URBAN TREE CANOPY

ASSESSMENT

HURRICANE MICHAEL: IMPACT IN GEORGIA

OCTOBER | 2021

Georgia Tree COUNCIL
Sustaining Georgia's Green Legacy

GEORGIA FORESTRY COMMISSION

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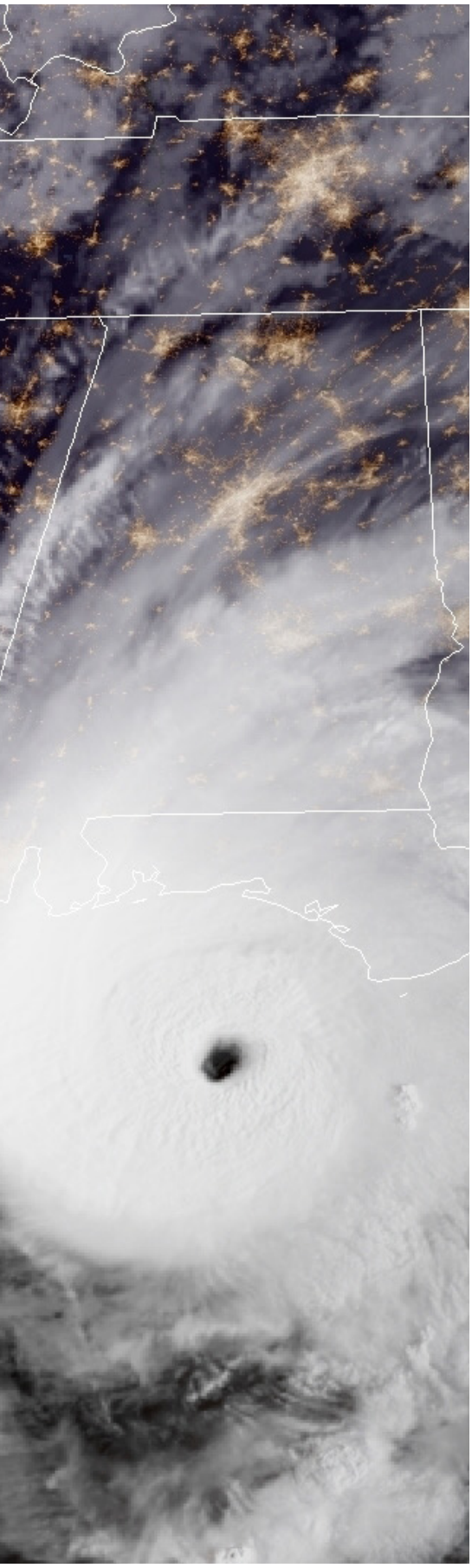

IMPACTS OF HURRICANE MICHAEL ON URBAN TREE CANOPY IN

GEORGIA COMMUNITIES

> **Someone is sitting in the shade today because someone planted a tree a long time ago.**
> **-Warren Buffet**

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PROJECT INTRODUCTION

Hurricane Michael struck the Florida coast near Panama City as a category 5 hurricane on October 10, 2018. The hurricane caused significant damage to beaches, infrastructure, and trees along the Florida coast and inland, impacting over 19 counties in Georgia. It was the first category 5 hurricane to make landfall in the continental United States since Hurricane Andrew in 1992. With wind speeds of 160 mph, Hurricane Michael was the third most powerful hurricane on record to strike Florida. Due to the high wind speeds, the storm had a particularly severe impact on trees near the coast and northeast along its path across the Florida panhandle and into southwest Georgia.

Ultimately, Michael caused roughly $25 billion worth of damage in the United States. Although the hardest hit areas were in the Florida panhandle near the coast, the storm caused significant damage to inland areas as well. Nine Georgia counties in particular Calhoun, Crisp, Decatur, Dougherty, Lee, Miller, Mitchell, Seminole, and Terrell experienced the most severe winds of the storm. 22 cities within those, and neighboring, counties were included in the assessment area of this study. Cities were selected using on-the-ground observations and knowledge of the severity of the storm damage in combination with geospatial data of the hurricane's path and wind speeds. Generally speaking, this study looks at the damage that occurred in cities that experienced hurricane force winds, but several other cities that had significant damage are also included. Figure 1 shows the area that experienced hurricane force winds and cities selected for this assessment.

CITIES IN THE STUDY AREA LOST THE EQUIVALENT OF

1,300

FOOTBALL FIELDS

OF TREE CANOPY AFTER HURRICANE MICHAEL

With category 5 hurricanes and other damaging storms, there is often significant damage followed by an ongoing recovery period for the impacted areas. In recent years, earth observation tools have become available that can make recovery efforts more effective by providing more accurate, relevant, and timely information to decision makers. Urban tree canopy assessments were first developed in the early 2000's and, in the past 5-10 years, have become a key part of many cities' urban forest management strategies by providing increased understanding of the effectiveness of management activities and the impacts of pests, disease, development, and severe weather events on tree canopy.

Hurricane Michael is the first category 5 hurricane to make landfall in the continental U.S. since tree canopy assessments have become a common practice of urban forestry management. Michael was especially damaging to tree canopy in the impacted region, as results from this assessment show that the study area lost over 1,700 acres of tree canopy between 2017 and 2019. This study also provides information to impacted communities that will assist in their recovery. Key information on income levels and racial and ethnic makeup of populations is highlighted to help urban forest managers locate the most important areas to focus their efforts. This project represents a novel approach to recovery efforts of urban tree canopy in storm-affected areas.

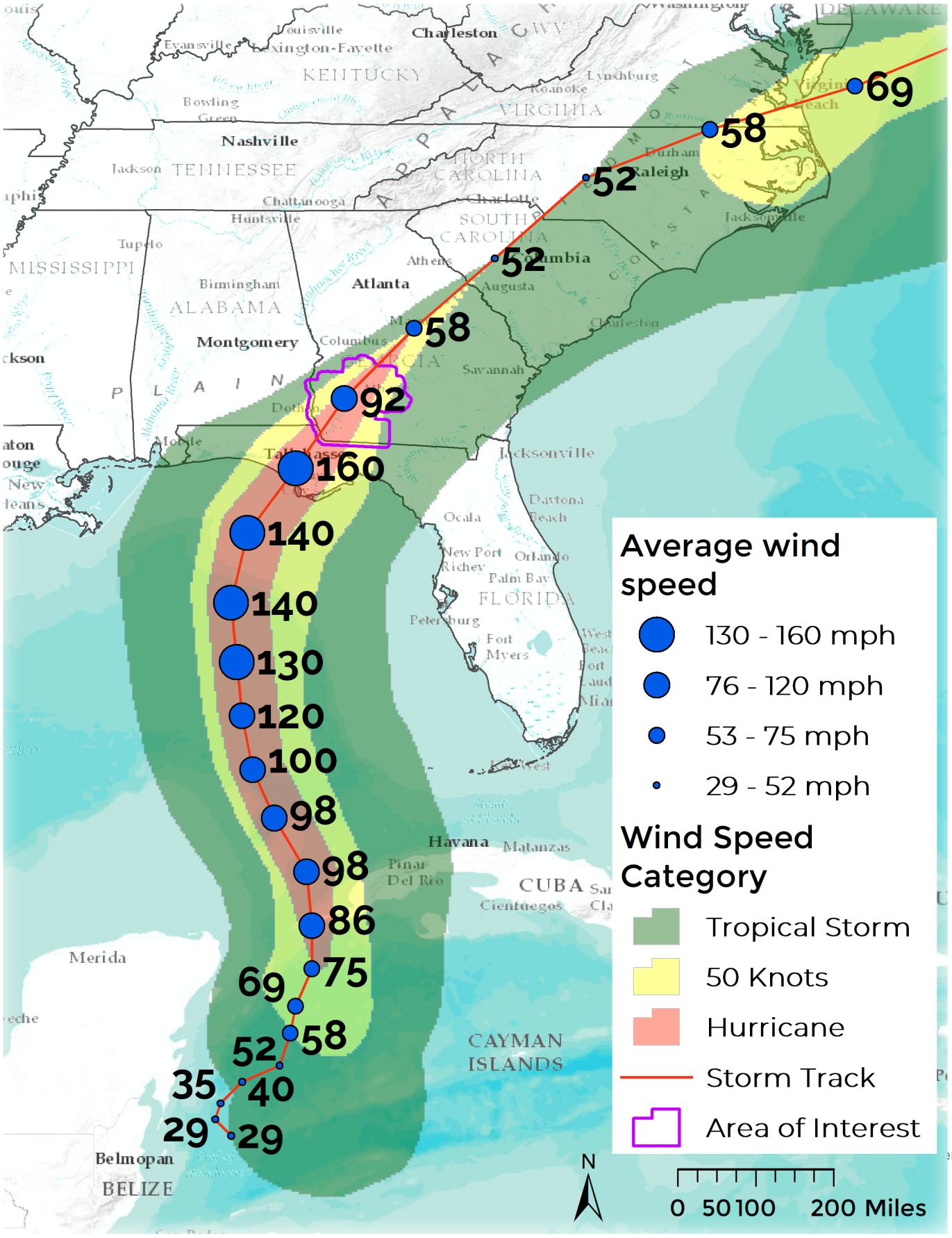


Figure 1. | Hurricane Michael storm path and wind speeds.

2%

OF PRE-STORM TREE CANOPY IN THE STUDY AREA LOST TO HURRICANE MICHAEL

-1,787

ACRES OF CANOPY

EXECUTIVE SUMMARY

The urban forest is a valuable asset providing residents and visitors with many environmental, social, and economic benefits. In 2018, Hurricane Michael caused severe damage to the Florida panhandle around Panama City and inland areas to the northeast extending into Georgia. The Urban and Community Forestry Grant from the USDA Forest Service as well as Hurricane Michael relief funds allowed the Georgia Forestry Commission and the Georgia Tree Council to embark on a project to establish the pre-storm tree canopy levels, identify the areas which lost the most canopy, and identify where suitable areas for new plantings exist.

This assessment mapped urban tree canopy (UTC), possible planting area (PPA), and tree canopy changes before and after Hurricane Michael to analyze how tree canopy within the cities most directly in the path of the storm was affected. In total, 22 cities were selected to be included in the Georgia study area. The distribution of tree canopy throughout each city was assessed within watersheds, ZIP codes, and census block groups within the city boundary.

The results, based on 2019 and 2017 imagery from the USDA's National Agriculture Imagery Program (NAIP), provide pre- and post-storm information on the state of tree canopy and will allow each city and state managers to revise and develop existing and new strategies to restore, expand, and protect the urban forest. This study used a modern machine learning technique to create tree canopy data for both time periods with identical methods to allow for the most accurate comparison possible.

In 2019, the study area had 45% UTC cover and 28% PPA, not including any surface water bodies in the study area. In 2017, the study area had 48% UTC. In total, Hurricane Michael resulted in a 2% loss in UTC. The most populous city included in the assessment was Albany which had 47% UTC in 2017 and 46% in 2019, a loss of 1%. The storm caused a 7% decrease of UTC in Baconton and a 6% decrease in Bainbridge and Blakely, the hardest hit areas in Georgia.

To help further understand the distribution of pre- and post-storm tree canopy within the selected cities, UTC, PPA, and UTC Change were analyzed within three geographic scales: ZIP codes, watersheds, and census block groups. These provide additional information on the distribution of tree canopy change and plantable space to further assist city and state officials in their efforts to recover and restore lost tree canopy.

