CLIMATE CHANGE ASSESSMENT AND TREES

EXECUTIVE SUMMARY

August 2022

SAVANNAH TREE FOUNDATION

Our Trees – Our Future

CLIMATE CHANGE ASSESSMENT AND TREES

ABSTRACT

In 2022, Savannah Tree Foundation collaborated with Savannah College of Art and Design (SCAD) to enhance Savannah's urban tree canopy equity. Over the course of two quarters, graduate student researchers from a variety of backgrounds worked to address the greatest areas of opportunity and compare tree density, temperature readings and potential impacts thereof in four of Savannah's neighborhoods: specifically, Ardsley Park, Hudson Hill, West Savannah and Woodville.

Through countless hours of on-ground tree surveying, temperature monitoring and studying secondary research, the goal is to collect data to help Savannah Tree Foundation communicate with the public, develop new initiatives and successfully obtain grants through unbiased research.

Image:

Forsyth Park is Savannah's oldest park, spanning over 30 acres and was established in 1841.

SAVANNAH TREE FOUNDATION

About Savannah Tree Foundation

Founded in 1982, Savannah Tree Foundation protects and grows Chatham County's urban forest through tree planting, community engagement, and advocacy.

Trees are one of Chatham County's most treasured natural resources. Beyond their beauty and cultural significance, the impacts of trees are far-reaching and compounding, spanning from economic benefits to health improvements to climate change resilience. Trees are woven into almost every aspect of our lives.

Savannah Tree Foundation has coordinated the planting of over 5,000 trees in Chatham County.

While it is easy to take our live oaks and magnolias for granted, our trees are facing an increasing number of natural and man-made threats. Sprawling construction, increased severe weather, encroaching salt water levels, and a lack of funding for proper maintenance all contribute to tree loss in our region. If we are to continue enjoying the beauty and benefits of our trees, we must protect the trees we have and plant the trees of tomorrow. Properly cared for, our urban forest will create a safer and healthier community. Our trees will shape our future. For more information, visit **savannahtree.org**.

Image (Left): Savannah Tree Foundation founders Susie Williams, Linda Beam and Page Hungerpiller, 1978.

MISSION

Savannah Tree Foundation protects and preserves Chatham County's urban forest through tree planting, community engagement, and advocacy.

VISION

To inspire and educate our community to create and sustain a healthy urban forest today, tomorrow, and forever.

URBAN FORESTS ENABLE CITIES TO BETTER ADAPT TO THE EFFECT OF CLIMATE CHANGE ON TEMPERATURE PATTERNS AND WEATHER EVENTS.

–United States Department of Agriculture (USDA)

Introduction

CLIMATE CHANGE AND TREES

In this paper, we explore the direct and indirect effects of trees on climate change. Trees provide many direct benefits to cities, neighborhoods and citizens but a lack of tree coverage can be just as harmful to those same populations. The positive impacts of an urban forest effect are widely documented across many academic studies. The downsides of ignoring this data have wide-reaching consequences, including but not limited to, early death, heart disease, lung health issues, increased inequity among the poorest members of the population, adverse weather events and intensification of the urban heat island effect.

Key Insights

LOWER SURFACE & AIR TEMPERATURES

Shaded surfaces can be up to 20-40^{0}F cooler than the peak temperatures of unshaded materials.

Trees lower surface and air temperatures by providing shade. Shaded surfaces may be 20–45°F cooler than the peak temperatures of unshaded materials.

Trees cool the city by up to 10°F by shading our homes and streets and releasing water vapor into the air through their leaves.

Evaporation of water from trees has a cooling influence.

(U.S. EPA)

CARBON DIOXIDE REMOVAL

Mature trees can have a significant impact in absorbing carbon dioxide and releasing oxygen in exchange.

As trees grow, they help stop climate change by removing carbon dioxide from the air, storing carbon in the trees and soil, and releasing oxygen into the atmosphere.

Over one year, a mature tree will absorb more than 48 pounds of carbon dioxide (CO2) from the atmosphere and release oxygen in exchange.

One large tree can provide a day's supply of oxygen for up to four people.

(US Forest Service)

ENERGY SAVINGS

The placement of where trees are planted and grow on properties can help cool a home and reduce energy use.

Deciduous trees, planted on the south and west sides, will keep your house cool in the summer and let the sun warm your home in the winter, reducing energy use.

(U.S. Department of Energy)

Just three trees, properly placed around a house, can save up to 30% of energy use.

(U.S. Forest Service Center for Urban Forest Research)

TREE SHADE BENEFITS

Shaded areas over heating and air conditioning units can reduce the level of emissions produced by those units.

Shading and reduction of wind speed by trees can help to reduce carbon emissions by reducing summer air conditioning and winter heating demand and, in turn, the level of emissions from supplying power plants.

Shading can also extend the useful life of street pavement by as much as ten years, thereby reducing emissions associated with the petroleum-intensive materials and operation of heavy equipment required to repave roads and haul away waste. (USDA)

ADAPT TO THE EFFECT OF CLIMATE CHANGE

With cities being generally warmer, urban forests help cities better adapt to climate change and related outcomes.

Cities are generally warmer than their surroundings (typically by about 1-2°C, though this difference can be as high as 10°C under certain climactic conditions), meaning that average temperature increases caused by global warming are frequently amplified in urban areas.

