add to and expand canopy coverage; development, disasters, disease, and pests can take it away. Canopy assessments based on aerial imagery can track these changes precisely. This report evaluates changes in tree canopy within Hickory, North Carolina, primarily located in Catawba County. Results are summarized at the public property, zoning, and census block group level to better understand how tree canopy is distributed within the city.

Based on 2022 imagery from the USDA's National Agriculture Imagery Program (NAIP), this study provides a near-current view of land cover in Hickory. This enables the City of Hickory to revise existing strategies and develop new ones for protecting and expanding the community forest. This study used machine learning techniques to create land cover data to facilitate more uniform comparisons in future tree canopy assessments. **Following US Forest Service standards, this assessment focuses on tree canopy as a percentage of land, excluding water.** The key goals of this tree canopy cover assessment include:

- **Quantify the amount and location of tree canopy and other land cover types**
- **Analyze the change in canopy cover from 2014 to 2022**
- **Measure the ecosystem services provided by the tree canopy**
- **Identify areas where tree canopy can be expanded (Possible Planting Area analysis)**
- **Provide data to inform future planning and to establish canopy coverage goals**

HICKORY'S COMMUNITY CANOPY

In 2022, less than half of Hickory (42%) was covered with tree canopy. The remaining portion of the city was split between areas unsuitable (35%) and suitable for planting (24%).

Hickory's tree canopy cover was assessed in 2014 and 2022. Over the 8-year study period, Hickory's tree canopy cover slightly increased. Within the current city boundary, tree canopy increased by 264 acres, a +1.3% increase from 2014 to 2022. While it's likely that the canopy coverage fluctuated over the past eight years, the imagery used in this assessment provides a snapshot of the canopy at the time the imagery was collected.

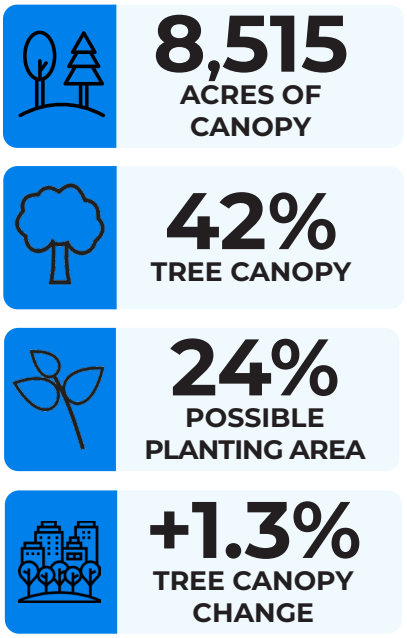


Figure 1. Based on an analysis of 2022 high-resolution imagery.

PROJECT METHODOLOGY

MAPPING LAND COVER

This assessment utilized high-resolution (60-centimeter) multi-spectral imagery from the US Department of Agriculture's National Agriculture Imagery Program (NAIP), collected in 2022, to derive land cover data and classify all types of land cover. Additionally, 1-meter resolution data from 2014 was utilized for historical tree canopy classification and change analysis.

The land cover data set, sourced from the EarthDefine US Tree Map (https://www.earthdefine.com/treemap/), provided a six-class land cover data set. EarthDefine employs machine-learning techniques to extract tree canopy cover and other land cover types from the latest 2022 NAIP imagery. Only the tree canopy land cover type was extracted from the 2014 imagery.

Figure 2. This study identified six (6) unique land cover classes within the 2022 assessment imagery: tree canopy, shrubs, other vegetation, bare soil and dry vegetation, impervious surfaces, and water.

IDENTIFYING POSSIBLE PLANTING AREAS

In addition to quantifying Hickory's existing tree canopy cover, areas suitable for planting trees (PPA-Possible Planting Area) to increase canopy cover were identified. To identify PPA, areas absent of tree canopy cover were classified as either PPA or unsustainable for planting. Unsuitable areas for tree planting, such as recreation fields, utility corridors, landfills, airports, wastewater treatment areas, golf courses, etc., were manually delineated and overlaid with the existing land cover data set (Figure 3). The final classifications include PPA Vegetation, Unsuitable Impervious, Unsuitable Vegetation, Unsuitable Soil, and Water.

