COMMUNITY CANOPY

# ASSESSMENT

LENOIR,
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 always changing. Growth and plantings add to the canopy, while 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 Lenoir, in Caldwell County, North Carolina. Results are summarized at the public property, zoning, and census block group level to better understand how tree canopy is distributed in 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 Lenoir. This enables the City of Lenoir 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**

## LENOIR'S COMMUNITY CANOPY

**In 2022, more than half of Lenoir was covered with tree canopy (53%). The remaining portion of the city was almost evenly split between areas suitable for planting (25%) and areas unsuitable for planting (22%).**

Lenoir's tree canopy cover was assessed in 2014 and 2022. Over the 8-year study period, Lenoir's tree canopy cover slightly increased. Within the current City boundary, tree canopy increased by 249 acres, a +1.9% 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.

**7,018** ACRES OF CANOPY

**53%** TREE CANOPY

**25%** POSSIBLE PLANTING AREA

**+1.9%** TREE CANOPY CHANGE

*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 Lenoir'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.

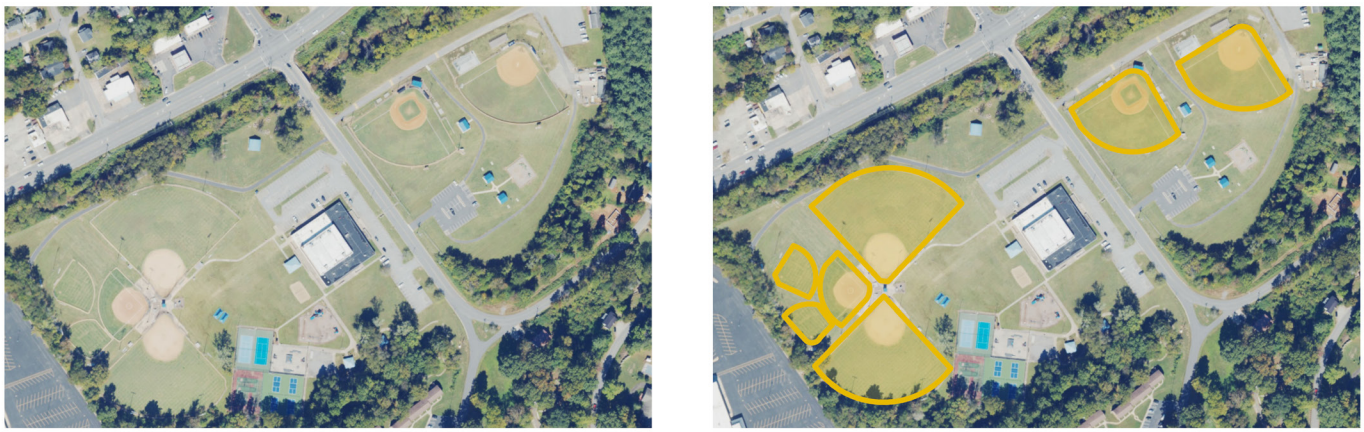


*Figure 3. The study identified vegetated areas where it would be feasible for tree plantings but undesirable based on their current usage (left) in the data as "Unsuitable" (right).*

# 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 Lenoir 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 Lenoir, **including water bodies.** More than half of the city (53%) was covered with tree canopy over permeable surfaces. Vegetation, such as grass and low bushes, accounted for approximately 26% of the city. Buildings and roads made up another 20% of Lenoir's area. Bare soil and tree canopy over impermeable surfaces each constituted 1% of the city's land, while water bodies and shrub areas each represented less than 1% of Lenoir's total area.