Urban forests help control this "heat island" effect by providing shade and by reducing urban albedo and through cooling evapotranspiration.

(USDA)

MENTAL HEALTH AND COMMUNITY

Overall, forested urban areas appear to have potentially stronger and more stable communities.

Community stability is essential to the development of effective long-term sustainable strategies for addressing climate change. For example, neighborhoods with stronger social networks are more likely to check on elderly and other vulnerable residents during heat waves and other emergencies.

(USDA)

Who Does This Impact?

This research is based on four neighborhoods located in Savannah, Georgia. Here is an overview of the history of the neighborhoods included: Ardsley Park, Hudson Hill, West Savannah and Woodville.

The area that became Hudson Hill, West Savannah and Woodville originally belonged to the Yamacraw. In 1757, the lands were handed over to the crown who then distributed them to colonists. It then became the Royal Valley Plantation.

People settled in the area during the early 20th century, and residential development happened in the late nineteenth century.

Work was the magnet that brought families into West Savannah, Hudson Hill and Woodville, primarily through the railroad. However, this began to decrease by the 1970s, and crumbled in the 1990s.

The Ardsley Park neighborhood is the result of two planned subdivisions that were laid out in 1909 and 1910. This was a time of great growth and prosperity in Savannah and substantial houses of the neighborhood reflect this affluence.

The developers of Ardsley Park, Savannah-natives Harry Hays Lattimore and William Lattimore, laid out the neighborhood according to a strict grid with one-acre landscaped parks placed in regular intervals and offset along the north-south corridor of Abercorn Street.

Sources: *Low Land and the High Road: Life and community in Hudson Hill, West Savannah, and Woodville Neighborhoods*, Public Library of Savannah's historical records and Historic Savannah Foundation.

ARDSLEY PARK

Residents
3,338
Average Income
$81,224

Demographics
84% White
12.4% Asian & other
2.9% Black

WEST SAVANNAH

Residents
3,653
Average Income
$22,578

Demographics
54.6% Black
28% White
16.5% Asian & other

HUDSON HILL

Residents
2,320
Average Income
$22,578

Demographics
78.4% Black
12% Asian & other
9.5% White

WOODVILLE

Residents
460
Average Income
$39,333

Demographics
52.9% Black
26.6% Asian & other
21.5% White

Source: point2homes.com and city-data.com

History of Savannah's Urban Forest

1800s

1ST FOREST

The forest was composed of trees such as Longleaf pine, Sugarberrys, Chinaberries, AmericanSycamore Trees. The 1893 hurricane was a main destructive force, but other factors such as logging contributed as well.

1900s

2ND FOREST

Live Oaks were commissioned to replant after the 1893 hurricane. However they were all planted 10-15 years after each other , and will die out at around the same time, around 2040. Other trees planted included Sugarberry, Chinaberry, Sycamore, though there are some that remain, they have mostly died out because of blights, stressors and age.

CURRENT

3RD FOREST

In Chatham county, 21,499 acres have been lost in the last 22 years. The equivalent of 3 football fields per day. Mostly this is caused by development, storms and hurricanes, and also the increased stress of climate change like drought; improper care, or lack of education.

FUTURE

4TH FOREST

Savannah will boast a resilient, multi-species, varied in age, healthy forest in perpetuity.

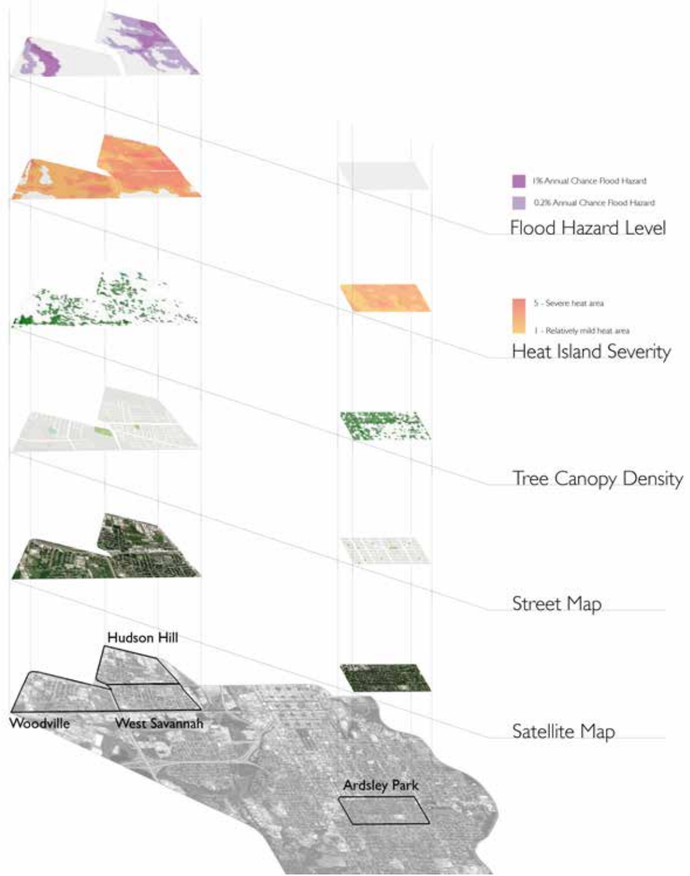
Average Temperatures

Heat Stack Map

The map depicts the location of all 4 neighborhoods, Ardsley Park, West Savannah, Hudson Hill and Woodville, in relation to each other. The layers of maps including satellite map, street map, tree canopy density, heat island severity and flood hazard level. Comparing to Ardsley Park, the other 3 neighborhoods, with less tree canopy density, have higher heat island level and face more risk of flood hazard.