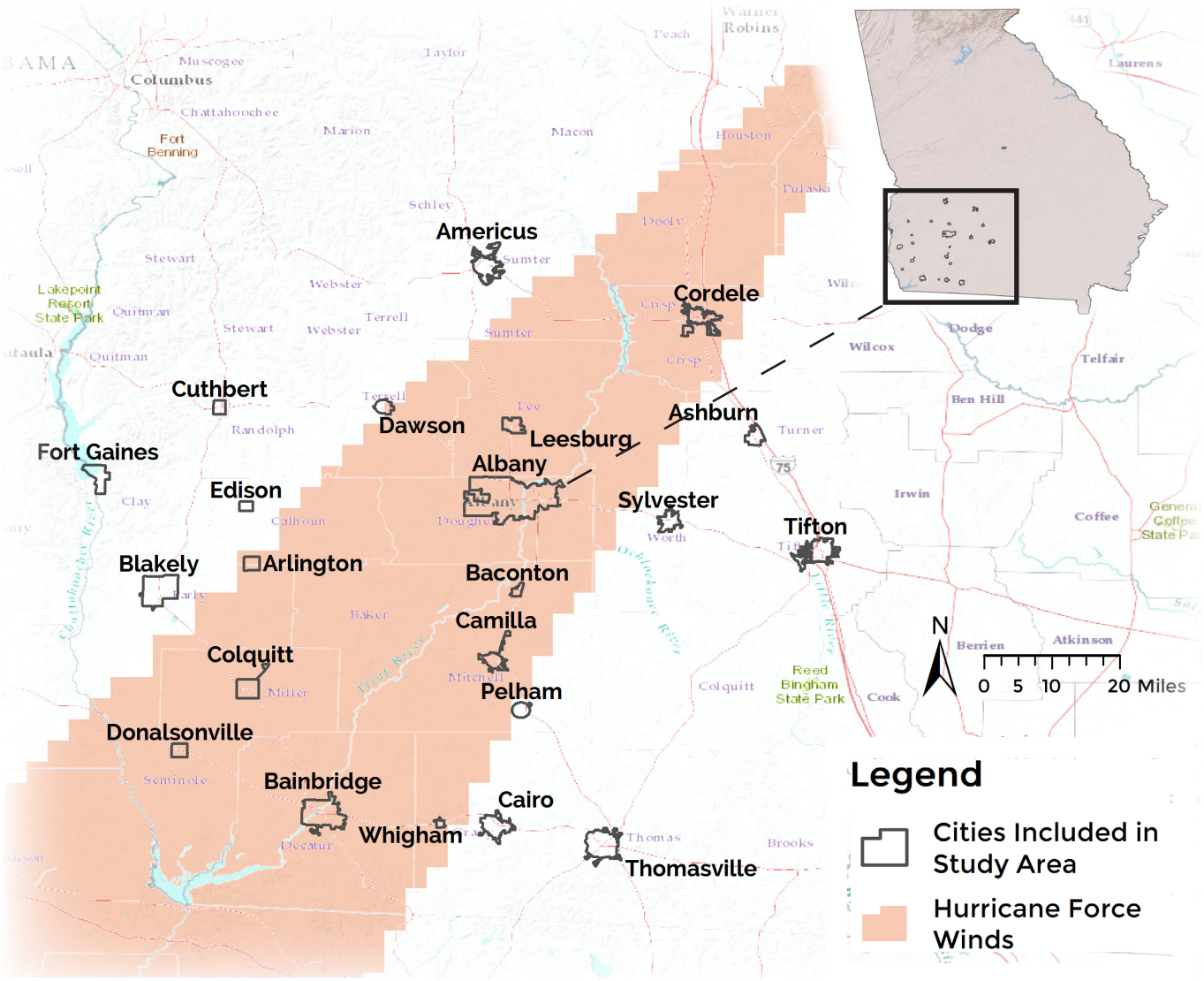


Figure 2. | The study area includes 22 cities and covers approximately 219 square miles in southwest Georgia.

45%
URBAN TREE CANOPY

28%
POSSIBLE PLANTING AREA

27%
UNSUITABLE PLANTING SURFACES

Figure 3. | Based on an analysis of 2019 high-resolution imagery, the study area contains 45% tree canopy, 28% areas that could support canopy in the future, and 27% other surfaces.

PROJECT METHODOLOGY

Urban tree canopy and possible planting areas were mapped using the sources and methods described below. These datasets provide the foundation for the metrics reported at the selected geographic assessment scales.

DATA SOURCES

This assessment utilized high-resolution (1-meter and 60-centimeter) multispectral imagery from the U.S. Department of Agriculture's National Agriculture Imagery Program (NAIP), collected in 2017 and 2019, to derive the land cover data sets. The NAIP imagery was used to classify all types of land cover.

MAPPING LAND COVER

An initial land cover dataset was to be created prior to mapping tree canopy. The land cover data set is the most fundamental component of an urban tree canopy assessment. Tree canopy data from the EarthDefine US Tree Map (link: https://www.earthdefine.com/treemap/) were provided. The US Tree Map is produced using a modern machine learning technique to extract tree canopy cover and other land cover types from the highest resolution NAIP imagery. Additionally, an object-based image analysis (OBIA) software program called Feature Analyst was used to classify plantable space features through an iterative approach. In this process, objects' spectral signatures across four bands (blue, green, red, and near-infrared), textures, and pattern relationships were considered. This remote sensing process used the 2019 NAIP imagery to derive the vegetation classification. All surfaces not classified as vegetation or tree canopy were automatically classified as unsuitable for planting. These three classes are shown in Figure 4 and described in the Glossary on page 24.

After manual classification improvement and quality control were performed on the remote sensing products, additional waterbody data from the USGS National Hydrography NHDPlus data set were incorporated to create a 4-class land cover data set.

URBAN TREE CANOPY

NON-CANOPY VEGETATION

UNSUITABLE FOR PLANTING

Figure 4. | Four (4) distinct land cover classes were identified in the 2019 tree canopy assessment: urban tree canopy, other non-canopy vegetation, surfaces unsuitable for planting, and water.

IDENTIFYING POSSIBLE PLANTING AREAS AND UNSUITABLE AREAS FOR PLANTING

In addition to quantifying tree canopy in 2017 and 2019, another metric of interest in this assessment was areas where trees could be planted to restore tree canopy lost to the storm. To assess this, all land area in the impacted cities that was not existing tree canopy coverage was classified as either possible planting area (PPA) or unsuitable areas for planting. Possible planting areas were derived from the non-canopy vegetation layer. Unsuitable areas, or areas where it was not feasible to plant trees due to biophysical or land use restraints (e.g. golf course playing areas, recreation fields, airports, etc.), were manually delineated and overlaid with the existing land cover data set (Figure 5). The final results were reported as PPA Vegetation, Unsuitable Vegetation, and Total Unsuitable.

Figure 5. | Vegetated areas where it would be biophysically feasible for tree plantings but undesirable based on their current usage (left) were delineated in the data as "Unsuitable" (right). These areas included recreational sports fields, golf courses, and other open space.

DEFINING ASSESSMENT LEVELS

In order to best inform the Georgia Forestry Commission, Georgia Tree Council, city officials, and various stakeholders, urban tree canopy and other associated metrics were tabulated across a variety of geographic boundaries (Figure 6 shows Tifton as an example). These boundaries include the city boundaries, ZIP codes, watersheds, and U.S. Census block groups.

- Twenty-two (22) **city boundaries** are the main area of interest for this assessment, over which all metrics are summarized.
- Tree canopy was analyzed for the seventy-six (76) **HUC-12 watersheds**, within the assessment city boundaries, to identify the amount of tree canopy as it relates to stormwater mitigation and water quality.
- Thirty-two (32) **ZIP codes** were assessed to provide insight into different areas in each city in the study area.
- Two hundred and thirty-nine (239) **census block groups** were assessed to provide information at a geographic scale commonly used to track populations. Census block groups are used by the U.S. Census Bureau to assure statistical consistency when tracking populations across the United States and can be valuable indicators of environmental justice as they are directly linked with demographic and socioeconomic data.

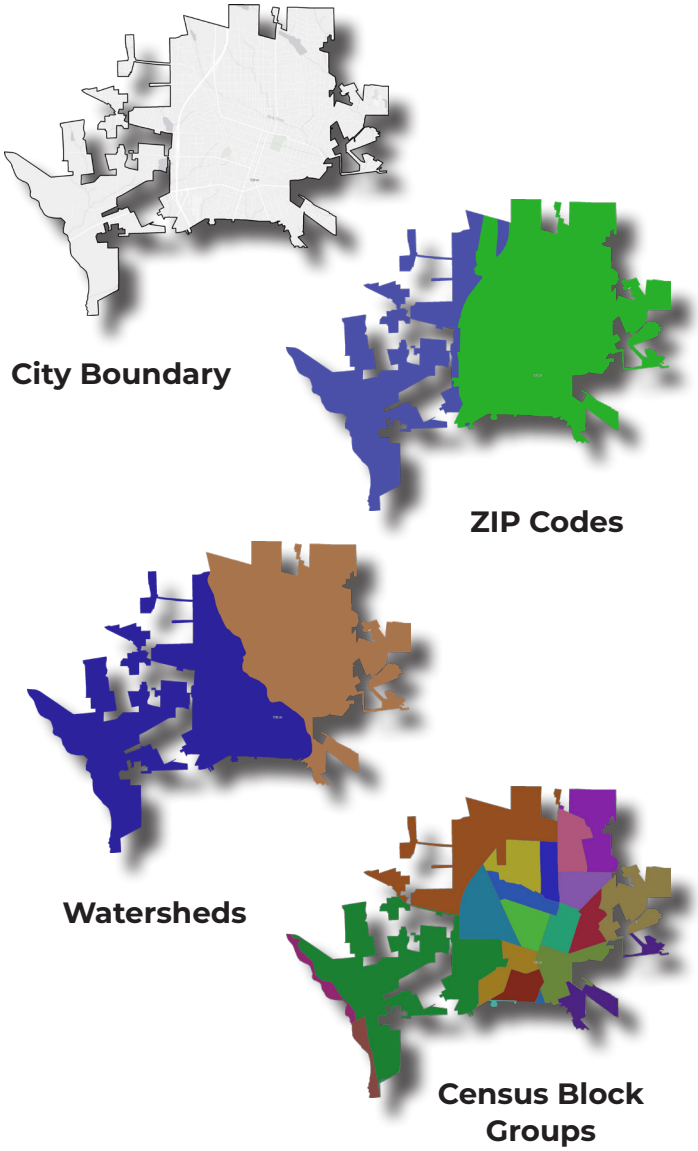


Figure 6. | Four (4) distinct geographic boundaries were explored in this analysis: the full city boundaries, ZIP codes, watersheds, and U.S. Census block groups.

KEY FINDINGS AND CANOPY CHANGE

The results and key findings of this study, including a land cover map of Albany, the most populated city in the study area, and results for all cities are presented below. These results can be used to design strategic approaches to identifying existing canopy, areas of significant canopy loss, and future planting areas. The land cover percentages below are based on the total study area, while urban tree canopy, canopy change, possible planting area, and unsuitable percentages are based on land area. Water bodies are excluded from land area because they are typically unsuitable for planting new trees without significant modification.

Table 1. | Land cover classes in acres and percent in the study area.

Land Cover Type	Acres	%
Total Study Area	136,656	100%
Tree Canopy	60,349	44%
Non-Canopy Vegetation	38,050	28%
Impervious and Soil	34,353	25%
Water	3,904	3%

Total Area, Land Area, and UTC Area by City

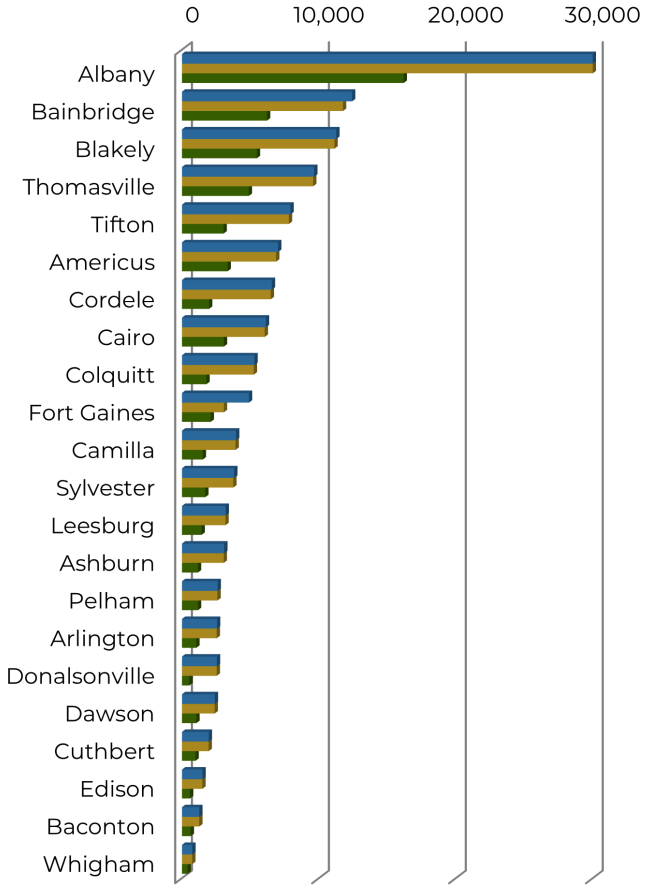


Figure 7. | Urban tree canopy compared to total area and land area, in acres, in the study area by city.