*Table 1. Land cover classes in acres and percent in Lenoir.*

| Class | Acres | Percent |
|---|---|---|
| **Tree Canopy** | 7,018 | 53% |
| **Non-Canopy Vegetation** | 3,483 | 26% |
| **Impervious Surfaces** | 2,640 | 20% |
| **Soil/Dry Vegetation** | 134 | 1% |
| **Water** | 26 | <1% |
| **Shrubs** | 24 | <1% |

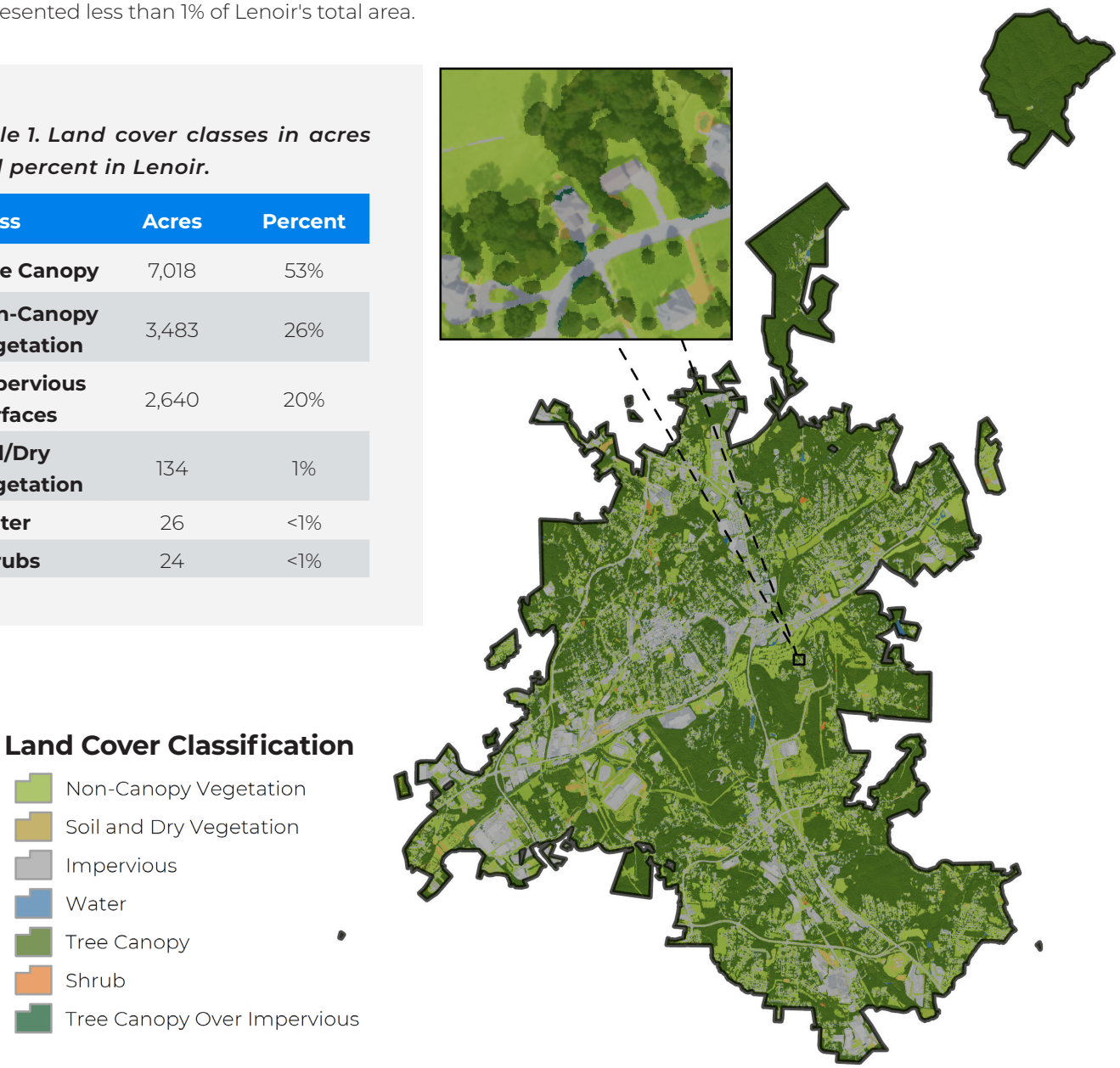



*Figure 4. Land cover classification results (percentages based on the total area of Lenoir's boundary including water bodies).*

## CITY-WIDE TREE CANOPY COVER

Excluding the 26 acres of surface water, the city occupies 13,300 land acres. In 2022, 53% percent of Lenoir's land area was covered by tree canopy. Twenty-five percent, or 3,332 acres, were available to plant trees (PPA). However, it is not feasible to plant trees in some land cover classes. The 22% of land deemed unsuitable was largely due to the presence of 2,640 acres of impermeable surfaces.