Figure 3. The study identified vegetated areas where it would be feasible for tree plantings but undesirable based on their current usage (left) in the data as "Unsuitable" (right).

STATE OF THE CANOPY AND KEY FINDINGS

The results of this study can be used to design a strategic approach to managing existing canopy and identifying future planting areas. The land cover data presented below depicts the current city limits of Hickory as of 2024.

This assessment report focuses solely on the metrics within the city limits and does not include unincorporated areas. Figure 4 illustrates the distribution of land cover in Hickory, **including water bodies.** Less than half of the city (42%) was covered with tree canopy. Vegetation, such as grass and low bushes, accounted for approximately 25% of the city's land cover. Buildings and roads made up another 29% of Hickory's area. Bare soil constituted 3%, while water bodies and shrub areas represented less than 2% of the total area.

Table 1. Land cover classes in acres and percent in Hickory.

Class	Acres	Percent
Tree Canopy	8,515	42%
Non-Canopy Vegetation	5,073	25%
Impervious Surfaces	6,031	29%
Soil/Dry Vegetation	567	3%
Shrubs	296	<1%
Water	33	<1%

Figure 4. Land cover classification results (percentages based on the total area of Hickory's boundary including water bodies).

CITY-WIDE TREE CANOPY COVER

Excluding the 33 acres of surface water, the city occupies 20,482 land acres. In 2022, 42% of Hickory's land area was covered by tree canopy. Twenty-four percent, or 4,823 acres, were available to plant trees (PPA). However, planting trees in some land cover classes is not feasible, and the remaining 35% of land was considered unsuitable, primarily due to 6,031 acres of impervious surfaces.

In 2014, Hickory had 8,252 acres of tree canopy, meaning the city has gained canopy (1.3% increase or 264 acres) over the eight-year study period.

Table 2. Tree canopy potential in acres and percent in Hickory.

Class	Acres	Percent
Existing Canopy	8,515	42%
Possible Planting Area	4,823	24%
Unsuitable Planting Area	7,144	35%

Figure 5. Distribution of tree canopy, possible planting area, and areas unsuitable for tree canopy within the City of Hickory.

Hickory gained 1.3% tree canopy cover between 2014 and 2022.

TREE CANOPY COVER BY ZONING

Tree canopy was assessed on five permitted zoning classes, to identify any relationships between the city's zoning classes and tree canopy cover. This approach provides insights for urban planning and environmental management, facilitating targeted strategies for sustainable urban development. Zoned areas within the city limits total 17,651 acres, contributing 7,856 acres of tree canopy.

Residential zones comprised over 45% of the city's total land. This zoning type contained 60% of all tree cover (5,126 acres) in Hickory, making it the most significant zoning type in terms of canopy coverage. Residential and Industrial zones represent 84% of the city's total canopy cover distribution. They also offer the largest potential planting area, with a combined total of 3,232 acres, which is 67% of all the space available for planting.

Between 2014 and 2022, only one zoning class, Office, lost canopy cover (-33 acres or -4%). Residential zones saw the greatest gain, 145 canopy acres (1.5% increase).

Table 3. Tree canopy and possible planting acres, percent, and percent distribution by zoning classes.