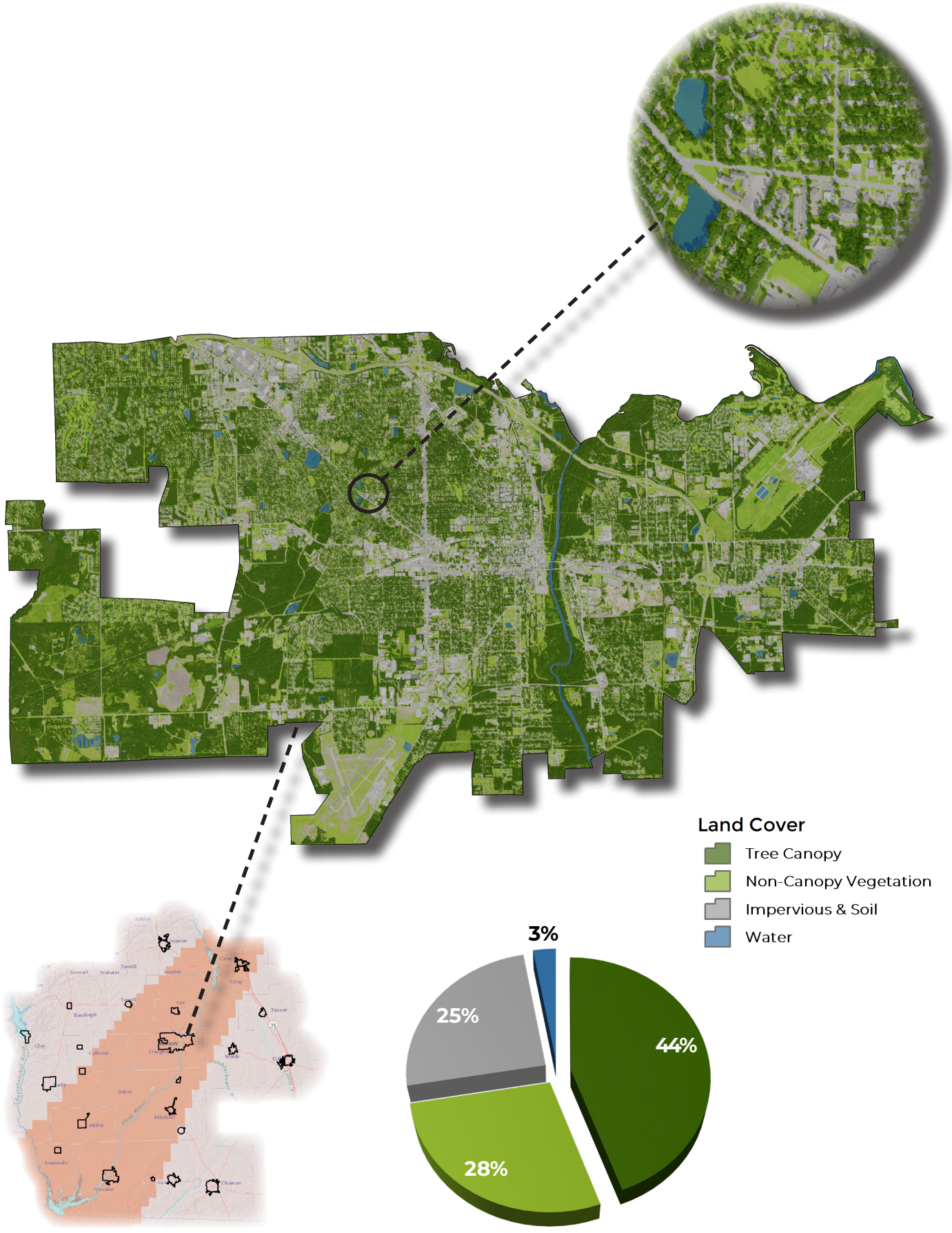


Figure 8. | Land cover in the Albany city boundary.

STUDY-WIDE URBAN TREE CANOPY

This urban tree canopy assessment utilized the land cover map as a foundation to determine possible planting areas throughout the study area. Additional layers and information regarding land considered unsuitable for planting were also incorporated into the analysis. Note that the results of this study, shown in Table 2, are based on land area, which excludes water bodies, as opposed to total area, which includes water bodies.

Results of this study indicate that within the study area's 22 cities, 62,325 acres are covered with urban tree canopy, making up 45% of the 136,223 land acres in the study area; 37,748 acres are covered with other vegetation where it would be possible to plant trees (PPA), making up 28% of the study area; and the other 33,1515 acres were considered unsuitable for tree planting, making up 27% of the study area. The unsuitable areas include recreational sports fields, golf course playing areas, impervious surfaces, and agricultural areas.

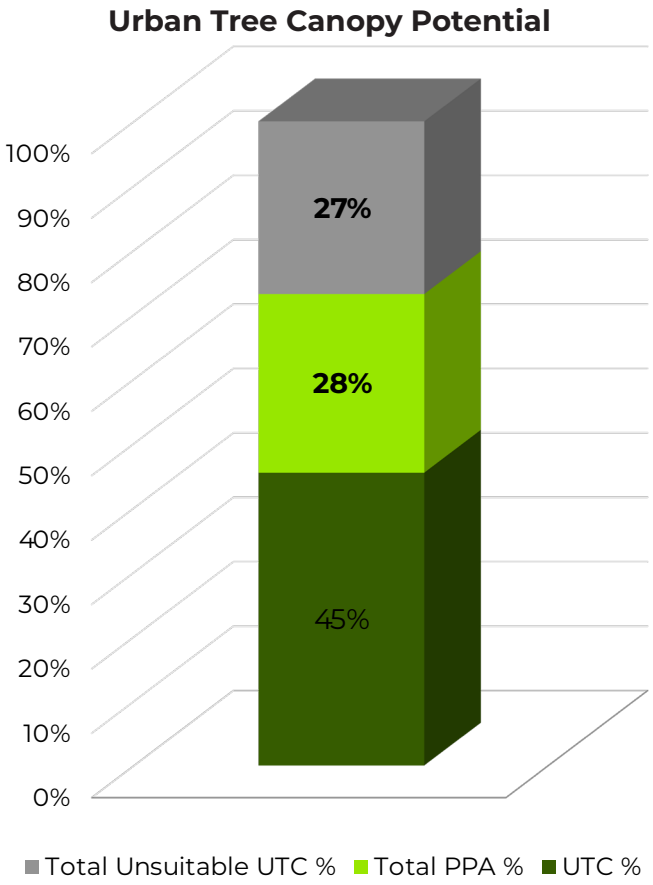


Figure 9. | Urban tree canopy, possible planting area, and area unsuitable for UTC in the study area.

Table 2. | Urban tree canopy assessment results by acres and percent. (Percentages based on land acres.)

Study Area	Acres	%
Total Area	136,656	100%
Land Area	132,752	97%
Urban Tree Canopy	60,349	45%
Total Possible Planting Area	36,817	28%
Unsuitable Vegetation	1,234	1%
Unsuitable Impervious	34,353	26%
Total Unsuitable Area	35,586	27%

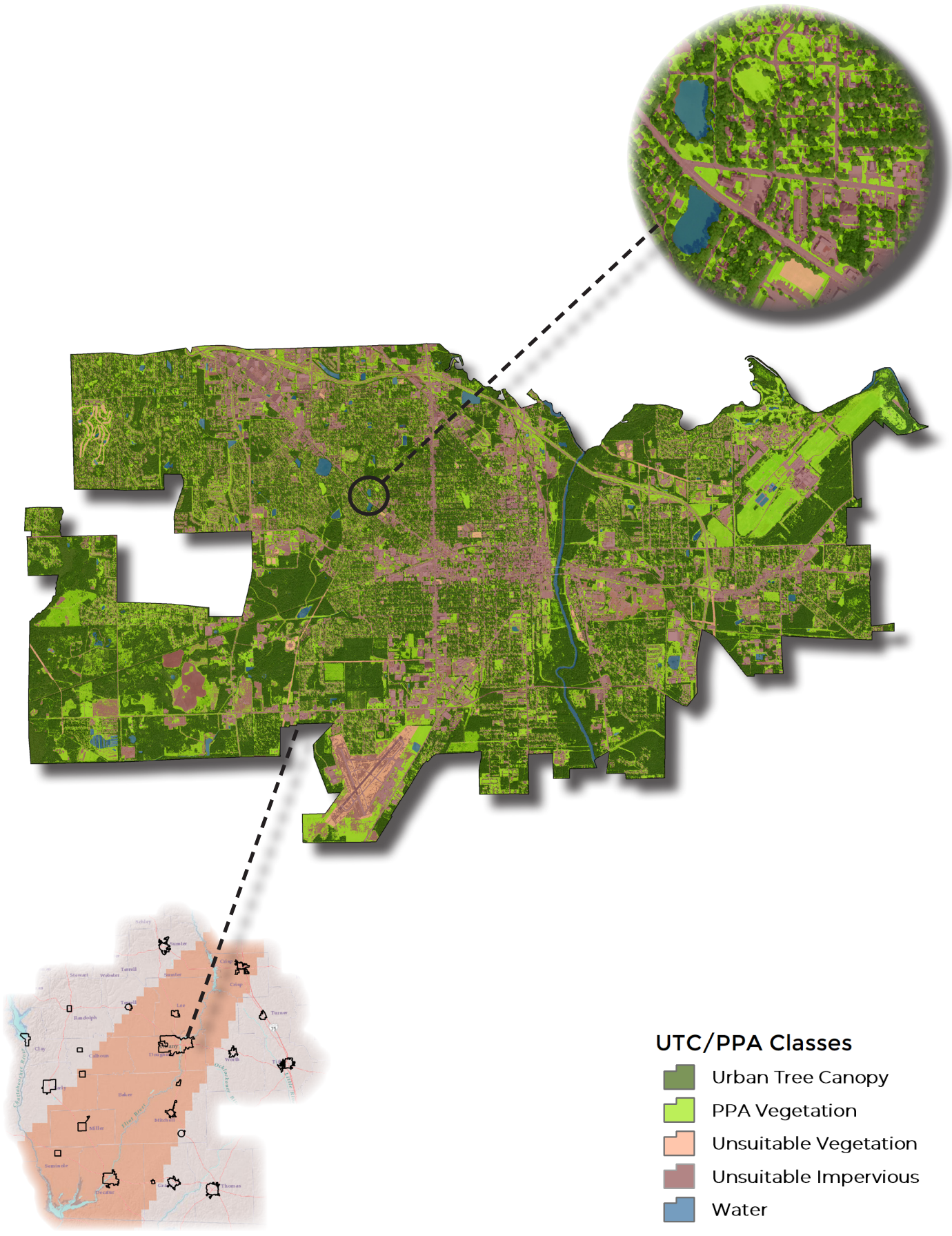


Figure 10. | UTC, PPA, and unsuitable planting areas in Albany, GA.

URBAN TREE CANOPY BY CITIES

UTC and PPA were assessed in 22 cities. UTC varied across the cities in the study area. The city with the lowest canopy cover in 2019 was Donalsonville (22%) and the city with the highest canopy cover was Fort Gaines (69%). The average UTC across all cities was 45%. Prior to Hurricane Michael, Donalsonville had 25% canopy cover. Fort Gaines, located largely outside of hurricane force winds, experienced a gain in tree canopy (68% in 2017). PPA levels in 2019 were also varied throughout the studied cities. The lowest PPA was in Fort Gaines (19%) and the highest in Donalsonville (44%). Albany covered the largest area of all cities and thus contained the largest portion of UTC and PPA in the study area containing 27% of all UTC and 26% of all PPA in the study area. The City experienced a 1% loss of canopy between 2017 and 2019.