In 2014, Lenoir had 6,769 acres of tree canopy, meaning the city has gained canopy (2% increase or 249 acres) over the eight-year study period.

*Table 2. Tree canopy potential in acres and percent in Lenoir.*

| Class | Acres | Percent |
|---|---|---|
| **Existing Canopy** | 7,018 | 53% |
| **Possible Planting Area** | 3,332 | 25% |
| **Unsuitable Planting Area** | 2,950 | 22% |

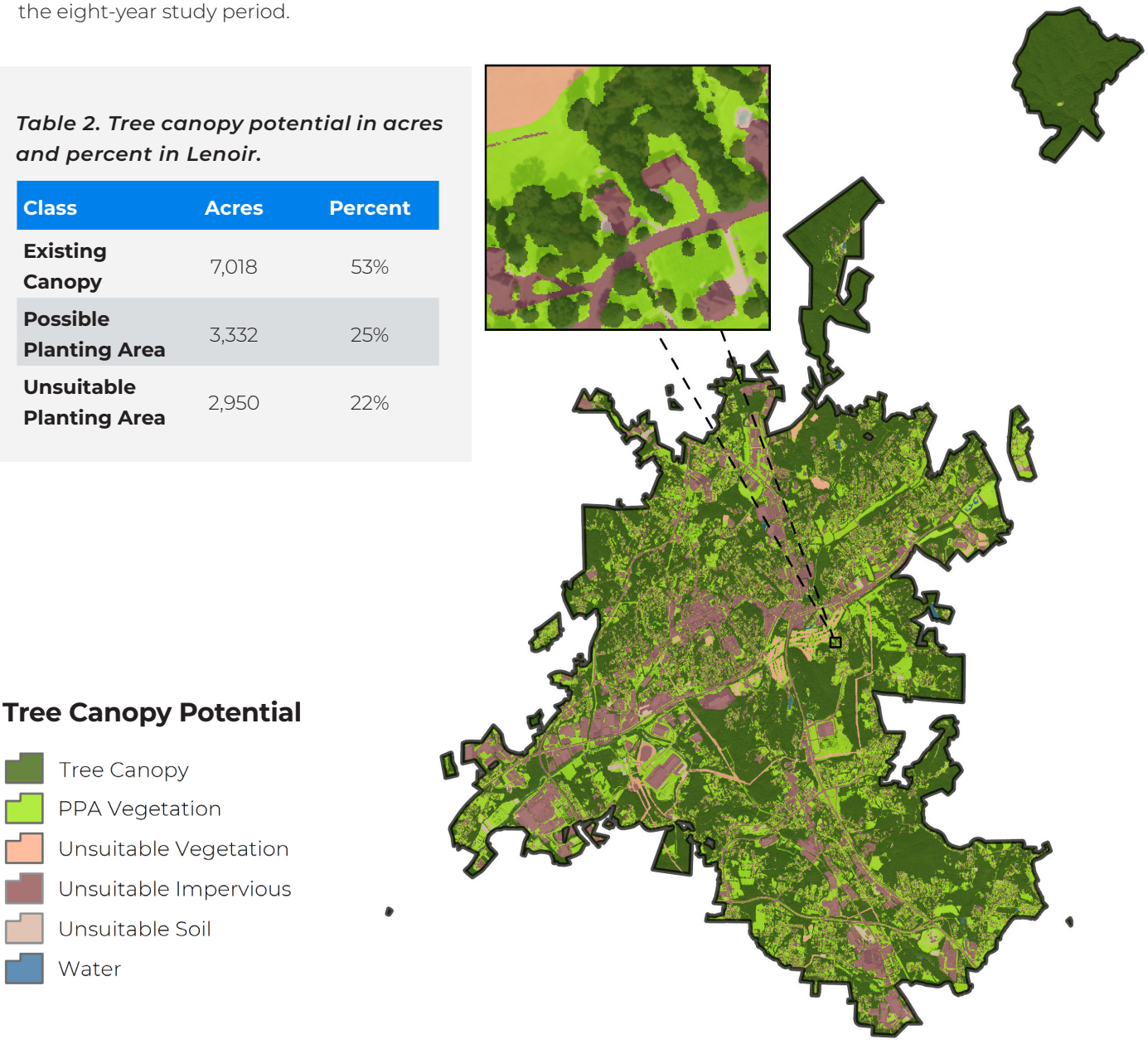



*Figure 5. Distribution of tree canopy, possible planting area, and areas unsuitable for tree canopy within the City of Lenoir.*

**Lenoir gained 2% tree canopy cover between 2014 and 2022.**

## TREE CANOPY COVER BY PUBLIC PROPERTY

Tree canopy metrics were evaluated for five types of public properties in Lenoir: recreation areas, facilities, utility rights-of-way (ROW), parking lots, and vacant lots. These properties occupied 1,186 acres across Lenoir and contain 923 acres of tree canopy. Assessing tree canopy on City-owned properties helps set realistic canopy goals for areas directly controlled by the city.

Lenoir's facilities represented 60% of all public property and contained a majority of the public property tree canopy (70%). Facilities contain 649 canopy acres, and had the highest canopy coverage