Zoning Classes	Total Area (Acres)	Land Area (Acres)	Distribution of Land Area (%)	TC (Acres)	TC (%)	Distribution of TC (%)	Total PPA (Acres)	Total PPA (%)	Distribution of PPA (%)
Commercial	2,608	2,607	15%	589	23%	8%	535	21%	13%
Industrial	3,949	3,941	22%	1,486	38%	19%	775	20%	19%
Office	917	916	5%	317	35%	4%	220	24%	5%
Planned Development	764	763	4%	337	44%	4%	167	22%	4%
Residential	9,413	9,391	53%	5,126	55%	65%	2,457	26%	59%
Totals & Averages	**17,651**	**17,619**	**100%**	**7,856**	**45%**	**100%**	**4,154**	**24%**	**100%**

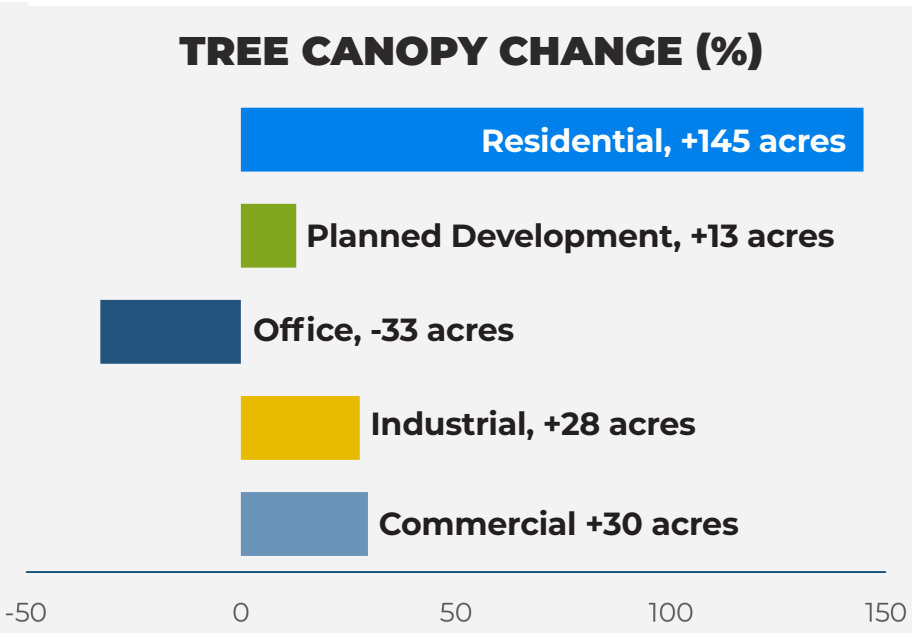


Figure 6. Change in tree canopy acres from 2014 to 2022 by zoning type.

TREE CANOPY COVER BY PUBLIC PROPERTY

Tree canopy metrics were evaluated for public properties throughout Hickory, summarized by 24 individual parks as well as one combined feature representing all other public lands These properties occupied 1,588 acres across Hickory and contained 855 acres of tree canopy. Assessing tree canopy on city-owned properties helps set realistic canopy goals for areas directly controlled by the city.

In Hickory, the majority of the tree canopy on public properties (67%) was found on non-park public lands, which had an average tree canopy coverage of 49%. In contrast, park properties had a higher average canopy coverage of 69%. Among the parks, Geitner/Rotary Park stood out with 93 canopy acres and the highest canopy coverage at 91%. West Hickory Park had the lowest TC coverage at 12%. In addition to current canopy coverage, non-park land had a total of 134 available for planting, whereas park lands had a third of that area with 54 acres of PPA.

During the eight-year assessment period, public property types had a net canopy loss of 4 acres. Southside Height Park had the most significant gain in canopy (+10%). In contrast, Hickory City Park had the most extensive loss of canopy (-28%).

Table 4. Distribution of land area, tree canopy, plantable space, and percent unsuitable by public property.