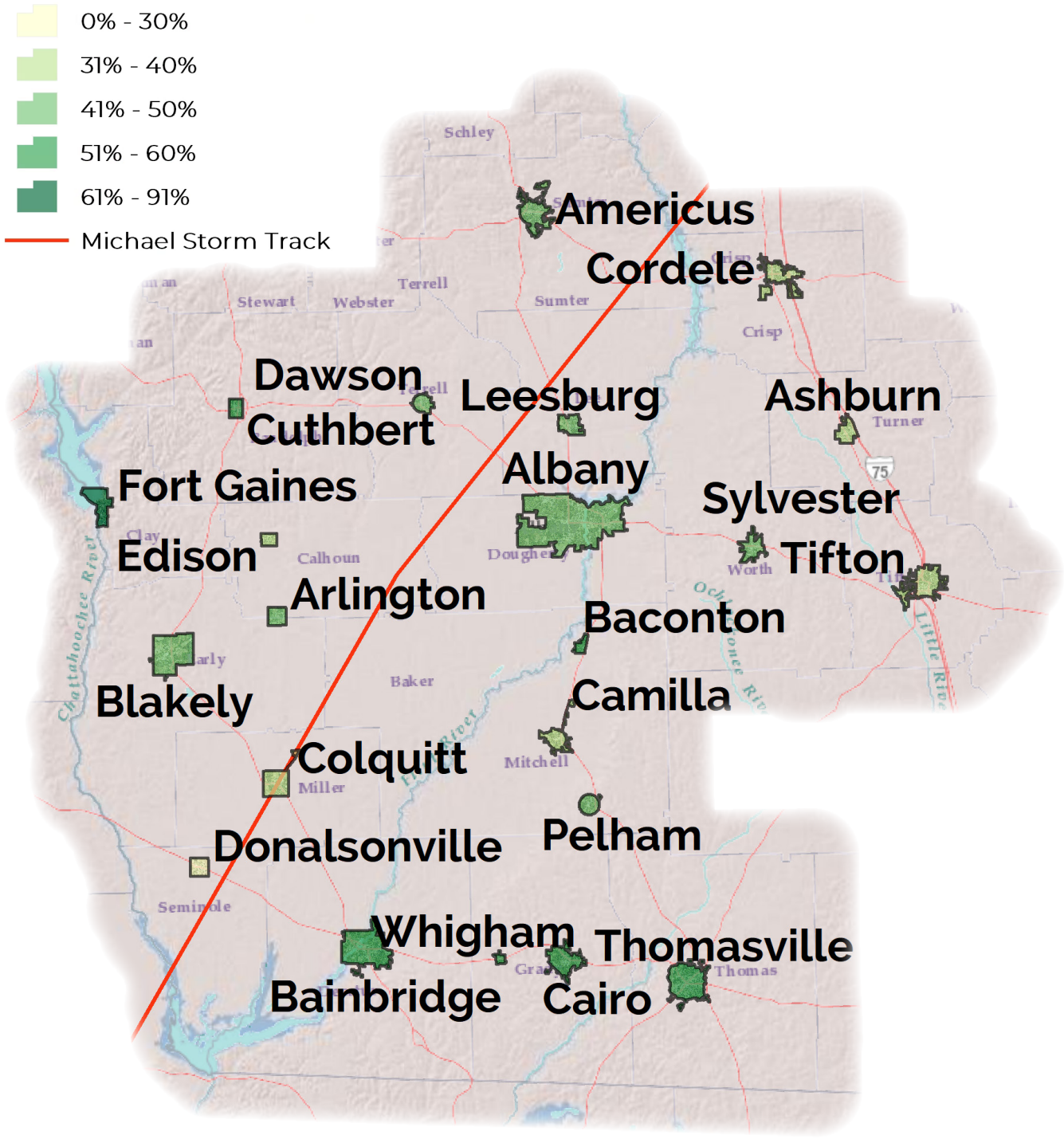


Figure 11. | Map of urban tree canopy by city in the study area.

Table 3. | Urban tree canopy assessment results by cities. UTC and PPA results include acres, percent of area covered by UTC or PPA (%), and distribution of each city's total UTC or PPA within the study area.

City Name	Land Area		Urban Tree Canopy			Possible Planting Area		
	Acres	*Dist.*	*Acres*	*%*	*Dist.*	*Acres*	*%*	*Dist.*
Albany	35,317	27%	16,192	46%	27%	9,554	27%	26%
Americus	6,880	5%	3,337	49%	6%	1,344	20%	4%
Arlington	2,541	2%	1,049	41%	2%	883	35%	2%
Ashburn	3,051	2%	1,168	38%	2%	792	26%	2%
Baconton	1,266	1%	643	51%	1%	497	39%	1%
Bainbridge	11,760	9%	6,214	53%	10%	3,116	26%	8%
Blakely	11,140	8%	5,470	49%	9%	2,890	26%	8%
Cairo	6,045	5%	3,061	51%	5%	1,616	27%	4%
Camilla	3,917	3%	1,520	39%	3%	1,330	34%	4%
Colquitt	5,248	4%	1,786	34%	3%	2,025	39%	5%
Cordele	6,487	5%	1,979	31%	3%	2,084	32%	6%
Cuthbert	1,949	1%	990	51%	2%	548	28%	1%
Dawson	2,391	2%	1,053	44%	2%	646	27%	2%
Donalsonville	2,540	2%	549	22%	1%	1,129	44%	3%
Edison	1,492	1%	595	40%	1%	490	33%	1%
Fort Gaines	3,064	2%	2,100	69%	3%	590	19%	2%
Leesburg	3,179	2%	1,433	45%	2%	801	25%	2%
Pelham	2,594	2%	1,168	45%	2%	838	32%	2%
Sylvester	3,750	3%	1,705	45%	3%	1,002	27%	3%
Thomasville	9,582	7%	4,882	51%	8%	2,143	22%	6%
Tifton	7,810	6%	3,039	39%	5%	2,268	29%	6%
Whigham	748	1%	415	55%	1%	232	31%	1%
Totals	**132,752**	**100%**	**60,349**	**45%**	**100%**	**36,817**	**28%**	**100%**

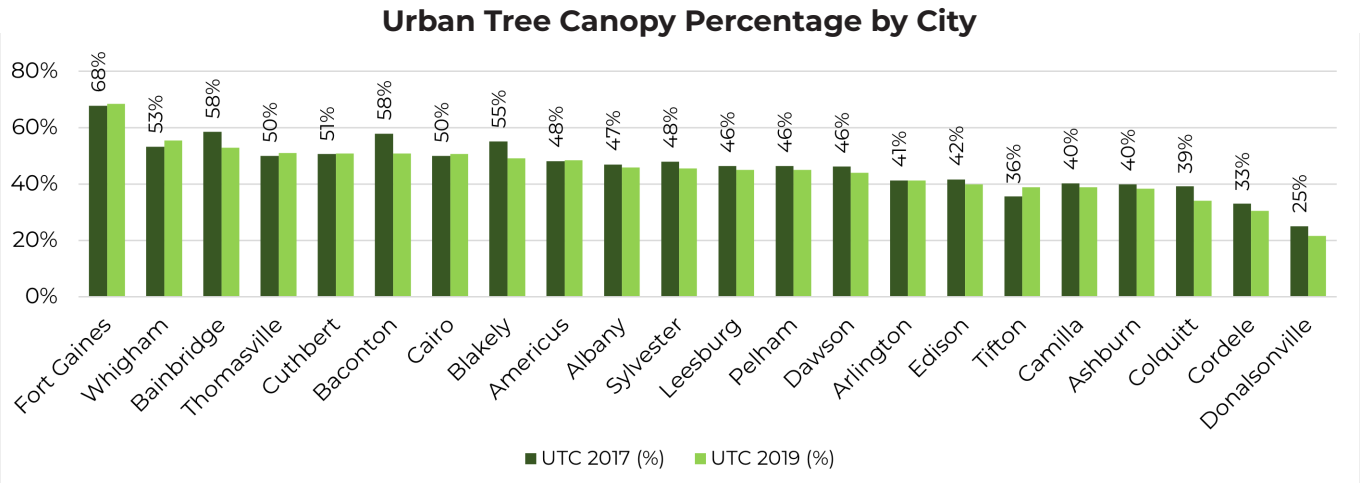


Figure 12. | 2017 and 2019 urban tree canopy in the study area by cities.

STUDY-WIDE URBAN TREE CANOPY CHANGE

All results from this study were then compared to tree canopy assessment results created with imagery collected in 2017, the year before Hurricane Michael made landfall. These assessments mapped tree canopy using nearly identical methods. 1-meter, high resolution NAIP aerial imagery was used for 2017, and 60-centimeter imagery was used for 2019. Changes between both time periods were assessed within each city's boundary, watersheds, ZIP codes, and census block groups.

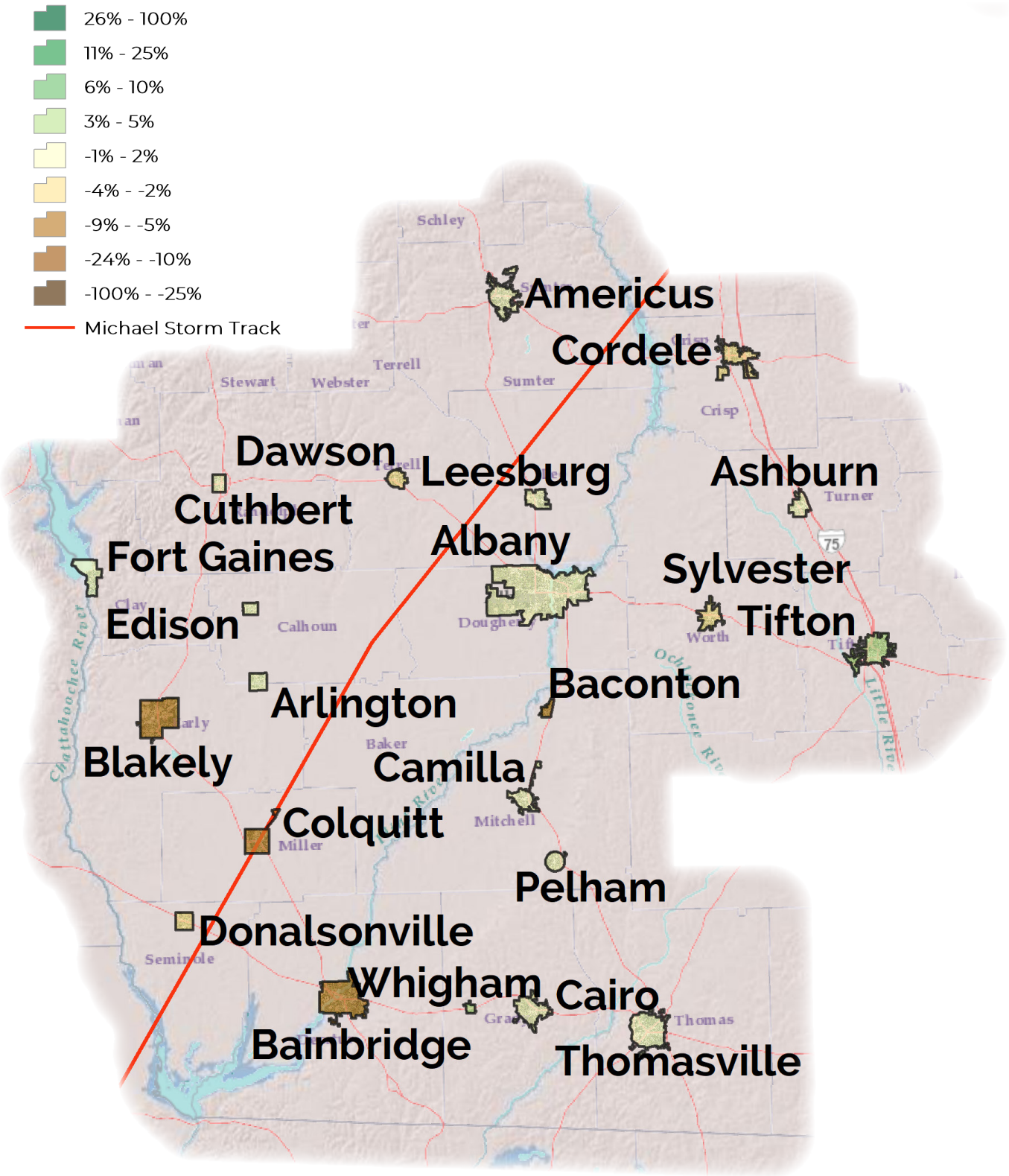


Figure 13. | Urban tree canopy change by cities.

URBAN TREE CANOPY CHANGE BY CITIES

In 2019, urban tree canopy coverage within the study area, was 46% with 40,579 acres. In 2017, before Hurricane Michael, canopy coverage was 48% with 42,366 acres. A total of 1,787 acres of canopy were lost between 2019 and 2017 or a loss of 2% across the study area.

While there were obvious and significant canopy losses directly due to winds and other damage caused by Hurricane Michael, there was also evidence of natural tree canopy growth. These gains were generally more noticeable in more northern communities and in cities further away from where the strongest winds occurred

Assessing UTC before and after the hurricane and measuring the change highlights where the storm's impact was most significant. Two cities had measurable increases in tree canopy between 2017 and 2019: Tifton, which gained 3% UTC, and Whigham, which gained 2% UTC. Both cities were nearly or entirely outside of the hurricane force winds.

Eleven other cities had negligible canopy cover changes between -1% and 1%. The city which had the most significant change in canopy was Baconton, with a UTC loss of 7%. This city is located south of Albany and just east of where Michael's eyewall passed. Blakely lost the largest acreage of tree canopy with a loss of 673 acres of UTC or 6% citywide.