at 91%. Lenoir's recreational properties contained 233 acres of canopy. Together, these two types comprised 96% of the total canopy across all public properties. Recreational properties offer the most potential for canopy growth, with 94 acres of plantable land.

During the 8-year assessment period, all public property types experienced canopy gains. Recreational properties experienced a 16-acre increase, representing a 4% net growth.

***Table 3. Tree canopy and possible planting acres, percent, and percent distribution by public property type.***

| Public Property | Total Area (Acres) | Land Area (Acres) | Distribution of Land Area % | TC (Acres) | TC (%) | Distribution of TC (%) | Total PPA (Acres) | Total PPA (%) | Distribution of PPA (%) |
|---|---|---|---|---|---|---|---|---|---|
| Recreation | 382 | 380 | 32% | 233 | 61% | 25% | 94 | 25% | 59% |
| Facilities | 714 | 713 | 60% | 649 | 91% | 70% | 34 | 5% | 21% |
| Utilities ROW | 65 | 65 | 5% | 33 | 52% | 4% | 20 | 31% | 13% |
| Parking Lots | 4 | 4 | 0% | 0.5 | 13% | 0% | 0.1 | 3% | 0% |
| Vacant | 21 | 21 | 2% | 7 | 35% | 1% | 11 | 51% | 7% |
| **Totals & Averages** | **1,186** | **1,182** | **100%** | **923** | **78%** | **100%** | **158** | **13%** | **100%** |