Public Property	Distribution of Land Area (%)	TC (%)	Total PPA (%)	Total Unsuitable (%)
Bruce Meisner	4.0%	86%	7%	6%
Civitan Park	0.5%	24%	29%	47%
Cliff Teague Park	0.5%	74%	18%	9%
Fairbrook Optimist Dog Park	0.5%	30%	23%	47%
Geitner/Rotary Park	6.5%	91%	3%	6%
Glenn C Hilton Jr. Memorial Park	4.5%	86%	12%	3%
Hickory City Park	0.6%	22%	37%	41%
Hickory Optimist Park	0.3%	47%	21%	32%
Ivey Arboretum at Sally Fox Park	0.2%	57%	39%	4%
Jaycee Park	0.2%	30%	19%	50%
Kiwanis Park	0.8%	31%	28%	41%
Lowes Foods City Park	0.0%	30%	6%	64%
McComb Park	0.1%	70%	30%	0%
Miracle of Hickory Park	0.1%	41%	34%	25%
Neill W. Clark Jr. Rec Park	0.9%	23%	24%	53%
Other City-Owned Land	**74.7%**	**49%**	**11%**	**40%**
Robinson Park	0.1%	75%	23%	1%
Shuford Gardens	0.1%	30%	44%	26%
Southside Heights Park	0.8%	72%	22%	7%
Stanford Park	1.6%	41%	25%	33%
Taft Broome Park	0.0%	40%	28%	32%
Viewment Park	0.0%	72%	27%	1%
West Hickory Park	0.2%	12%	33%	56%
Westmont Recreation Park	0.1%	17%	38%	45%
Winkler Park	2.5%	49%	13%	38%
Totals & Averages	**100%**	**54%**	**12%**	**34%**

TREE CANOPY COVER BY CENSUS BLOCK GROUPS

Hickory's census block groups represent clusters of census blocks, organized into even population divisions. These areas serve as a key unit for assessing the equitable distribution of tree canopy across the city and can be readily linked to demographic and socio-economic data published by the American Community Survey (ACS).

The largest block group (37-035-011000-1) in the city is located in the southeast and has the most tree canopy area (670 acres). Two adjacent block groups in the mid-western portion of the city (37-035-010700-1 and 37-035-010600-4) are tied for the lowest TC percent at 20%. These block groups contain Main Avenue NW and Main Avenue SW. In addition to providing the most canopy acres, block group 37-035-011000-1 also has the most opportunity for future planting with 468 acres, or 22% of its total area available.

Among the 46 block groups, 26 gained canopy while 12 experienced a loss throughout the eight-year study period. The other eight block groups stayed relatively stable (less than a +/- 1% change).