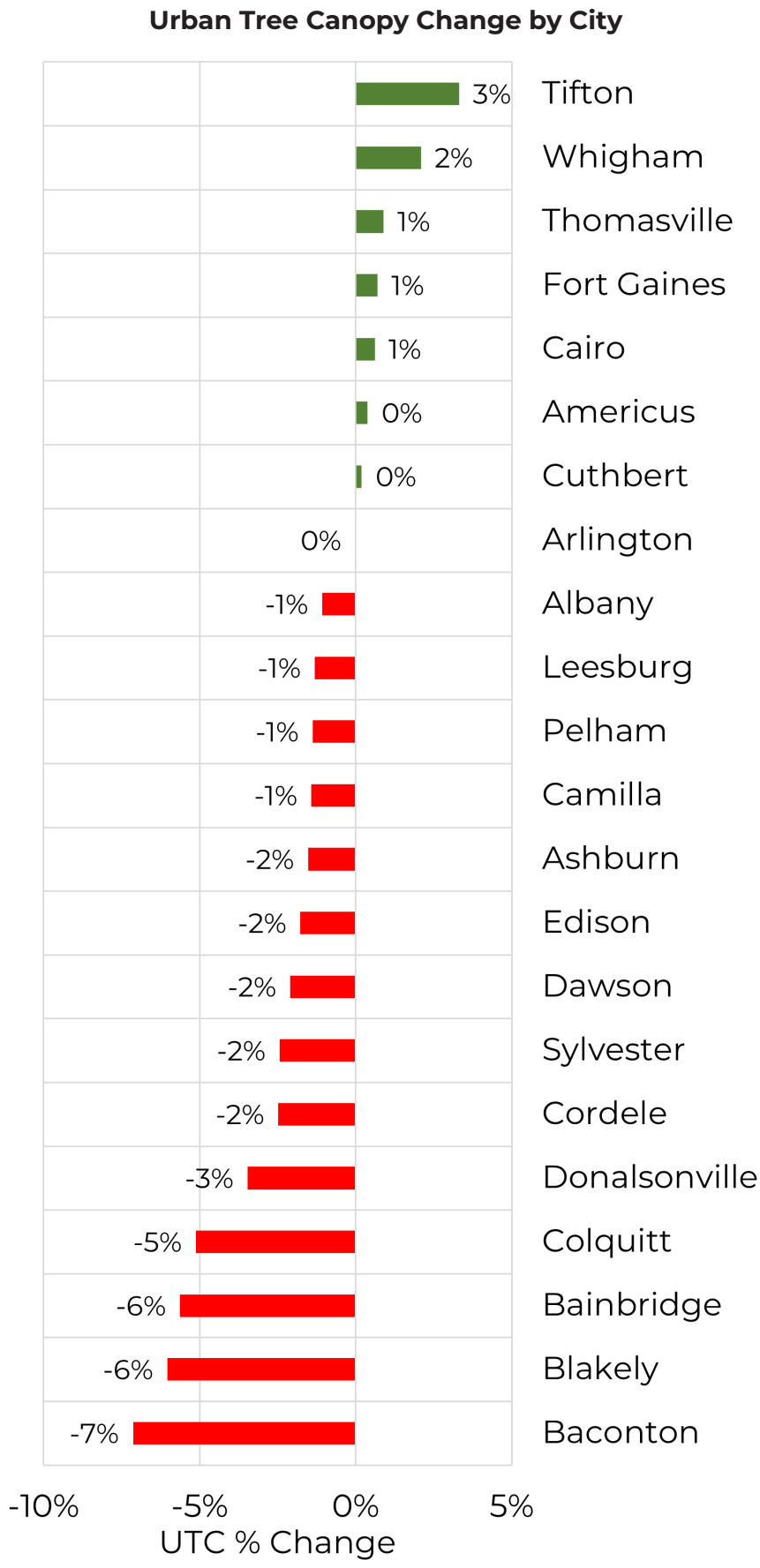


Figure 14. | Urban tree canopy change in the study area by cities.

ALBANY URBAN TREE CANOPY CHANGE

Results showed that citywide Albany had 47% UTC in 2017 and 46% UTC in 2019. Between 2017 and 2019, Albany lost 379 acres of tree canopy or 1% of its land area. Albany contains sixty-three (63) census block groups which are the smallest geographic boundary at which land cover and canopy change results were assessed. Thirty-seven (37) block groups in Albany lost an acre or more tree canopy after the storm. Tree canopy change varied throughout the city with some block groups in Albany experiencing 13% UTC loss and others gaining 3% UTC.

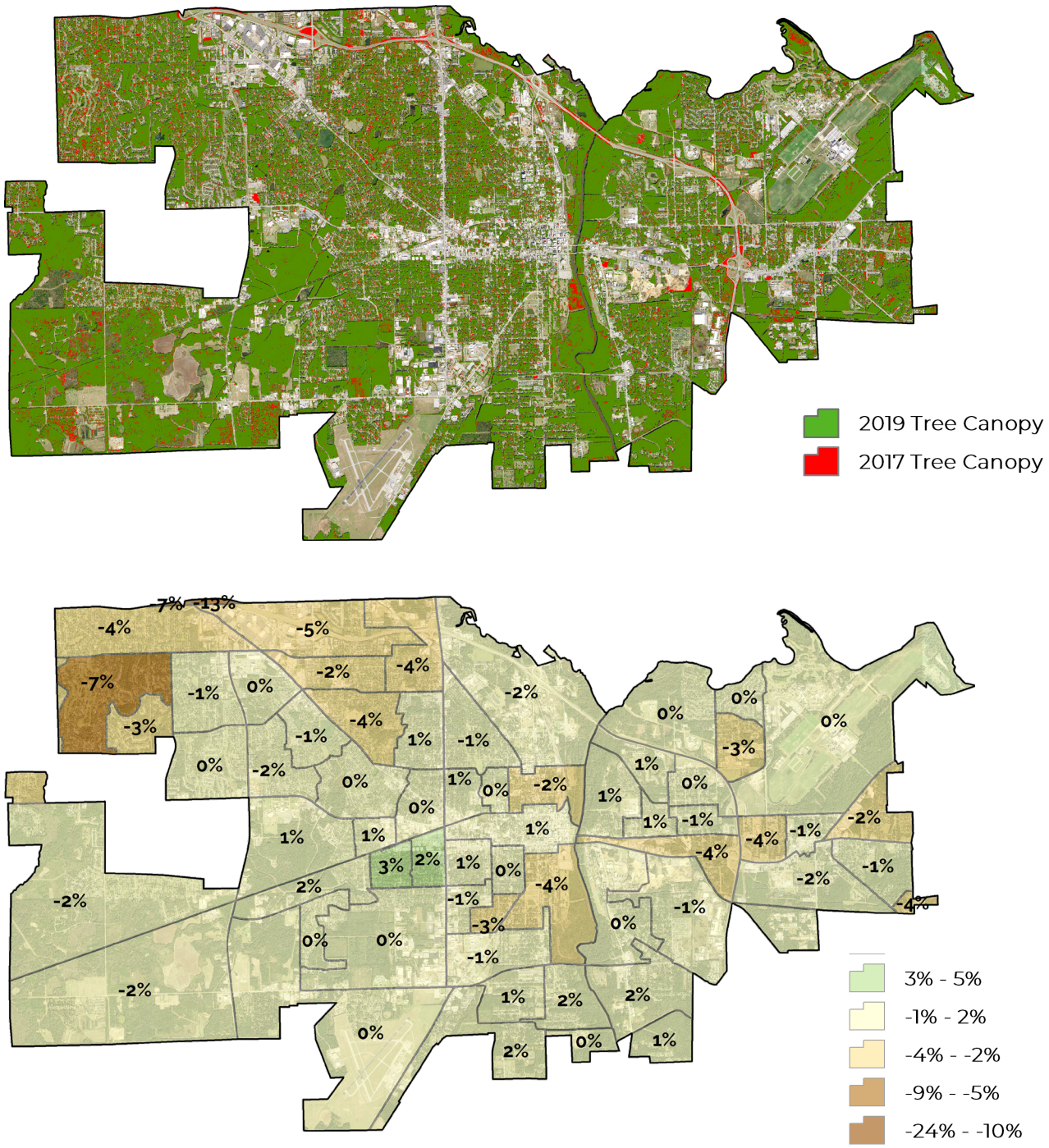
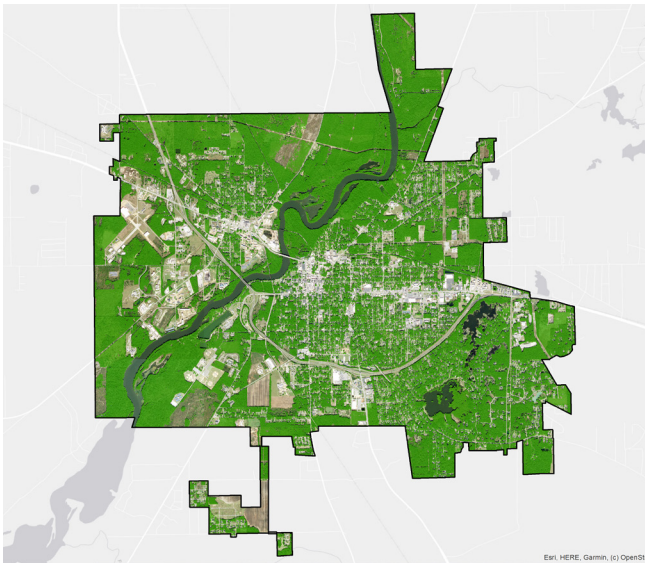


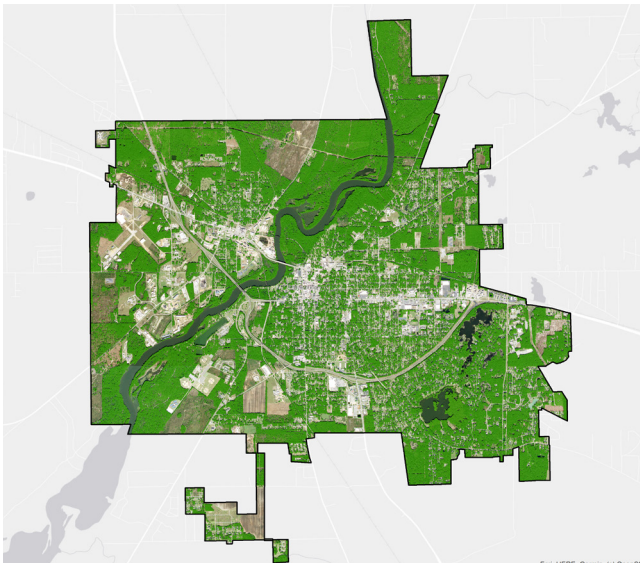
Figure 15. | Urban tree canopy change in Albany. (Top)
Urban tree canopy change by census block groups in Albany. (Bottom)

BAINBRIDGE URBAN TREE CANOPY CHANGE

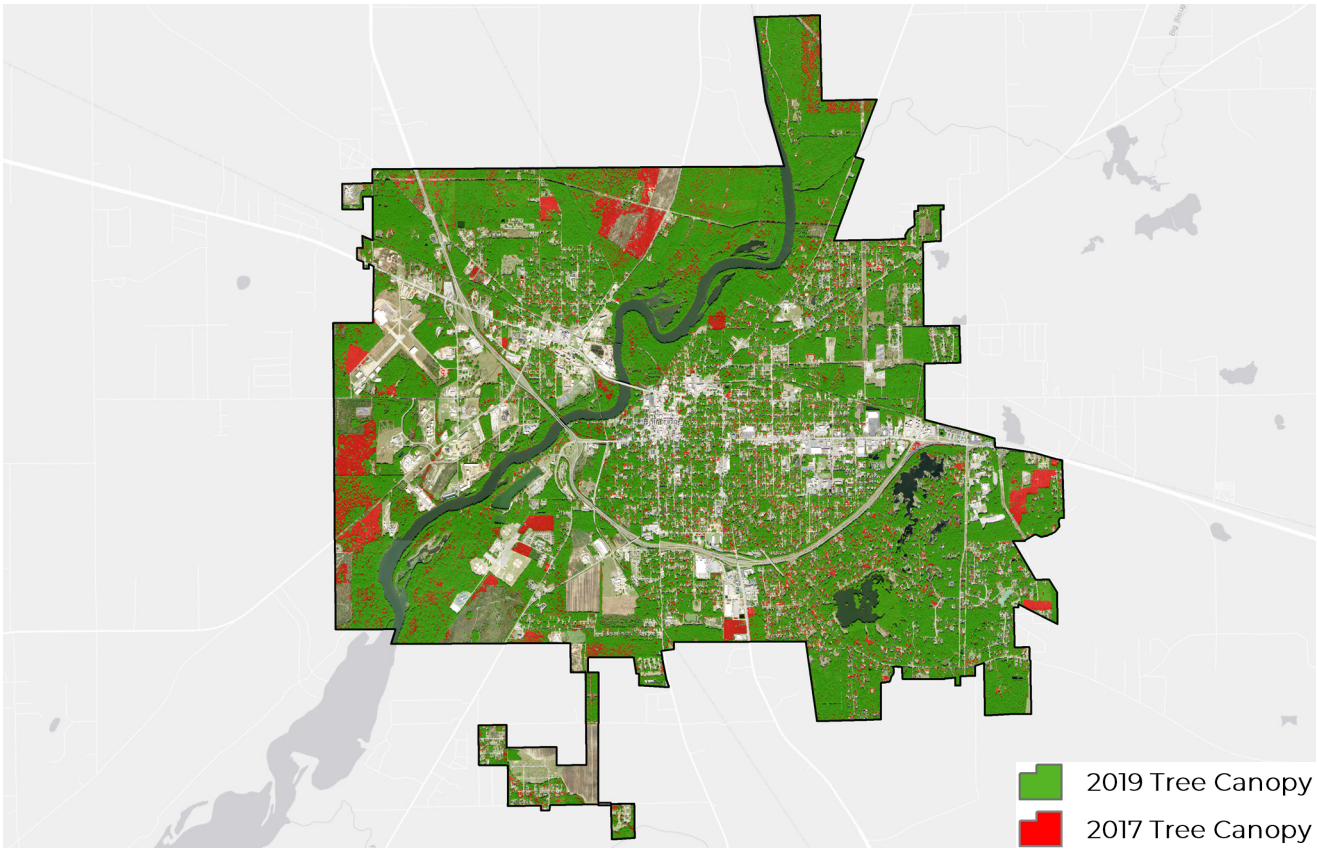
Urban tree canopy change was assessed within the Bainbridge city boundary. In 2017, Bainbridge contained 6,877 acres of tree canopy or 58% of its land area. In 2019, results showed the City contained 6,214 acres of tree canopy, equal to 53% of its land area. Hurricane Michael and other development and landscape changes resulted in 662 acres of tree canopy loss or 6% of the land area of Bainbridge.