Source: arcgis.com

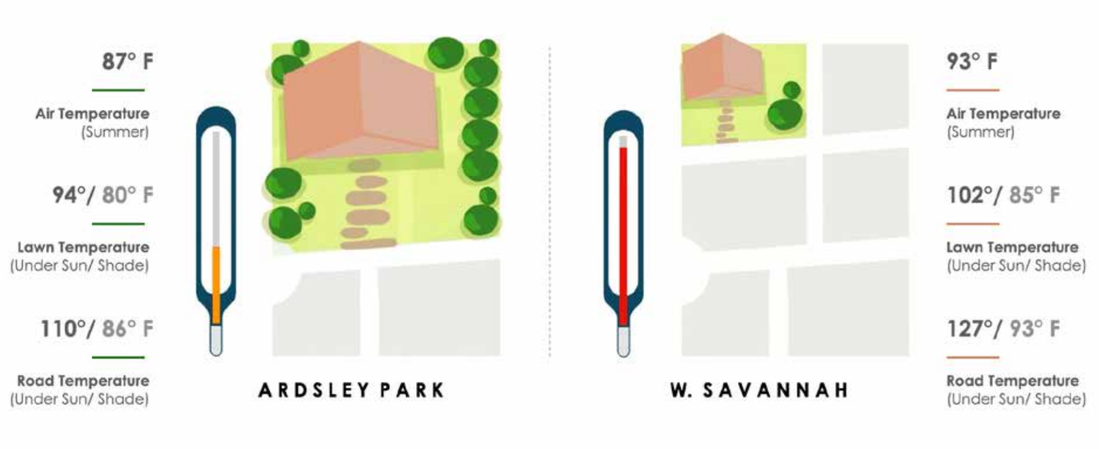
Funding for this project was provided by the U.S. Forest Service (USFS). RedCastle Resources, Inc. produced the dataset under contract to the USFS. Geospatial Technology and Applications Center., Savannah Area GIS, Esri, HERE, Garmin, SafeGraph, FAO, METI/ NASA, USGS, EPA, NPS

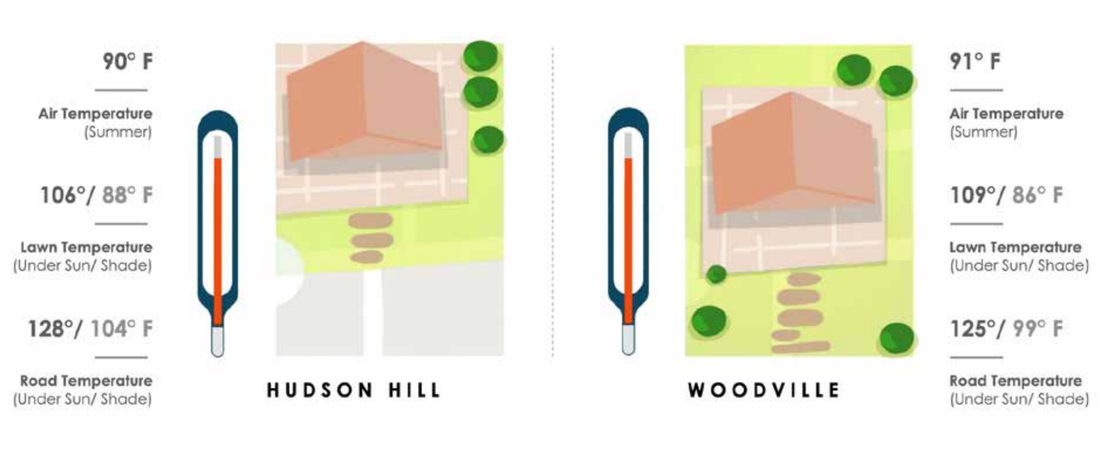


Impervious Land and Trees Per Lot Comparison

The above graphics depict our four focus neighborhoods, with the average lot sizes, house sizes and tree coverage by neighborhood. While the percentage of impervious land may seem similar across neighborhoods, the above graphics illustrate the contrast between lot size and tree coverage.

Average Temperatures Lot Comparison

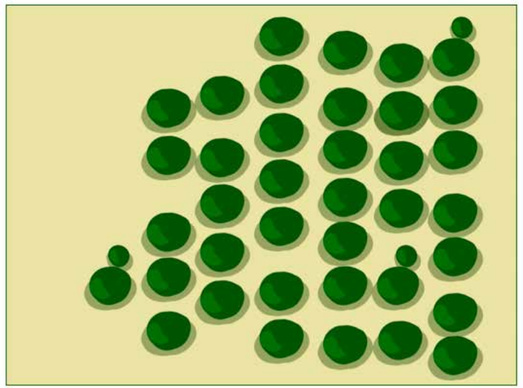




The above graphics depict our four focus neighborhoods, with the average lot sizes, house sizes and tree coverage by neighborhood. The large disparities in lot size and tree coverage have a direct effect on average temperature.