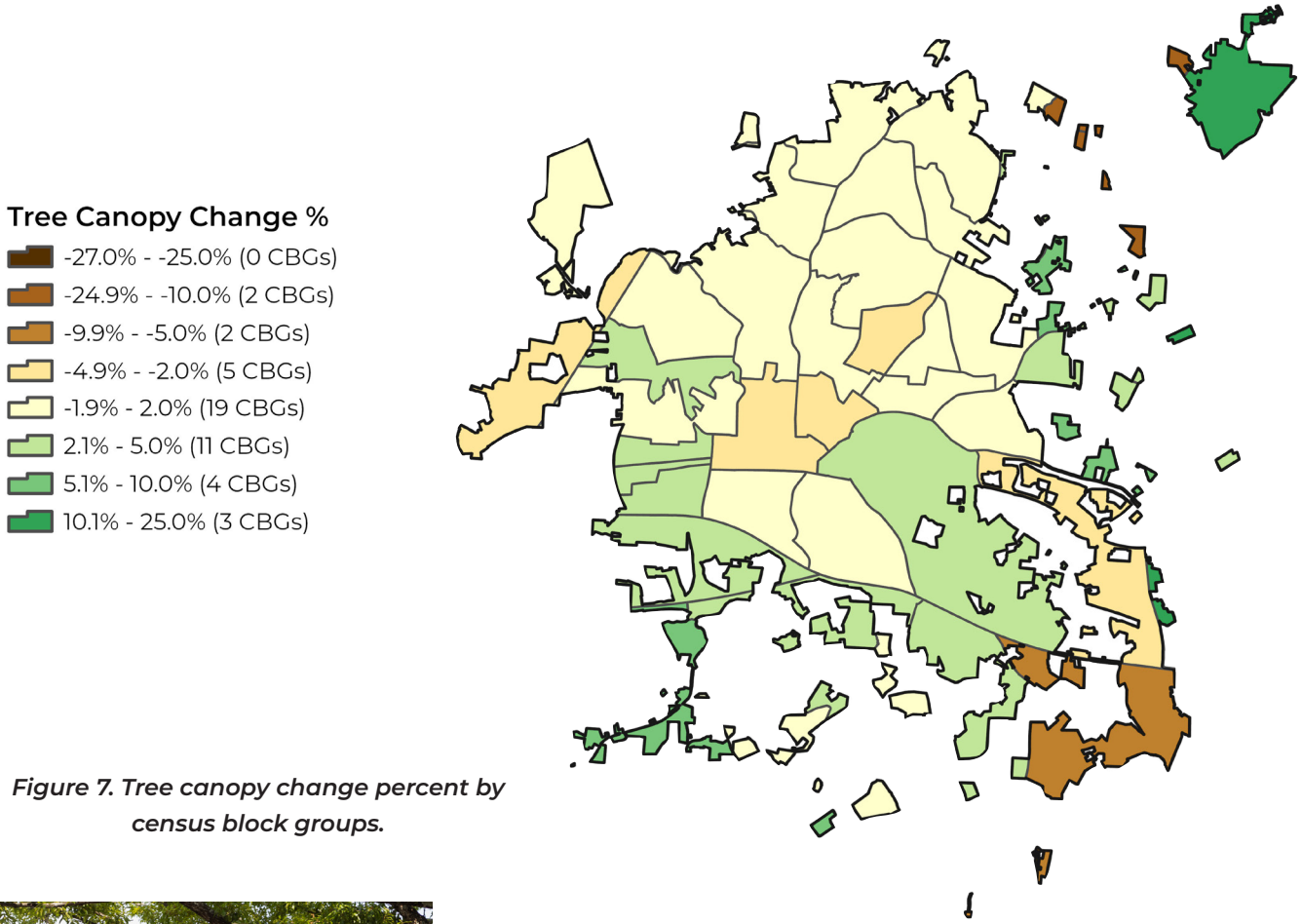


Figure 7. Tree canopy change percent by census block groups.

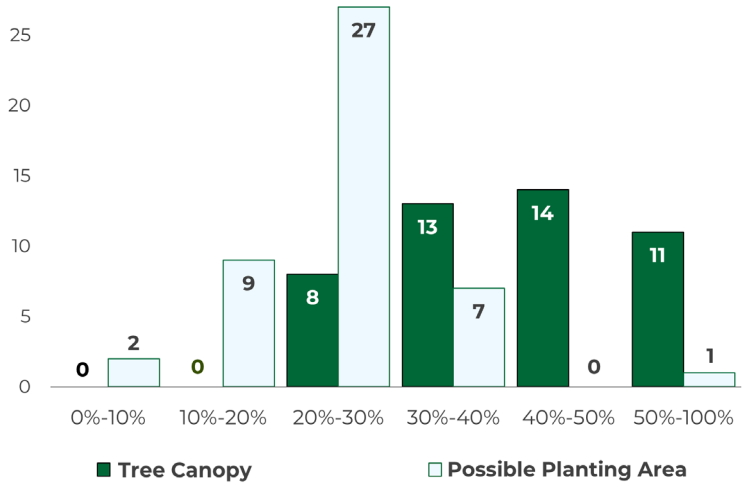


Figure 8. Distribution of census block groups within TC and PPA ranges.

TREE PLANTING PRIORITIZATION

Increased tree canopy cover can provide many benefits to a community and its visitors. Several socioeconomic, demographic, and accessibility data sources were analyzed at the census block group (CBG) scale, and each was ranked according to the area's unique needs. Rankings are sorted from high priority (dark blue) to low priority (light yellow) and were calculated for each criterion as well as overall to show where multiple needs overlap.