2017 Tree Canopy Classification



2019 Tree Canopy Classification



Tree canopy change in Bainbridge between 2017 and 2019

BLAKELY URBAN TREE CANOPY CHANGE

Results showed that, citywide, Blakely had 55% UTC in 2017 and 49% UTC in 2019. Hurricane Michael and other development and landscape changes resulted in a 6% loss in tree canopy. Of the nine census block groups within the City's boundary, all experienced canopy loss between 2% and 10%. Blakely includes five watersheds. The largest is Upper Dry Creek which lost 8% UTC or 431 acres. All other watersheds lost between 1% and 5% of their land area in tree canopy.

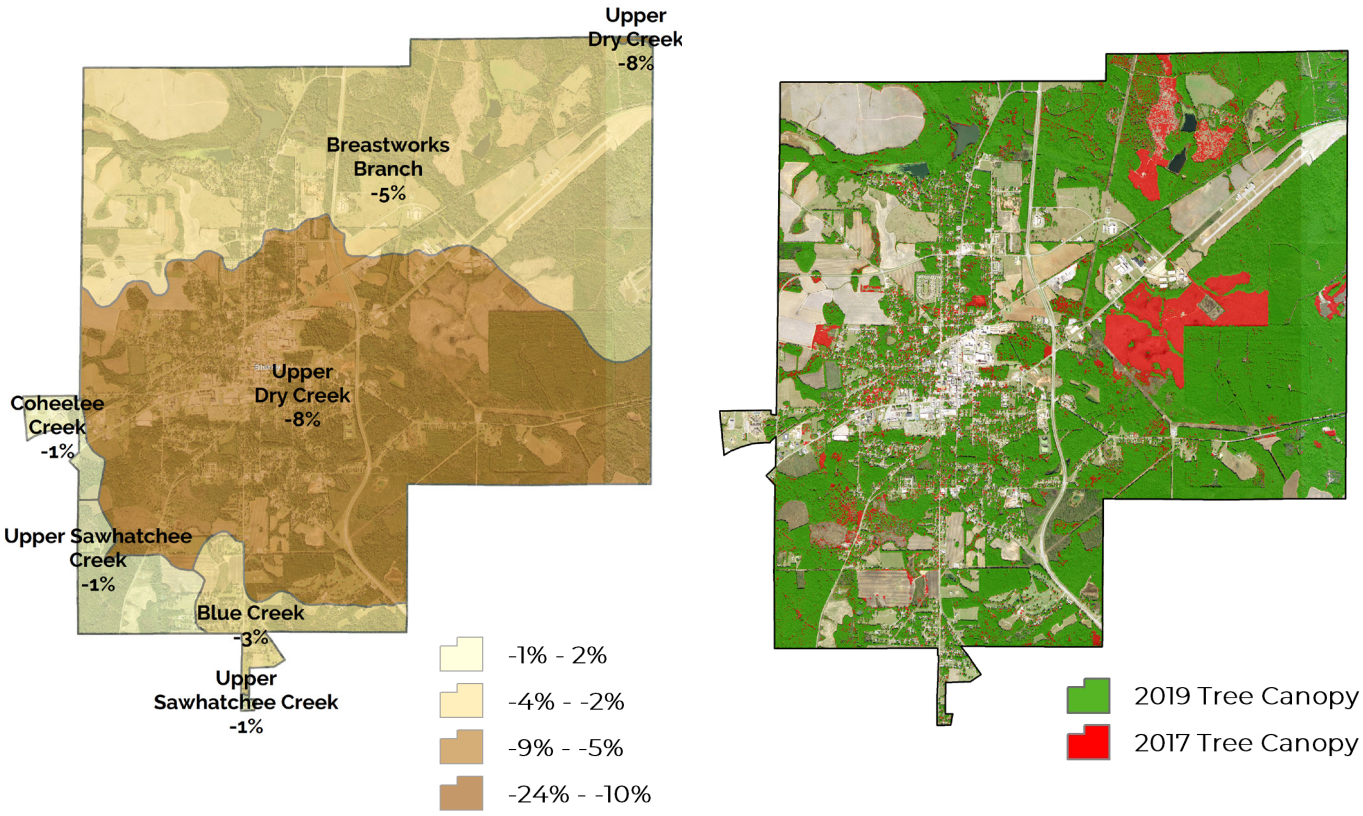


Figure 16 | Urban tree canopy change by watersheds in Blakely, GA (left). Citywide urban tree canopy change in Blakely, GA (right).

Table 4. | Urban tree canopy change results by watersheds in Blakely, GA.

Blakely Census Block Groups	Land Area		UTC 2017		UTC 2019		UTC Change	
	Acres	*Dist.*	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*
013-099-090200-1	2,101	19%	1,169	56%	1,056	50%	-113	-5%
013-099-090200-2	1,265	11%	470	37%	446	35%	-25	-2%
013-099-090200-3	646	6%	189	29%	160	25%	-29	-4%
013-099-090200-4	776	7%	344	44%	295	38%	-49	-6%
013-099-090300-1	471	4%	167	35%	140	30%	-27	-6%
013-099-090300-2	765	7%	474	62%	439	57%	-36	-5%
013-099-090400-1	3,580	32%	2,626	73%	2,275	64%	-351	-10%
013-099-090400-2	732	7%	281	38%	252	34%	-29	-4%
013-099-090400-3	804	7%	424	53%	408	51%	-15	-2%
Totals	**11,140**	**100%**	**6,143**	**55%**	**5,470**	**49%**	**-673**	**-6%**

QUANTIFYING ECOSYSTEM BENEFITS

Using the best available science from i-Tree tools, values were calculated for some of the benefits and functions provided by trees and forests, both individually for each city and collectively for the whole study area. The urban forest holds millions of dollars worth of savings in avoided infrastructure costs, pollution reduction , and stored carbon. Hurricane Michael had dramatic impacts on tree canopy and the benefits that it provides.

AIR QUALITY

Trees produce oxygen, indirectly reduce pollution by lowering air temperatures, and improve public health by reducing air pollutants, which cause death and illness.

- The existing tree canopy in the study area removes 2,373 tons of air pollution annually, valued at $7.6 million.
- In 2017, tree canopy was removing an estimated 2,456 tons of air pollution annually, valued at $7.8 million.

STORMWATER AND WATER QUALITY

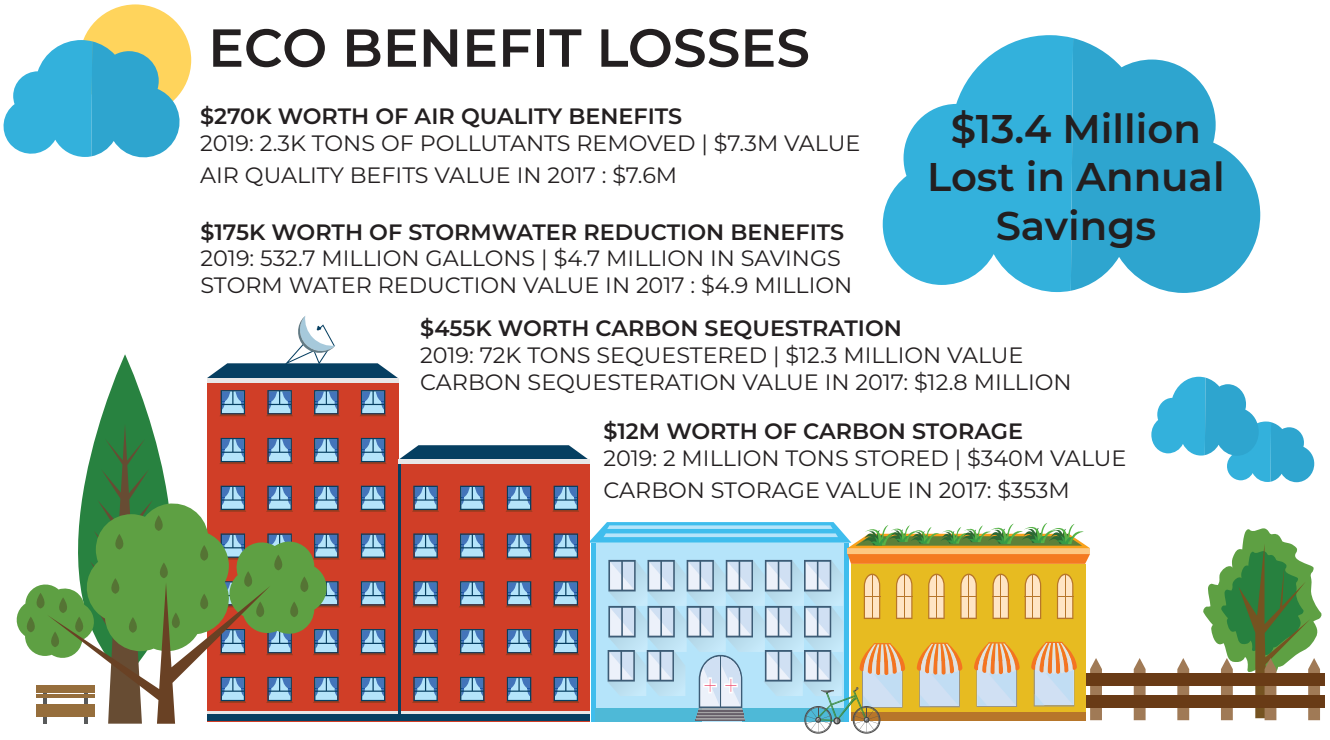
Trees and forests mitigate stormwater runoff, which minimizes flood risk, stabilizes soil, reduces sedimentation in streams and riparian land, and absorbs pollutants, thus improving water quality and habitats.

- On average, each acre of tree canopy in the study area absorbs 9,000 gallons of water. This benefit of avoided runoff is valued at roughly $78.89 per acre/per year. Extrapolated for the whole study area, this means that existing tree canopy provides $4.9 million annually in stormwater benefits. In 2017 trees were providing an estimated $5.1 million in annual stormwater benefits.

CARBON STORAGE AND SEQUESTRATION

Trees accumulate carbon in their biomass; with most species in a temperate forest, the rate and amount increase with age.

- Trees in the study area store approximately 2 million tons of carbon, valued at $351 million and each year the tree canopy absorbs and sequesters approximately 74,000 tons of carbon dioxide, valued at $12 million.
- In 2017, the carbon stored by trees in the study area was valued at $364 million and tree canopy sequestered $13 million worth of carbon dioxide.



TREE PLANTING PRIORITIZATION

Urban tree canopy provides a multitude of direct and indirect benefits to residents and visitors alike. Five criteria were analyzed across the study area at the census block group level to understand how the distribution of the benefits of tree canopy was impacted, to assist in the prioritization of future planting efforts, and to ensure the benefits of tree canopy are equitably restored. Planting prioritization criteria were created using the 2019 land cover data set and American Community Survey 5-year estimates. These results represent possible planting areas as determined by remote sensing classification. Possible planting areas have not been evaluated for conflicts between overhead or underground utilities and should be visited to determine site suitability prior to planting.

PRIORITIZATION CRITERIA AND RESULTS

Areas with Low Existing Tree Canopy - It is important to understand the existing distribution of existing tree canopy across the city. This criteria highlights block groups in the study area which have low existing urban tree canopy.

Possible UTC - One of the primary purposes of this study is to identify where to prioritize new tree plantings. This criteria highlights the percent of total area available for future tree planting.

UTC Loss - Tree canopy loss was not uniform across the study area. This criteria highlights the block groups which experienced greater losses. Block groups with greater tree canopy loss were given a higher priority.

Median Household Income - Also referred to as Economic Vitality, the presence of trees typically aligns with increased economic vitality and quality of life in urban areas. This criteria highlights the median household income, as reported by the U.S. Census American Community Survey 2014-2019 5-year summaries.