Trees Per Acre and Tree Benefits Over 10 Years*

ARDSLEY PARK



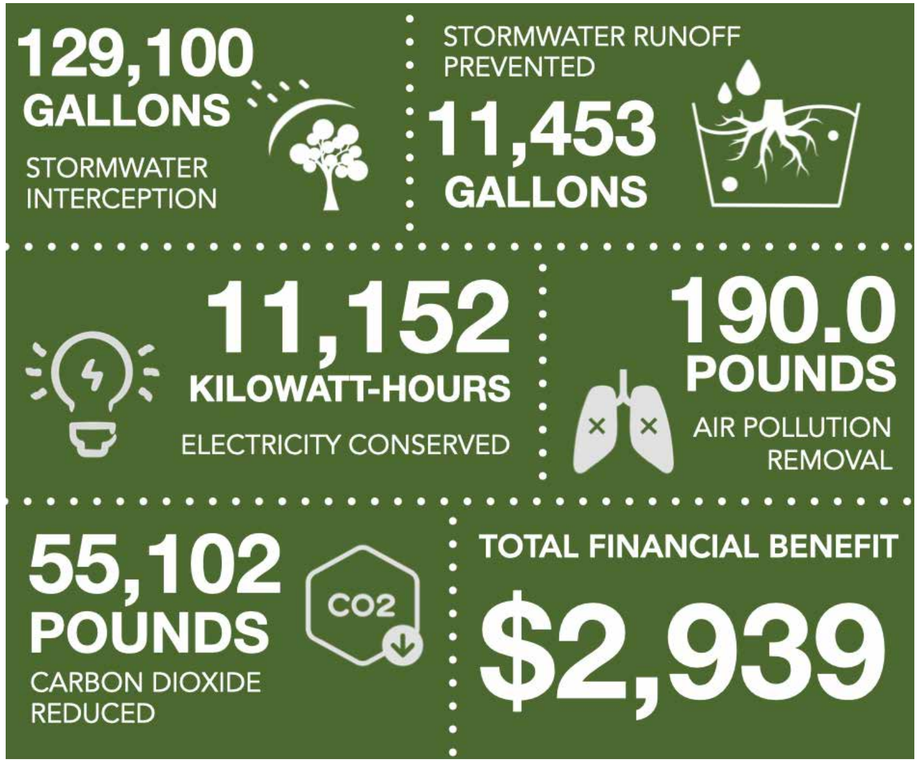
38.2

Trees per Acre
(Residential Area)

3.8

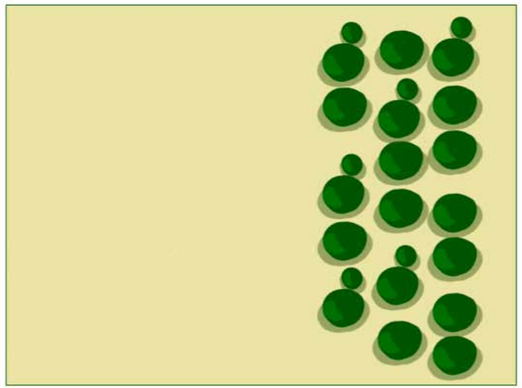
Trees per Person
(Residential Area)

***Average Tree Density across the neighborhoods is extrapolated from the average number of healthy trees per acre of residential land. Fact comparisons based on potential benefits from trees per average lot across the neighborhoods. Figures are extrapolated from itree canopy. Average benefit per lot is calculated over 10 years.**



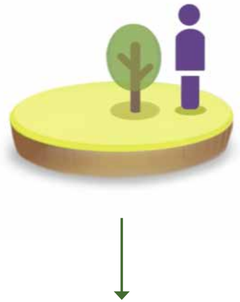
Trees Per Acre and Tree Benefits Over 10 Years*

WEST SAVANNAH



18.6

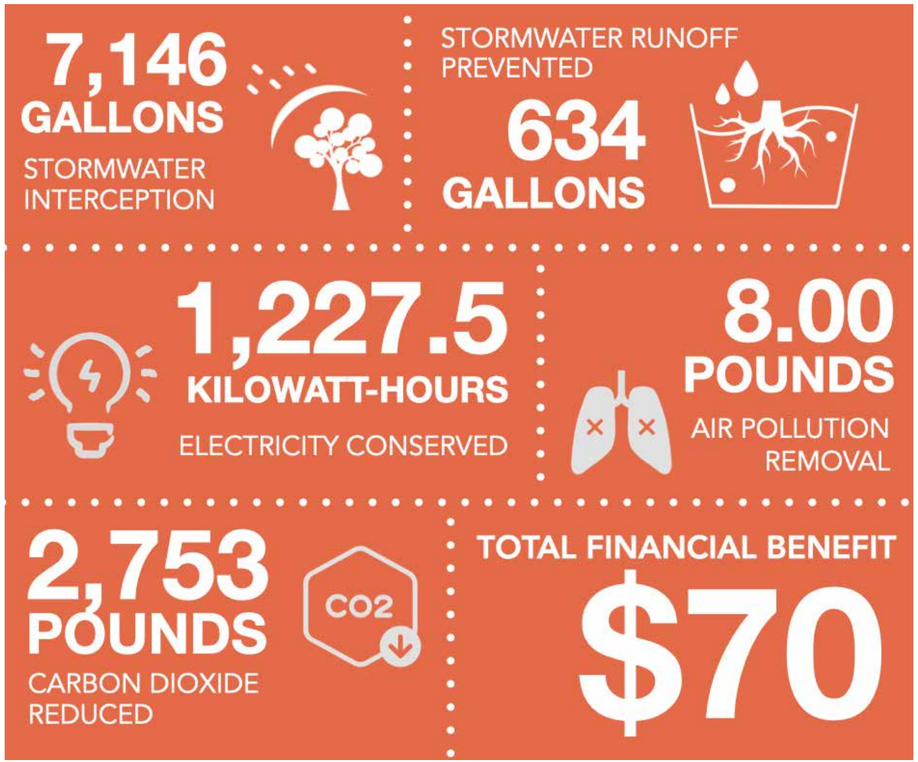
Trees per Acre
(Residential Area)