ASSESSED CRITERIA & RESULTS MAP:

Low Existing Tree Canopy:

prioritizes CBGs with higher percentages of areas that are not covered by tree canopy.

Possible Tree Canopy:

prioritizes CBGs with higher percentages of possible planting areas.

Poverty Rate:

percentage of residents living below the federally designated poverty level.

Median Household Income:

Median household incomes as reported by the American Census Bureau.

Vulnerable Population:

the ratio of residents under the age of 18 or over 65 compared to the working-age population.

Unemployment Rate:

percentage of the labor force that does not have a job, are available to work, and are looking for a job.

Educational Attainment:

percentage of the population without a high school diploma or the equivalent General Educational Development (GED).

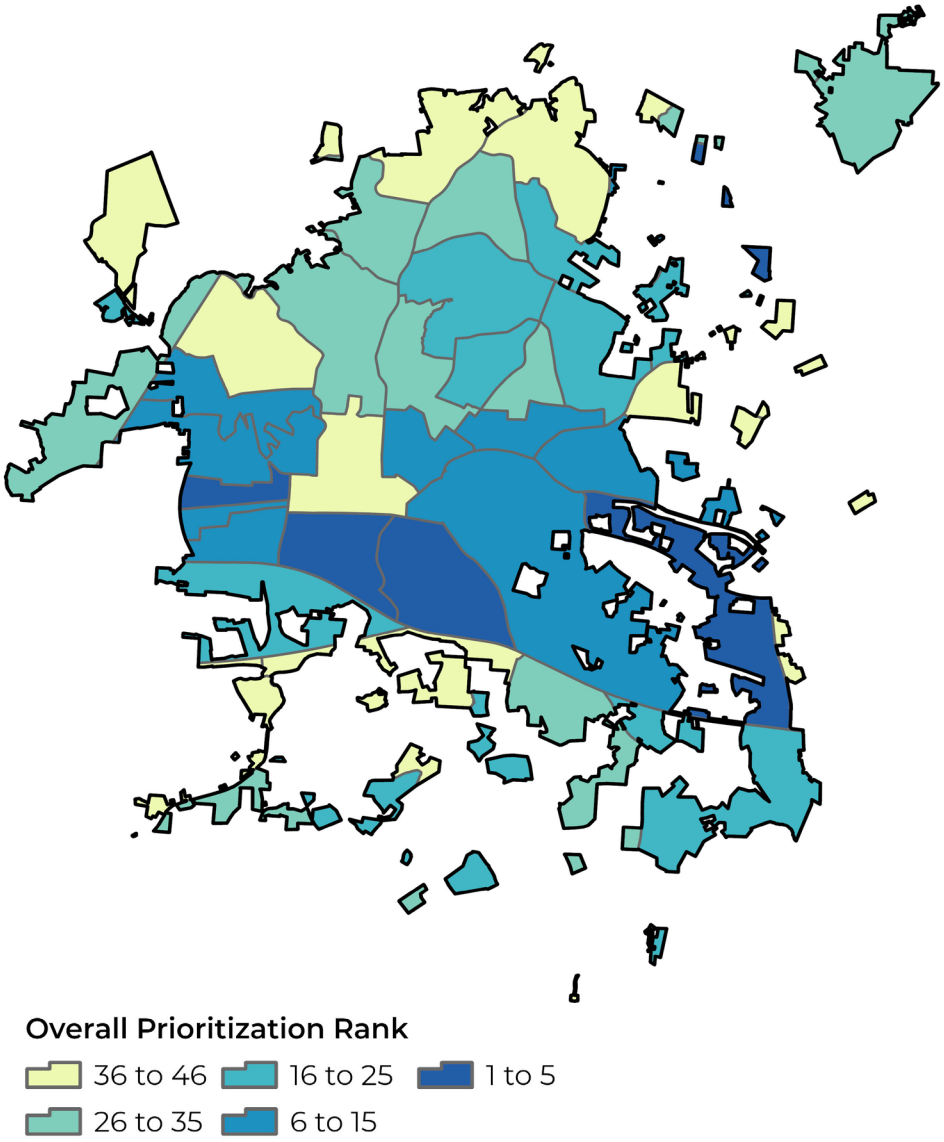


Figure 9. Overall prioritization rankings for Hickory's census block groups based on the seven above indicators. Rankings range from 1, indicating the highest priority for tree planting, to 46, signifying the lowest priority areas.

QUANTIFYING ECOSYSTEM BENEFITS