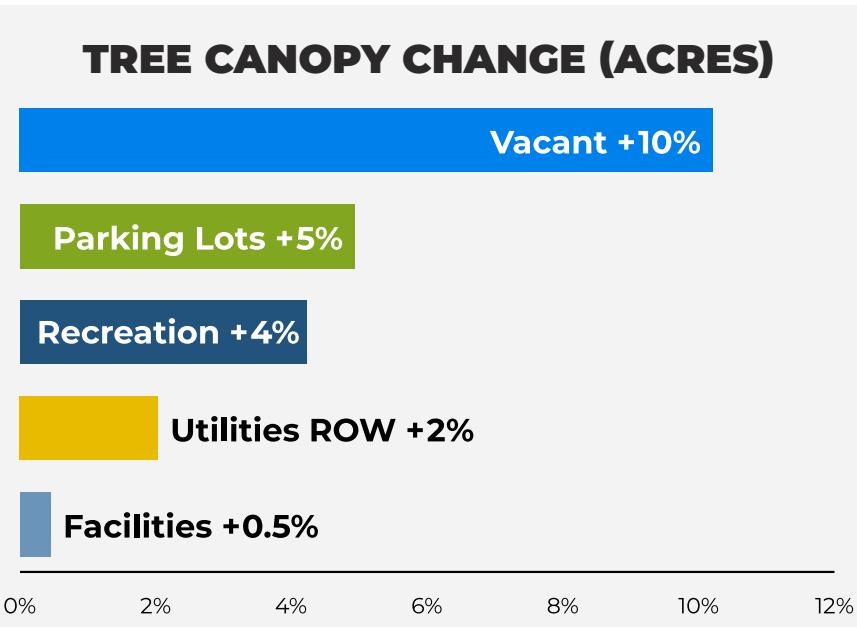
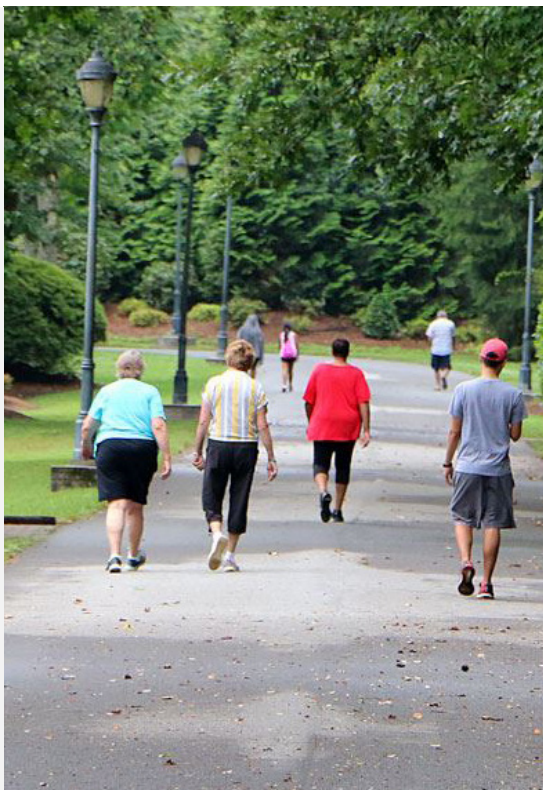



*Figure 6. Percent change in tree canopy from 2014 to 2022 by public property type.*



## TREE CANOPY COVER BY ZONING

Tree canopy was assessed within fifteen 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 11,435 acres, contributing 6,134 acres of tree canopy.

Single Family Residential zones comprised 50% of the city's total land. This zoning type contained 60% of all tree cover (3,652 acres) in Lenoir, making it the most significant land use type in terms of the city's total tree canopy coverage. Together, Single Family Residential and Multi-Family Residential zones represent 80% of the total canopy cover distribution. They also offer the largest potential planting area, with a total of 1,974 acres, which is 66% of all the space available for planting.

Between 2014 and 2022, six zoning classes gained at least 15 acres of canopy each. Office and Institutional zones experienced the greatest loss of 5 canopy acres. Single Family Residential zones saw the greatest gain of 83 canopy acres.

***Table 4. Distribution of land area, tree canopy, plantable space, unsuitables, and percent change by zoning type.***

| Zoning | Distribution of Land Area (%) | TC (%) | Total PPA (%) | Total Unsuitable (%) | 2014-2022 Change (%) |
|---|---|---|---|---|---|
| Central Business | 1% | 12% | 14% | 74% | +1% |
| Conditional Zoning | 3% | 37% | 36% | 26% | +6% |
| Exclusive Business | 1% | 46% | 33% | 22% | 0% |
| General Business | 10% | 34% | 26% | 40% | +2% |
| Heavy Industrial | 10% | 29% | 24% | 47% | +4% |
| Light Industrial | 5% | 43% | 28% | 29% | +3% |
| Multi-Family Residential | 17% | 59% | 27% | 14% | +2% |
| Neighborhood Business | 0% | 43% | 43% | 14% | +4% |
| Neighborhood Mixed-Use | 0% | 52% | 22% | 26% | +1% |
| Not Classified | 0% | 22% | 27% | 51% | -2% |
| Office & Institutional | 1% | 28% | 24% | 48% | -4% |
| Planned Highway Business | 0% | 58% | 41% | 1% | +7% |
| Residential - Commercial | 0% | 18% | 36% | 46% | -5% |
| Rural Residential | 2% | 59% | 31% | 10% | +2% |
| Single Family Residential | 50% | 64% | 26% | 10% | +1% |
| Transitional Business | 0% | 22% | 75% | 3% | 0% |
| **Totals & Averages** | **100%** | **54%** | **26%** | **20%** | **+2%** |