0.5

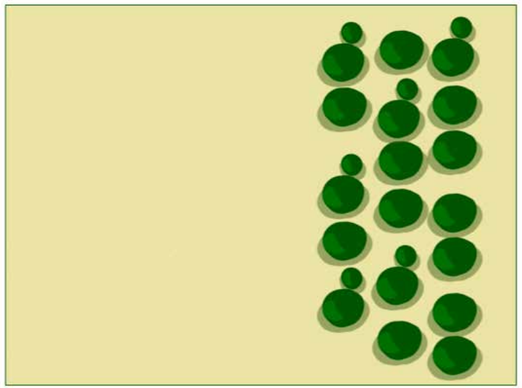
Trees per Person
(Residential Area)

***Average Tree Density across the neighborhoods is extrapolated from the average number of healthy trees per acre of residential land. Fact comparisons based on potential benefits from trees per average lot across the neighborhoods. Figures are extrapolated from itree canopy. Average benefit per lot is calculated over 10 years.**



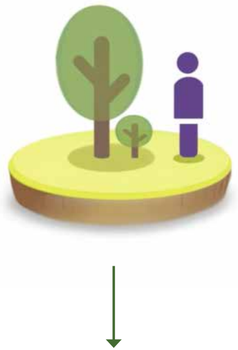
Trees Per Acre and Tree Benefits Over 10 Years*

HUDSON HILL



8.53

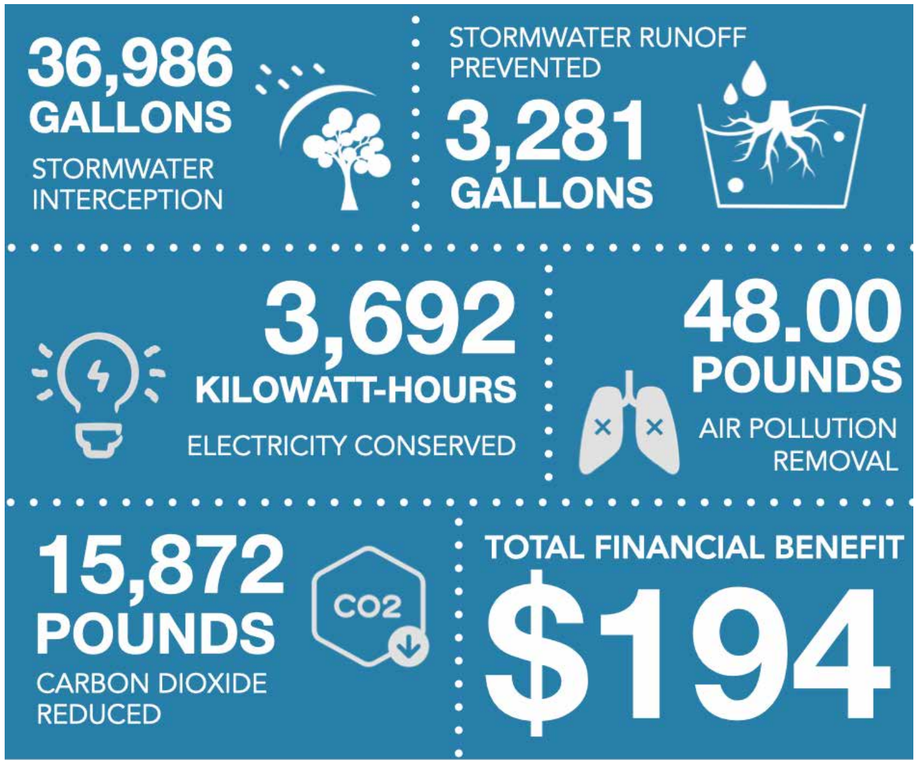
Trees per Acre
(Residential Area)



1.1

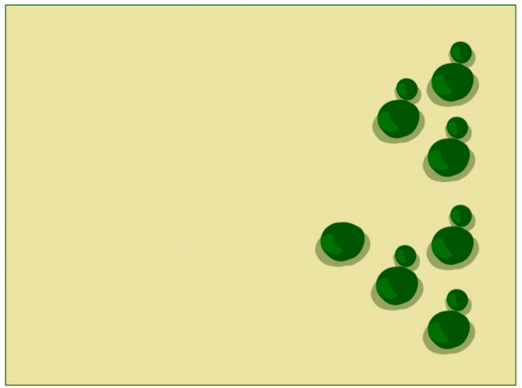
Trees per Person
(Residential Area)