People of Color - There is generally a negative correlation between tree canopy and the percentage of the population who are people of color. This criteria represents the percentage of people who are Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and includes all people classified as Hispanic reported by the U.S. Census American Community Survey 2014-2019 5-year summaries.

Table 5. | Top ten combined tree planting prioritization scores by census block group.

Block Group	City Name	People of color%	Median Household Income	UTC % Change	Low Tree Canopy %	Possible Tree Canopy	Overall Score
013-081-010201-3	**Cordele**	99%	35,375	-9%	80%	39%	3.53
013-095-010302-4	**Albany**	100%	0	-3%	65%	41%	3.13
013-081-010202-3	**Cordele**	100%	0	-4%	71%	34%	3.10
013-243-790200-1	**Cuthbert**	48%	26,296	-8%	62%	48%	3.02
013-177-020403-2	**Albany**	18%	97,135	-13%	100%	45%	2.94
013-081-010201-4	**Cordele**	99%	14,093	-5%	65%	30%	2.92
013-253-200200-2	**Donalsonville**	80%	29,697	-4%	70%	41%	2.91
013-095-000100-3	**Albany**	98%	18,955	-4%	66%	29%	2.81
013-253-200200-1	**Donalsonville**	64%	31,625	-2%	80%	46%	2.80
013-261-950300-1	**Americus**	84%	29,153	-4%	66%	37%	2.76

Results indicated that the majority of the highest combined priority block groups were located in Albany, Cordele, and Donalsonville. Fifteen cities contain a block group ranked in the top 25 highest priority in the study area. Albany contains the highest concentration of high priority block groups due to its size, in terms of population and area. Donalsonville, already lowest in terms of tree canopy compared to other cities, experienced 3% canopy loss after Hurricane Michael. As a result, two of the three block groups in the city boundary experienced more than the average canopy loss and also contained more than the study-wide average percentage of people of color (62%) and lower than the study-wide average median household income ($36,800). Figure 17 shows all block groups in Albany ranked by their overall planting priority and highlights block groups with higher than average canopy loss, higher than average percentage of people of color, and lower than average median income.

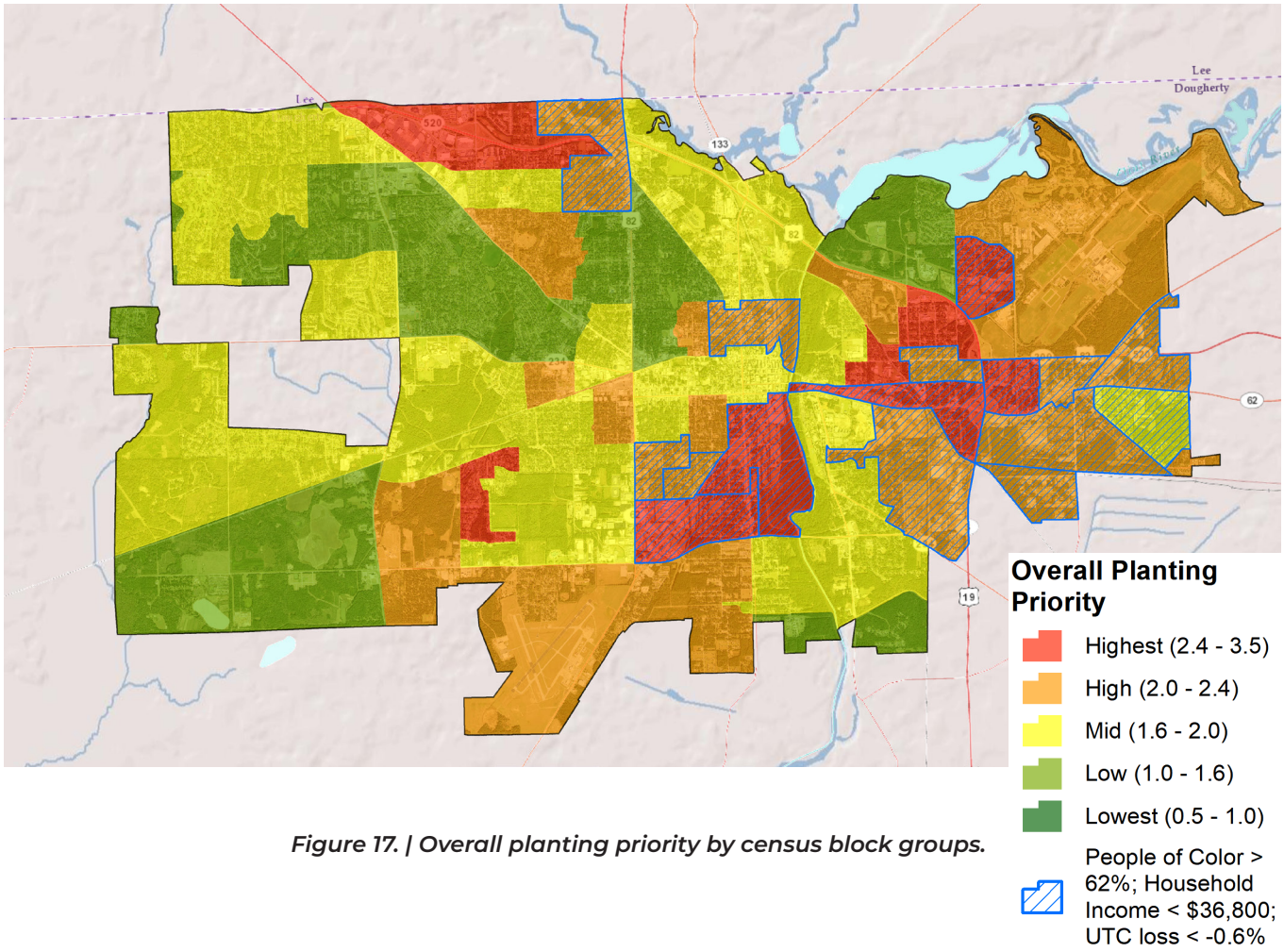


Figure 17. | Overall planting priority by census block groups.

CONCLUSIONS AND RECOMMENDATIONS

The Georgia Forestry Commission and Georgia Tree Council have demonstrated that they value their natural resources and are interested in the maintenance of a healthy and sustainable urban environment. Given the difference in size of the largest and smallest communities in this assessment, the implementation of these results will naturally take on different forms for each city and community. It is up to the state and individual cities to take these results and use the resources available to them to continue monitoring the health of the urban forest and to implement the following recommendations to ensure the urban forest is considered during future city planning and development. These results should be used to sustain and enhance the benefits that trees provide to their communities.

Use prioritization data to target new tree plantings in high priority block groups

To recover from the damage that Hurricane Michael caused to tree canopy and to monitor the success of recovery efforts, cities should have a tree canopy assessment performed on a regular interval. As each city changes, they will be able to use these data to ensure that their existing urban forest policies, or any future policies and management practices, prioritize maintenance, health, and growth. The urban forest provides a wealth of environmental, social, and even economic benefits, which relate back to greater community interest in local initiatives and priorities. These results can be used to identify where existing tree canopy cover should be preserved, where there are opportunities to expand the canopy cover, and which areas would receive the greatest benefits from the investment of valuable time and resources into the urban forest.

1. Leverage the results of this assessment to promote the urban forest

The results of this assessment should be used to encourage investment in urban forest monitoring, maintenance, and management; to prepare supportive information for local budget requests/grant applications; and to develop targeted presentations for city leaders, planners, engineers, resource managers, and the public on the functional benefits of trees in addressing environmental issues. The land cover and planting prioritization data should be disseminated to diverse partners for urban forestry and other applications while the data are current and most useful for decision-making and implementation planning. The information from this study can help establish canopy cover goals for the short- and long-term.

2. Distribute available project materials and data to city decision makers and residents

The cities and their various stakeholders can utilize the results of the UTC, PPA, and planting site prioritization analyses to identify the best locations to focus future tree planting and canopy expansion efforts. These results are available as geospatial data, spreadsheets, PDF maps, and two-page fact sheets. The fact sheets provide specific information about each individual city and can be used in efforts to engage each community and its stakeholders. Also provided are Excel spreadsheets detailing the assessment results for all geographic scales. The geospatial data is also provided and accessible to all city, county, and state GIS personnel.

3. Develop outreach programs towards private landowners

In addition to the examples above, the provided ArcGIS StoryMap and TreePlotter™ CANOPY software should be distributed to appropriate audiences in order to disseminate information and provide interaction with the assessment results. Online interactive map tools are some of the most accessible ways to share geospatial data because they can be viewed on any desktop or mobile device and provide interactive, easy to absorb visualizations of complex data. First, the story map should be used to contextualize this assessment, understand the process, results, and benefits of tree canopy assessments, and provide a publicly accessible overview of the project. Then, decision makers can explore the TreePlotter™ CANOPY software. CANOPY allows users to visualize existing land cover, canopy growth and loss, and quantify impacts that canopy growth or loss has on air quality, stormwater runoff, and carbon sequestration. Users can explore a wide range of targeted, in-depth planting scenarios based on the prioritization criteria included in this assessment to identify the most equitable locations for tree planting efforts.

SOUTHWEST CORDELE CONTAINS 6 HIGH PRIORITY BLOCK GROUPS

4. Focus new plantings in high priority areas

Results of this assessment, specifically the planting prioritization results, should be used to inform the next steps in planting and recovery efforts. An important part of managing trees and citywide urban tree canopy for many cities is identifying suitable planting sites. Tree canopy in cities is often not distributed equitably across communities with different races and incomes. To identify suitable sites, cities should first use the prioritization results to identify areas with high amounts of possible UTC, low median household income, high percentage of people of color, and high UTC loss. Then, the highest priority areas should be visited and inspected for suitable sites. Suitable sites should be free of overhead or underground utilities and a set distance away from buildings or structures. Communities should be directed to existing resources for developing a storm plan and maintaining a sustainable urban forest such as those on the Georgia Forestry Commission website: https://gatrees.org/urban-community-forestry/trees-storm-safety/

REPORT APPENDIX

GLOSSARY/KEY TERMS

Land Acres: 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 biophysically possible to plant trees.

Possible Planting Area - Total: The combination of PPA Vegetation area and PPA Impervious area. In this project no impervious areas were identifies as plantable.

Soil/Dry Vegetation: Areas of bare soil and/or 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 and roads and all other types of impervious surfaces.

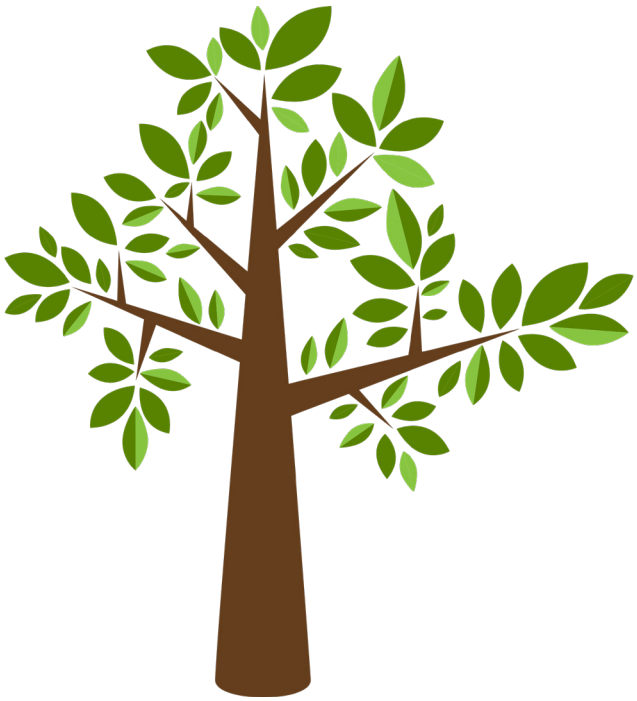
Unsuitable Planting Area: Areas where it is not feasible to plant trees. Airports, ball fields, golf courses, etc. were manually defined as unsuitable planting areas.

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

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

Urban Tree Canopy (UTC): 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 urban forest. Tree canopy was generally taller than 10-15 feet tall.

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



UTC ASSESSMENT RESULTS TABLES

***continued on next page**

The tables on the following pages include 2019 UTC and UTC change (2017-2019) percentages for all features (city boundaries, US census block groups, watersheds, and ZIP codes) within every city included in the study area.