Using i-Tree tools, values were calculated for some of the benefits and functions of the tree canopy throughout Hickory. Trees produce oxygen and improve public health by reducing air pollutants that can cause illness and death. Trees and forests mitigate storm-water runoff which minimizes flood risk, stabilizes soil, reduces sedimentation in streams and riparian land, and absorbs pollutants, thus improving water quality and habitats. Hickory's existing canopy provides over $3.5 million annually in avoided infrastructure costs and ecosystem benefits.

THE VALUE OF HICKORY'S COMMUNITY FOREST

MENTAL HEALTH

People without views of nature from their desks claimed 23% more sick days than workers with views of nature.

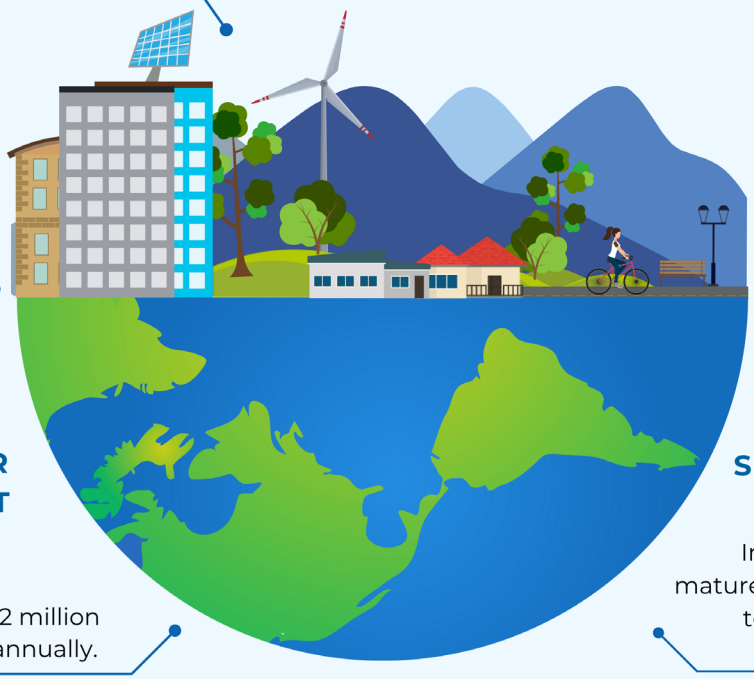
TOTAL ANNUAL BENEFITS

Hickory's trees annually provide **$3,593,158** in ecosystem benefits.

CLEANER AIR

$827,225

Each year, Hickory's roadside trees remove 268 tons of particulate matter.



CARBON STORAGE

$53,387,681

Hickory's urban forest stores 313,031. tons of carbon.

STORMWATER MANAGEMENT

$736,336

Hickory's trees intercept about 82 million gallons of runoff annually.

CARBON SEQUESTRATION

$2,029,597

In one year, Hickory's mature trees absorb 11,900 tons of CO2 from the atmosphere.

Figure 10. Ecosystem service benefits of Hickory's canopy cover. Data sourced from i-Tree, the US Forest Service, the Arbor Day Foundation, and the US Environmental Protection Agency.