***Average Tree Density across the neighborhoods is extrapolated from the average number of healthy trees per acre of residential land. Fact comparisons based on potential benefits from trees per average lot across the neighborhoods. Figures are extrapolated from itree canopy. Average benefit per lot is calculated over 10 years.**



Trees Per Acre and Tree Benefits Over 10 Years*

WOODVILLE



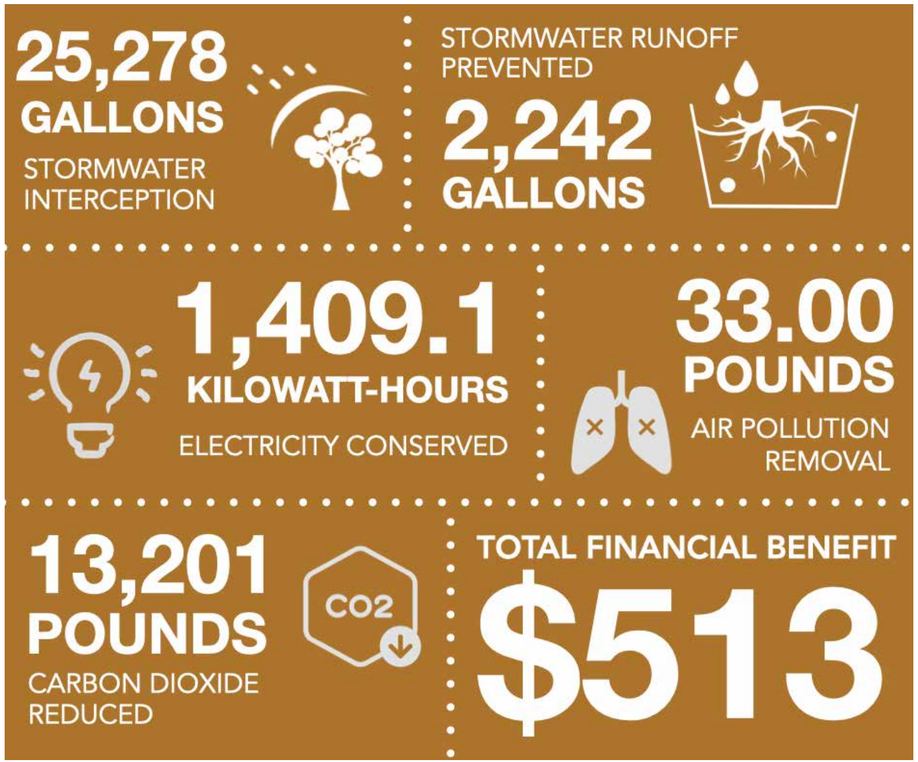
7.6

Trees per Acre
(Residential Area)

1.6

Trees per Person
(Residential Area)

***Average Tree Density across the neighborhoods is extrapolated from the average number of healthy trees per acre of residential land. Fact comparisons based on potential benefits from trees per average lot across the neighborhoods. Figures are extrapolated from itree canopy. Average benefit per lot is calculated over 10 years.**



Tree Impact Example: Candler Oak

AS THE OLDEST TREE IN SAVANNAH, THE CANDLER OAK SITS JUST OFF FORSYTH PARK AND ITS REIN SPANS THE HISTORY OF THE CITY.

At the time it took root, it was situated on a beautiful wooded bluff bordering a river. For over 300 years, this city landmark has provided shade on the hottest days to those who needed it most while making the area healthier for its residents and guests. Trees like this and the other most populous trees across the city, help to combat increasing climate issues by sequestering carbon, emitting oxygen and assisting with storm water mitigation.