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Albany, GA	**46%**	**-1%**
ZIP Codes		
31701	43%	-1%
31705	45%	0%
31707	46%	-1%
31721	49%	-3%
Watersheds		
Albany-Flint River	41%	0%
East Dougherty	51%	0%
Fowltown Creek	46%	-7%
James Pond-Kinchafoonee Creek	39%	-3%
Lower Piney Woods Creek	71%	1%
Machalee Creek-Lake Worth	44%	-1%
Percosin Creek	51%	-1%
Turner City-Flint River	42%	-1%
Upper Cooleewahee Creek	59%	-4%
Census Block Groups		
130950001001	42%	-2%
130950001002	32%	-1%
130950001003	34%	-4%
130950001004	47%	-2%
130950001005	56%	-1%
130950002001	48%	-1%
130950002002	38%	-4%
130950002003	62%	1%
130950002004	38%	1%
130950004001	36%	-4%
130950004002	36%	-2%
130950004003	21%	-5%
130950005011	38%	0%
130950005012	51%	-1%
130950005021	44%	-2%
130950005022	50%	0%
130950005023	39%	0%
130950005024	42%	-1%
130950006001	47%	-4%
130950006002	51%	1%
130950007001	53%	-1%
130950008001	37%	0%
130950008002	40%	-2%
130950009001	50%	1%
130950009002	38%	0%
130950010001	34%	1%
130950010002	62%	1%
130950011001	40%	2%
130950011002	53%	3%
130950011003	57%	2%
130950011004	45%	0%
130950011005	51%	0%
130950014031	49%	-4%
130950014032	26%	-1%
130950015001	52%	0%
130950015002	45%	-3%
130950015003	34%	-1%
130950103021	39%	0%
130950103022	53%	1%
130950103023	60%	0%
130950103024	35%	-3%
130950103025	40%	0%
130950104011	45%	-4%
130950104012	58%	-3%
130950104013	47%	-7%
130950104021	61%	-2%
130950104031	56%	-2%
130950105001	34%	0%
130950106011	62%	2%
130950106012	49%	1%
130950106021	66%	0%
130950106022	51%	2%
130950107001	38%	-1%
130950107002	58%	2%
130950107003	43%	0%
130950109001	79%	1%
130950112001	37%	0%
130950112003	50%	-4%
130950113001	40%	-2%
130950114001	44%	1%
130950114002	20%	1%
131770204031	56%	-7%
131770204032	0%	-13%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Americus, GA	**49%**	**0.4%**
ZIP Codes		
31709	48%	1%
31719	49%	-1%
Watersheds		
Deer Creek-Muckalee Creek	62%	5%
Parkers Mill Creek	39%	-2%
Wolf Creek-Muckalee Creek	50%	1%
Census Block Groups		
132619502001	45%	0%
132619502002	30%	1%
132619502003	59%	2%
132619502004	45%	1%
132619503001	34%	-4%
132619503002	64%	-1%
132619503003	43%	0%
132619503004	37%	0%
132619503005	66%	1%
132619505001	49%	0%
132619505002	67%	0%
132619506001	28%	1%
132619506002	45%	-1%
132619506003	43%	2%
132619507001	65%	0%
132619507002	58%	5%
132619507003	36%	2%
132619507004	42%	1%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Arlington, GA	**41%**	**0%**
ZIP Codes		
39813	41%	0%
Watersheds		
Mill Creek	28%	-1%
Neals Creek	44%	1%
Perry Creek-Spring Creek	44%	0%
Census Block Groups		
130379502001	44%	0%
130379502002	51%	0%
130990901002	32%	0%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Ashburn, GA	**38%**	**-2%**
ZIP Codes		
31714	39%	-2%
31790	12%	-2%
Watersheds		
Ashburn Branch-Little River	38%	-1%
Lower Deep Creek	9%	-1%
Upper Hat Creek	35%	-1%
West Fork Deep Creek	46%	-2%
Census Block Groups		
132879702001	43%	-2%
132879702002	47%	-2%
132879702003	33%	-1%
132879702004	34%	-2%
132879702005	35%	-1%
132879703001	12%	-2%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Bainbridge, GA	**53%**	**-6%**
ZIP Codes		
39817	54%	-6%
39819	51%	-5%
Watersheds		
Douglas Lake-Big Slough	59%	-4%
Flint River-Lake Seminole	43%	-7%
Fourmile Creek	25%	-3%
West Bainbridge-Flint River	58%	-6%
Census Block Groups		
130879701003	82%	-7%
130879703001	50%	-3%
130879703002	50%	-11%
130879703003	49%	-5%
130879703004	36%	-5%
130879704001	48%	0%
130879704002	64%	-4%
130879704003	55%	-1%
130879704004	40%	-3%
130879706001	49%	-4%
130879706002	44%	-6%
130879706003	39%	-3%
130879706004	65%	-5%
130879707001	81%	-11%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Baconton, GA	**51%**	**-7%**
ZIP Codes		
31716	51%	-7%
Watersheds		
Miller Springs-Flint River	50%	-6%
Wethington Slough	53%	-9%
Census Block Groups		
132050901001	51%	-7%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Blakely, GA	**49%**	**-6%**
ZIP Codes		
39823	49%	-6%
Watersheds		
Blue Creek	43%	-3%
Breastworks Branch	51%	-5%
Coheelee Creek	27%	-1%
Upper Dry Creek	48%	-8%
Upper Sawhatchee Creek	59%	-1%
Census Block Groups		
130990902001	50%	-5%
130990902002	35%	-2%
130990902003	25%	-4%
130990902004	38%	-6%
130990903001	30%	-6%
130990903002	57%	-5%
130990904001	64%	-10%
130990904002	34%	-4%
130990904003	51%	-2%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Cairo, GA	**51%**	**1%**
ZIP Codes		
39827	63%	-1%
39828	50%	1%
Watersheds		
Brumbley Creek	40%	-1%
Little Tired Creek	52%	0%
Middle Tired Creek	50%	1%
Upper Tired Creek	13%	6%
Census Block Groups		
131319503001	45%	2%
131319503002	51%	1%
131319503003	44%	2%
131319503004	49%	5%
131319504001	66%	-1%
131319504002	54%	1%
131319504003	54%	1%
131319504004	23%	1%
131319505001	45%	1%
131319505002	41%	-1%
131319505003	69%	0%
131319505004	60%	-4%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Camilla, GA	**39%**	**-1%**
ZIP Codes		
31730	39%	-1%
Watersheds		
Howell Lake-Big Slough	30%	-2%
Rigsby Lake-Big Slough	49%	-3%
Rock Pond-Big Slough	34%	0%
Census Block Groups		
132050903001	49%	-3%
132050903002	48%	-1%
132050903003	32%	1%
132050904001	23%	0%
132050904002	42%	-4%
132050904003	40%	-3%
132050904004	36%	0%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Colquitt, GA	**34%**	**-5%**
ZIP Codes		
39837	34%	-5%
Watersheds		
Town of Boykin-Spring Creek	26%	-10%
Town of Colquitt-Spring Creek	36%	-4%
Upper Aycocks Creek	16%	-8%
Upper Big Drain	12%	1%
Census Block Groups		
132019501001	32%	-7%
132019502001	40%	-6%
132019502002	26%	-2%
132019503002	33%	-5%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Cordele, GA	**31%**	**-2%**
ZIP Codes		
31015	31%	-2%
Watersheds		
Lower Cedar Creek	13%	-1%
Lower Gum Creek	32%	-1%
Lower Lake Blackshear	17%	-7%
Middle Gum Creek	31%	-2%
Upper Cedar Creek	32%	-3%
Census Block Groups		
130810101001	29%	-1%
130810101002	39%	-2%
130810101003	30%	-2%
130810102013	20%	-9%
130810102014	35%	-5%
130810102021	30%	3%
130810102022	34%	-1%
130810102023	29%	-4%
130810103001	28%	-2%
130810103002	56%	-1%
130810103003	21%	-2%
130810104001	38%	0%
130810104002	33%	-1%
130810104003	24%	-2%
130810104004	25%	-3%
130810104005	41%	-2%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Cuthbert, GA	**51%**	**0.2%**
ZIP Codes		
39840	51%	0.2%
Watersheds		
Upper Carter Creek	49%	0%
Upper Holanna Creek	65%	1%
Census Block Groups		
132437902001	38%	-8%
132437902002	49%	2%
132437902003	48%	2%
132437902004	53%	1%
132437902005	58%	1%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Dawson, GA	**44%**	**-2%**
ZIP Codes		
39842	44%	-2%
Watersheds		
Brantley Creek	44%	-2%
Headwaters Chickasawhatchee Creek	38%	-5%
Census Block Groups		
132731203001	41%	0%
132731203002	37%	-3%
132731203003	34%	2%
132731203004	39%	0%
132731204001	47%	-4%
132731204002	59%	-5%
132731204003	36%	0%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Donalsonville, GA	**22%**	**-3%**
ZIP Codes		
39845	22%	-3%
Watersheds		
Headwaters Fishpond Drain	19%	-3%
Upper Fishpond Drain	25%	-4%
Census Block Groups		
132532002001	20%	-2%
132532002002	30%	-4%
132532002003	19%	-5%
132532003003	8%	1%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Edison, GA	**40%**	**-2%**
ZIP Codes		
39846	40%	-2%
Watersheds		
Lower Little Pachitla Creek	41%	0%
Neals Creek	40%	-2%
Census Block Groups		
130379502003	44%	-3%
130379502004	37%	-1%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Fort Gaines, GA	**69%**	**1%**
ZIP Codes		
39851	69%	1%
Watersheds		
Lower Cemochehobee Creek	71%	1%
McRay Mill Creek-Chattahoochee River	73%	1%
Thomas Mill-Walter F. George Reservoir	53%	-1%
Census Block Groups		
130619603001	63%	0%
130619603002	65%	0%
130619603003	84%	1%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Leesburg, GA	**45%**	**-1%**
ZIP Codes		
31763	45%	-1%
Watersheds		
Coney Lake-Muckalee Creek	44%	0%
James Pond-Kinchafoonee Creek	45%	-2%
Census Block Groups		
131770203001	51%	-1%
131770203002	34%	-1%
131770203003	38%	-3%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Pelham, GA	**45%**	**-1%**
ZIP Codes		
31779	45%	-1%
Watersheds		
Big Creek	41%	-2%
East Branch Barnetts Creek	36%	0%
Howell Lake-Big Slough	54%	-1%
Town of Pelham-Big Slough	62%	-2%
Census Block Groups		
132050902001	44%	-3%
132050902003	37%	-1%
132050905002	48%	-1%
132050905003	34%	0%
132050905004	59%	0%
132050905005	53%	-2%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Sylvester, GA	**45%**	**-2%**
ZIP Codes		
31791	45%	-2%
Watersheds		
Horse Creek	87%	2%
Town Creek	43%	-2%
Upper Warrior Creek	46%	-3%
Census Block Groups		
133219502001	44%	-4%
133219502003	36%	-4%
133219502004	33%	-3%
133219504001	20%	1%
133219505001	66%	-1%
133219505002	61%	-1%
133219505003	44%	-2%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Thomasville, GA	**51%**	**1%**
ZIP Codes		
31757	36%	2%
31792	51%	1%
Watersheds		
Lees Creek-Ochlockonee River	54%	-2%
McKeever Slough-Wards Creek	72%	2%
Oliver Creek	50%	2%
Oquina Creek	50%	0%
Pine Creek-Ochlockonee River	50%	0%
Census Block Groups		
132759605001	24%	1%
132759605003	47%	2%
132759606001	66%	2%
132759606002	53%	2%
132759606003	36%	3%
132759606004	42%	2%
132759606005	44%	2%
132759607002	53%	-1%
132759607003	69%	2%
132759607004	55%	4%
132759607005	52%	-5%
132759607006	31%	4%
132759608001	45%	1%
132759608002	44%	-1%
132759608003	43%	4%
132759608004	47%	3%
132759608005	61%	2%
132759609001	50%	4%
132759609002	57%	1%
132759609003	57%	1%
132759610002	75%	0%
132759610003	70%	1%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Tifton, GA	**39%**	**3%**
ZIP Codes		
31793	44%	-1%
31794	36%	6%
Watersheds		
Cow House Branch-Little River	36%	1%
Upper New River	42%	6%
Census Block Groups		
132779602001	59%	-6%
132779603001	39%	7%
132779603002	31%	4%
132779603003	28%	3%
132779603004	36%	9%
132779603005	54%	7%
132779603006	54%	10%
132779604001	58%	13%
132779604002	49%	8%
132779604003	40%	4%
132779604004	50%	6%
132779604005	39%	6%
132779604006	49%	10%
132779606001	22%	5%
132779606002	33%	3%
132779606004	48%	-2%
132779607001	23%	4%
132779607002	41%	-1%
132779607003	14%	4%
132779607004	25%	6%
132779608001	84%	-3%
132779609003	53%	1%

Assessment Boundaries	UTC % in 2019	UTC % Change
City of Whigham, GA	**55%**	**2%**
ZIP Codes		
39897	55%	2%
Watersheds		
Wolf Creek	55%	2%
Census Block Groups		
131319502001	62%	3%
131319502002	47%	1%

OCTOBER 2021

URBAN TREE CANOPY

ASSESSMENT

HURRICANE MICHAEL: GEORGIA COMMUNITIES

Georgia Tree COUNCIL
Sustaining Georgia's Green Legacy

GEORGIA FORESTRY COMMISSION

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