ASSESSMENT RECOMMENDATIONS

1

Leverage the results of this assessment to promote the community forest

The findings of this assessment are pivotal for promoting investment in community forest monitoring, maintenance, and management. They also offer essential support for state, county, and local budget requests and grant applications. These results can be used to craft targeted presentations and resources for government leaders, planners, engineers, resource managers, and the public to make an empirical case for canopy needs and benefits.

2

Learn from cities with the largest canopy gains and losses

There is a story behind the tree canopy change in every community. Are tree ordinances proving effective? Are management plans working? Are storms and disease taking a toll? Hickory can seek out nearby and similarly-sized communities using the North Carolina Urban & Community Forestry CANOPY Application to understand what's working and what isn't.

3

Use TreePlotter to prioritize planting efforts

Utilization of TreePlotter™ CANOPY enables the City of Hickory to create detailed planting priority maps. Users can create uniquely weighted scenarios to target areas based on specific criteria such as low TC, high PPA, or specific socio-demographic criteria. By focusing on these areas, the allocation of community forest management resources can be maximized, offering a greater return on investment.

4

Set evidence-based canopy goals

As Hickory's population grows and urbanization expands, the preservation and growth of existing canopy is vital. These assessment findings can be used to develop short and long-term goals, such as: establishing annual tree planting targets, improving the quality of tree cover by planting a wider variety of large maturing trees, or setting specific canopy coverage goals by a future date.

5

Develop outreach programs towards private landowners

To increase canopy in Hickory, it's important to understand that most of its community forest is on private land. Incorporating these findings into community outreach and education programs for citizens and private landholders is crucial. Disseminating these data will help residents understand the changes in their local community forests and the numerous benefits trees offer. Pairing educational programming with tree giveaways, tree planting programs, and tree maintenance events can help increase tree canopy on private property.

6

Continue community forest monitoring to track progress and revise strategy

Regular canopy assessments with the latest available imagery are recommended to manage and expand tree canopy effectively. The imagery used in this assessment is updated every two to three years. By conducting recurring assessments, all forest stakeholders can keep an accurate pulse on the community forest and get key feedback on areas of growth and loss.

GLOSSARY/KEY TERMS

Land Acres: The total land area in acres of the assessment boundary (excludes water).

Non-Canopy Vegetation: Areas of grass and open space where tree canopy does not exist.

Possible Planting Area - Vegetation: Areas of grass and open space where tree canopy does not exist, and it is possible to plant trees.

Shrub: Areas of shrub or other leafy and woody vegetation (smaller than 10ft tall) that are not classified as tree canopy.

Soil/Dry Vegetation: Bare soil and dried, dead vegetation.

Total Acres: Total area, in acres, of the assessment boundary (includes water).

Unsuitable Impervious: Areas of impervious surfaces that are not suitable for tree planting. These include buildings, roads, and all other types of impervious surfaces.

Unsuitable Planting Area: Areas where it is not feasible to plant trees. Airports, ball fields, golf courses, etc., were manually defined as unsuitable planting areas.

Unsuitable Soil: Areas of soil/dry vegetation considered unsuitable for tree planting. Irrigation and soil augmentation may be required to keep trees alive in these areas.

Unsuitable Vegetation: Areas of non-canopy vegetation that are not suitable for tree planting due to their land use.

Tree Canopy (TC): The “layer of leaves, branches and stems that cover the ground” (Raciti et al., 2006) when viewed from above; the metric used to quantify the extent, function, and value of the community forest. The tree canopy was generally taller than 10-15 feet tall.

Water: Areas of open, surface water, not including swimming pools.

MARCH | 2024

COMMUNITY CANOPY

ASSESSMENT

HICKORY, NORTH CAROLINA

PlanIT Geo
developers of TreePlotter

earth design

north carolina urban forest council

HICKORY North Carolina
Life. Well Crafted.

NORTH CAROLINA FOREST SERVICE NC

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