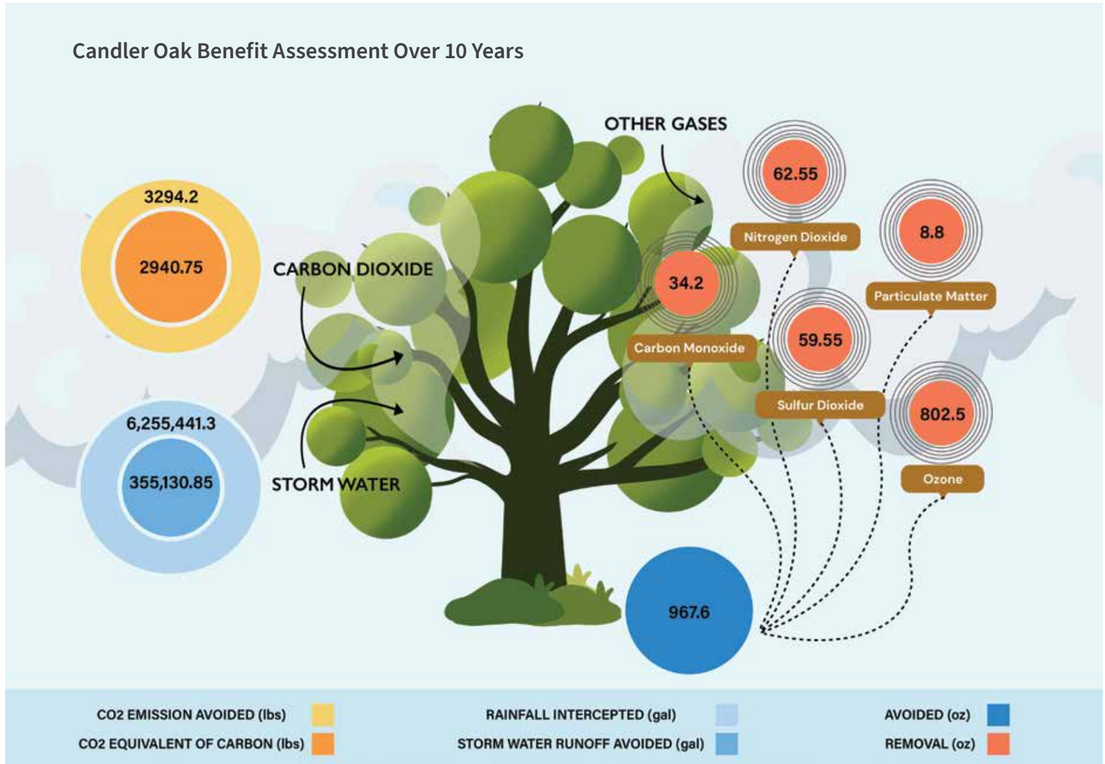
Although the Candler Oak is renowned for its age and size, both which directly contribute to carbon sequestration, trees provide the most benefit when diverse species are planted with purpose in order to address the needs of the community. Savannah, in particular, benefits greatly from its popular Eastern Red Cedar, Tupelo, Longleaf Pine and Bald Cypress trees which are drought tolerant and love areas prone to flooding. The Tupelo also has the added benefit of supporting the declining bee population.

While the large trees are always popular for shade and beauty, it is also important to nurture the existing smaller tree populations such as the Souther Catalpa and the Two-Wing Silverbell which are needed to help replace the aging Crape Myrtle trees throughout the county.

The benefits of these and other appropriate trees are reflected in the Candler Oak and all that this living organism has given the city of Savannah throughout its storied history.

Candler Oak, 1870

Candler Oak, Currently



Health Impacts of Air Pollution

RESPIRATORY	OTHER
Wheezing and coughing	Premature death
Shortness of breath	Susceptibility to infections
Asthma attacks	Heart attacks and strokes
Worsening COPD	Impaired cognitive functioning
Lung cancer	Metabolic disorders
	Pre-term births and low birth weight

Source: American Lung Association 2022 State of Air Report

Health Impacts of Exposure to Extreme Heat

Indirect Impacts

Impact on Health Services

- Increased Ambulance Call-Outs and Slower
- Response Times
- Increased Number of Hospital Admissions
- Heat Cramps
- Storage of Medicines

Increased Risk of Accidents

- Drowning
- Work-related Accidents
- Injuries and Poisonings

Increased Transmission

- Food and Waterborne Diseases
- Marine Algal Blooms

Potential Disruption of Infrastructure

- Power
- Water
- Transport
- Productivity

Direct Impacts

Heat Illness

- Dehydration
- Heat Cramps
- Heat Stroke

Accelerated Death from

- Respiratory Disease
- Cardiovascular Disease
- Other Chronic Disease (mental health, renal disease)

Hospitalization

- Respiratory Disease
- Diabetes Mellitus
- Renal Disease
- Stroke
- Mental Health Conditions

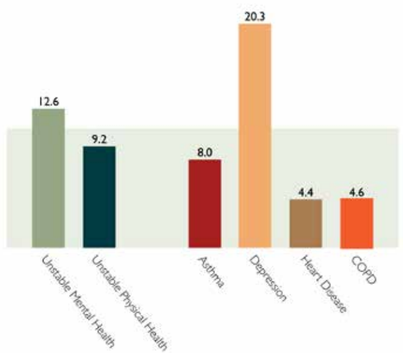
Source: World Health Organization

Health Comparison

ARDSLEY PARK

10.8%

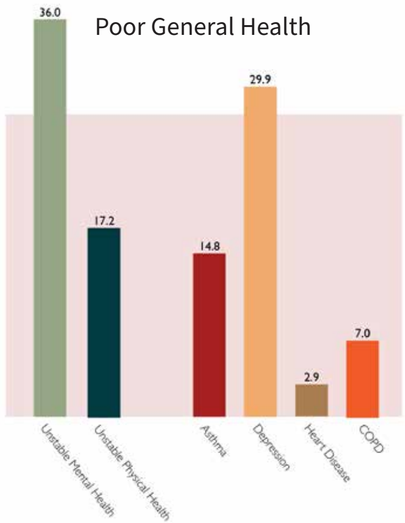
Poor General Health



WEST SAVANNAH

27.4%

Poor General Health



The chart compares the average percentage of health conditions including mental health, physical health and 4 major diseases of Ardsley Park and West Savannah. West Savannah has a much higher average prevalence of most health conditions.