## TREE CANOPY COVER BY CENSUS BLOCK GROUPS

Lastly, canopy metrics were evaluated for the twenty-nine census block groups in Lenoir. These groups, which contain clusters of census block boundaries, serve as a key unit for assessing the equitable distribution of tree canopy across the city, as they can be readily linked to demographic and socio-economic data.

The second largest block group (37-027-031100-3) in the city is located in the northernmost part and has the highest tree canopy coverage (85%) and acreage (1,201). It includes the Thousand Trails Green Mountain area and the non-contiguous boundary northeast of the city. On the other hand, the block group home to the Bernhardt Furniture Plant campus and the Lenoir Public Works Department has the lowest tree canopy coverage, 23% ( CBG 37-027-030100-6). Block group 37-027-030500-3, located east of the city center, has the most opportunity for future planting with 487 acres, or 30% of its total area available.

Among the 29 block groups, 23 gained canopy while 6 experienced a loss throughout the 8-year study period. The block group (37-027-030100-3) northwest of the Lenoir Golf Course witnessed the largest canopy loss of 11 acres.

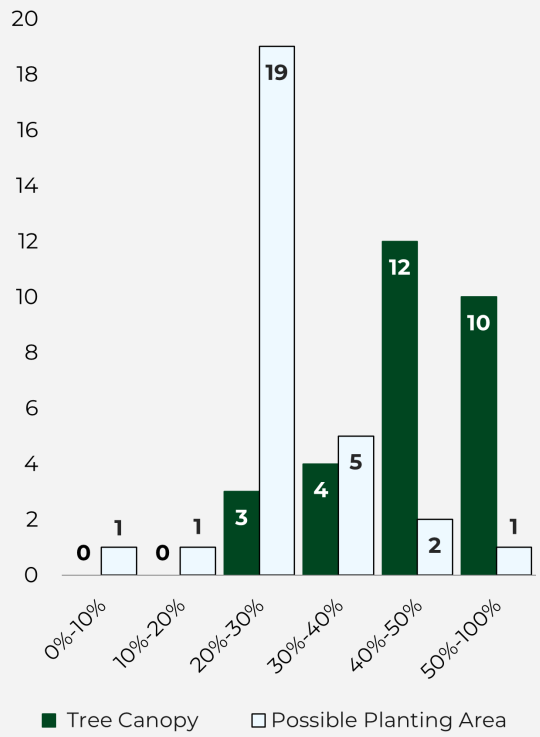



*Figure 7. Distribution of census block groups within TC and PPA ranges.*

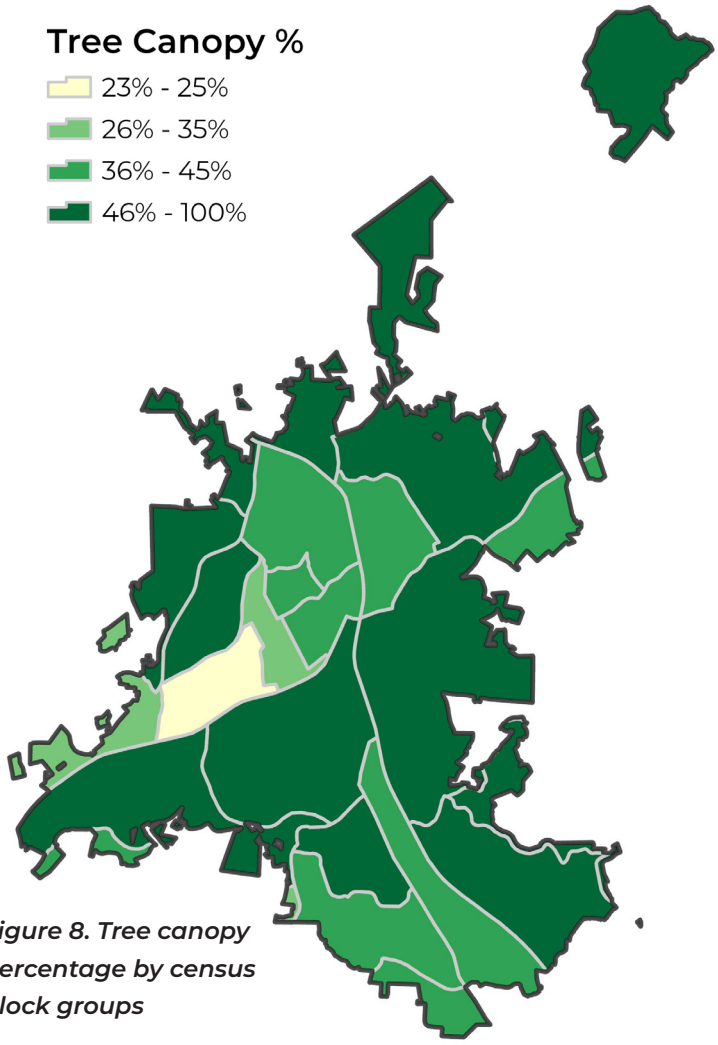



*Figure 8. Tree canopy percentage by census block groups*

# TREE PLANTING PRIORITIZATION

Increased tree canopy cover can provide a wide array of benefits to a community and its residents and visitors. To locate specific areas in need, several socioeconomic, demographic, and accessibility data sources were analyzed at the census block group (CBG) scale, and each was ranked by priority. Rankings are sorted from high (dark blue) to low (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).