Neighborhood Health Statistics

ARDSLEY PARK		WEST SAVANNAH	
Population	Mental health	Population	Mental health
2,986	**12.6%**	**1,811**	**36%**
General health	Physical health	General health	Physical health
10.8%	**9.2%**	**27.4%**	**17.2%**

The data above is based on Center for Disease Control statistics from a study documenting the annual prevalence from years 2011-2015 of the above health statuses. The percentages indicate the number of people experiencing poor health outcomes in 14 out of the previous 30 days.

Ways to Mitigate UHI Effect

- **Reintroduce vegetation** – expand green cover, plant street trees, install 'green roofs,' etc
- **Introduce 'cool roofs'** that feature bright coatings to reflect more sunlight and absorb less heat
- **Become a "sponge city"** that has transformed hard surfaces, such as roads and pavements, into permeable surfaces that can absorb, seep, purify and store water and later release stored water for use. The adoption of porous bricks and porous concrete could lower pavement surface temperature by 12 and 20°C, respectively and the air temperature by up to 1°C.
- **Adopt climate resilient development principles**
- **Incorporate more efficient physical infrastructure**, such as district-level cooling that efficiently uses energy to mechanically cool large areas in cities
- **Consider nature-based solution**s, such as increasing the extent and density of green spaces in cities and on walls and roofs
- **Integrate inclusive planning of urban stakeholders** to ensure that vulnerable urban residents are protected
- **Adopt sustainable cooling solutions:** switching to propane as a refrigerant could lessen the global temperature increase from space cooling

Conclusions

Climate change is no longer an academic thought experiment; we are experiencing the expansive effects on our communities at this very moment. While there are larger considerations and policies needed in order to address the widespread causes of climate change, there are still things that communities can do to help offset these effects. The impacts of planting trees in urban areas are a great start to helping mitigate adverse weather events, rising costs of cooling and the emissions generated by the cooling units, decrease in carbon dioxide in the air, healthier populations and stronger community bonds.

By focusing on supporting communities with tree planting and proper maintenance, those communities are directly contributing in the fight to roll back climate change and heal our planet.

Methodology

SCAD SERVE x SAVANNAH TREE FOUNDATION *Our Trees - Our Future*

1. Survey the tree canopy, temperatures and impervious surface data in the neighborhoods of Ardsley Park, West Savannah, Woodville and Hudson Hill.
2. Conduct and compile ethnographic data (surveys, interviews and conversations).
3. Compile secondary research related to the impact Urban Heat Islands (UHI), including quality of life, health, mental health, livability and other factors.
4. Visualize data in reports through infographics.
5. Share these findings with Savannah Tree Foundation and government partners, community leaders, local businesses and SCAD to build collaborative capacity for a comprehensive and equitable Savannah tree management plan.

Terms

Urban Forest: all trees within a densely populated area, including trees in parks, on streetways, and on private property

Urban Heat Island: this occurs when cities replace natural land cover with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat.

Urban Albedo: the fraction of solar radiation reflected back into the environment

Evapotranspiration: the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

SCAD SERVE

About SCADServe

The multidisciplinary course, GOOD 560 Design for Good, directly supports the mission of SCAD SERVE, our community service design studio. Focusing on four critical areas of need — food, clothing, shelter, and environment — SCAD SERVE empowers the SCAD community to listen to the needs of its neighbors and local leaders, and create meaningful design solutions that improve quality of life.

Volunteerism, public service, and social impact are and always have been an integral part of SCAD's character. GOOD 560 Design for Good employs our students' collective brilliance through elevated, design-for-good solutions that make a difference in our hometowns of Atlanta and Savannah. For more information, visit **scad.galaxydigital.com**.

Images (Right):

Summer and Spring GOOD 560 class members (listed below).

Lia Alemán, Design for Sustainability M.F.A. • Sofia Alturas, Design for Sustainability M.A.Shreyas • Athreya, Design for Sustainability M.F.A. • Lindsay Brine, Service Design M.F.A. • María Carrau, Architecture M.A. • Kiera Ceyssens, Design for Sustainability M.F.A. • Ankit Charturvedi, Design for Sustainability M.F.A. • Yushan Chen, Service Design M.F.A. • Emma Covello, Design for Sustainability M.F.A. • Amber Francis, Service Design M.A. • Tanvi Gudipudi, Design for Sustainability M.F.A. • Vivek Gupta, Design for Sustainability M.A. and Jewelry M.A. • Seth Holland, Design for Sustainability M.F.A. • Olivia Loeffler, Design for Sustainability M.F.A • Anirbaan Mukherjee, Design for Sustainability M.F.A. • Kanchi Parekh, Design Management M.A. • Morgan Rizzo, Design for Sustainability M.A. • Daniela Rodriguez, Design for Sustainability M.A. • Riley Shelton, Design for Sustainability M.F.A. • Olivia Snow, Design for Sustainability M.F.A. • Brittany Snyder, Design for Sustainability M.F.A. • Harshini Vasu, Design for Sustainability M.F.A. • Professor Scott Boylston, Graduate Coordinator, Design for Sustainability Program • Professor Saty Sharma, Design for Sustainability Program

MISSION

To enhance Savannah Tree Foundation's efforts in ensuring tree canopy equity through gathering and synthesizing data, experiences, and community relationships.

Published in conjunction with SCADServe