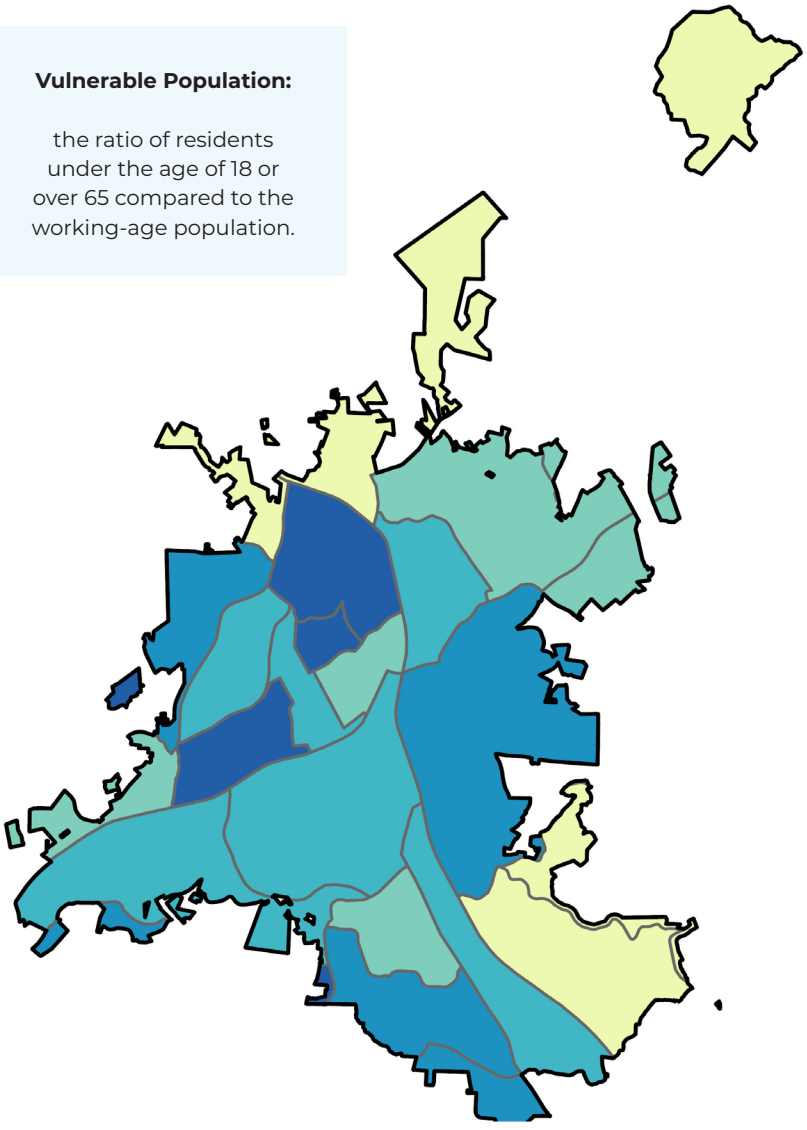



*Figure 9. Overall prioritization rankings for Lenoir's census block groups based on the seven above indicators. Rankings range from 1, indicating the highest priority for tree planting, to 29, signifying the lowest priority areas.*

# QUANTIFYING ECOSYSTEM BENEFITS

Using i-Tree tools, values were calculated for some of the benefits and functions of the tree canopy throughout Lenoir. 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. Lenoir's existing canopy provides over $2.4 million annually in avoided infrastructure costs and ecosystem benefits.

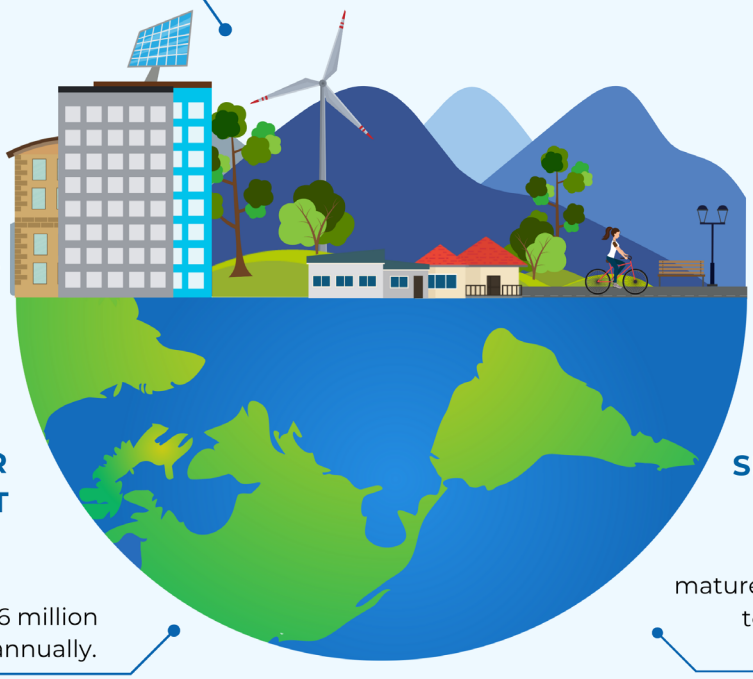
## THE VALUE OF LENOIR'S COMMUNITY FOREST

### MENTAL HEALTH

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

### TOTAL ANNUAL BENEFITS

Lenoir's trees annually provide **$2,452,931** in ecosystem benefits.



### CLEANER AIR

**$518,873**

Each year, Lenoir's roadside trees remove 193 tons of particulate matter.

### CARBON STORAGE

**$44,455,585**

Lenoir's forest stores 260,659 tons of carbon.

### STORMWATER MANAGEMENT

**$321,489**

Lenoir's trees intercept about 36 million gallons of runoff annually.

### CARBON SEQUESTRATION

**$1,612,569**

In one year, Lenoir's mature trees absorb 9,455. tons of CO2 from the atmosphere.

*Figure 10. Ecosystem service benefits of Lenoir'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? Lenoir 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 Lenoir 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 Lenoir'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 Lenoir, 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

## LENOIR, NORTH CAROLINA

PlanIT Geo
developers of TreePlotter

earthdefine

north carolina urban forest council

CITY OF LENOIR NC ★ CREATE WITH US

NORTH CAROLINA FOREST SERVICE NC

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